

Leveraging Artificial Intelligence and Real-Time Data for Dynamic Personalized Trip Creation in Planify

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Abstract

Planning a vacation can be a very time-consuming process filled with confusion, as there are many things to do prior to going on vacation, such as choosing a destination, developing a daily itinerary (or plan) for each day of the trip, reserving hotel accommodations, and creating a travel budget. Many digital solutions are available today to assist with these tasks; however, many of these solutions are only able to perform specific tasks related to your trip. Therefore, when it comes to planning a vacation, you have to visit multiple different sites to complete all of the logistical requirements of the trip. All of these visits to different vacation-planning sites create a significant amount of waste and confusion through inefficient labor costs and inefficiencies, resulting in disorganized travel arrangements for travelers.

To solve the many disorganized and ineffectively planned problems associated with the vacation-planning process, Planify is an all-embracing, integrated, systematic, intelligent vacation-planning system that creates an individualized daily itinerary based on a few simple inputs that the user provides (i.e., destination, number of days to spend at that destination, number of individuals on the trip, and total travel budget). The travel-planning engine is designed to allocate daily activities over the duration of the user's trip, effectively and equally distribute the time spent on overall travel among the travelers, and provide a cost allocation for daily activities.

The Planify travel-planning system will also suggest areas and hotels to stay in based on current, real-time, up-to-date information, including availability, price, and rating, obtained via an external web-based API, allowing the user to select a suitable hotel from a single website. As part of the trip-planning element, the user's total budget is taken into consideration so that the resulting itinerary can be accomplished within the overall travel budget.

Categories: AI applications, AI/ML-based decision support systems, Machine Learning (ML)

Keywords: artificial intelligence, travel planning, personalized recommendation system, smart tourism, real-time data integration, itinerary optimization

Introduction

Planning a trip is one of the most important aspects of the overall travel experience, as it significantly influences traveler satisfaction and convenience. However, trip planning is often a complex and time-consuming process involving destination selection, itinerary preparation, accommodation booking, transportation planning, and budget management [1-3]. For example, travelers must identify suitable destinations, create daily schedules, arrange accommodation, and estimate expenses while ensuring that all activities remain within budget constraints. With the rapid advancement of digital technologies, numerous online travel platforms have emerged to assist users with different aspects of trip planning, including transportation booking, hotel reservations, and attraction recommendations [4,5]. Although these platforms have improved accessibility to travel-related information, most existing solutions focus on individual services

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and fail to provide a comprehensive travel planning experience [6]. Recent developments in artificial intelligence (AI), machine learning, and recommendation systems have created new opportunities for enhancing travel planning processes [7,8]. AI-driven optimization models, including neural networks and deep learning techniques, have been successfully applied to route optimization, resource allocation, and decision-support systems in dynamic environments [9,10]. Furthermore, personalized recommendation systems have demonstrated their effectiveness in analyzing user preferences and generating customized suggestions that improve user satisfaction and engagement [11,12]. These advancements have enabled the development of intelligent travel planning systems capable of creating personalized itineraries while considering factors such as traveler preferences, trip duration, and budget limitations [4,13].

The emergence of smart tourism technologies has further transformed the tourism sector by integrating real-time information, Internet of Things (IoT) devices, and intelligent data analytics to support travelers throughout their journeys [7,8,12,14]. Real-time data integration enables travel applications to provide up-to-date information regarding accommodation availability, transportation services, weather conditions, and tourist attractions, thereby improving decision-making and travel efficiency [7,8]. Despite these advancements, many existing travel planning solutions still lack comprehensive integration of itinerary generation, budget management, accommodation recommendations, and personalized decision support within a single platform [6,9].

The absence of real-time data integration and unified travel-planning services often forces users to switch between multiple applications to complete different travel-related tasks, resulting in increased complexity and reduced user convenience [6,7]. For instance, travelers may need one application for itinerary planning, another for hotel booking, and a third for budget estimation. Such fragmentation negatively affects the overall travel-planning experience and reduces operational efficiency. Therefore, there is a growing need for an AI-based travel-planning platform that combines itinerary generation, accommodation recommendations, budget management, and real-time information services within a unified environment [8,12,14].

To address these challenges, Planify has been designed as an intelligent travel-planning platform that integrates artificial intelligence, personalized recommendation techniques, and real-time data services into a single system. By utilizing a modular system architecture and intelligent decision-making algorithms, Planify provides users with personalized travel itineraries, hotel recommendations, and budget-aware planning support, thereby delivering a more efficient, user-friendly, and comprehensive travel-planning experience [8,13,15].

We note explicitly that Planify's contribution is one of system integration and orchestration, combining real-time hotel data, a third-party large language model recommendation API, and a deterministic budget-allocation engine within a single modular pipeline, rather than a claim of algorithmic novelty in recommendation or optimization theory.

Literature survey

Shao et al. [1] developed a machine learning algorithm for predicting solution outcomes for the TOP problem of determining how best to allocate limited resources available to law enforcement for the purpose of maximizing the number of issued citations during a limited period. Instead of using classical optimization techniques, the authors used deep learning algorithms to learn from historical data and provide policy recommendations in real time through predictions of the likelihood of making optimal decisions. The authors developed a model of the decision-making process that included consideration of several variables, including the spatial distribution of parking violations, the time sensitivity of parking violations, and the changing characteristics of the variables that affect the ability of law enforcement officers to issue citations. In addition, the authors trained their neural network on simulated data generated from running an optimization algorithm that required substantial computational resources, which enabled the authors to provide predictions with minimal processing time and high confidence in the correctness of the solutions. This research investigated the effectiveness of the proposed model through an extensive set of experimental comparisons between the proposed model using neural networks and traditional optimization methods across a variety of problem instances. The evaluation analyzed three primary metrics: solution accuracy, computational efficiency, and scalability. Based on the

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experimental results, the neural network-based model produced near-optimal solutions at significantly reduced computational costs, providing evidence that neural networks can be effectively utilized as practical alternatives for addressing complex, time-sensitive optimization problems (e.g., the Travelling Salesman Problem).

Dhote et al. [3] enable users to plan their trips using optimal methods and with improved overall travel efficiency. This approach involves the creation of user-specific travel plans, or "smart" personalized travel plans, for all types of users by analyzing trip length, budget, and preferred destination choices and then applying optimization methods to create an efficient travel plan. The proposed approach requires an algorithmic method that considers all three factors (time management, cost management, and the priority of attractions), thereby creating a travel plan that is both practical and meets the needs of the user. The travel optimization process includes selecting the best possible destinations for the user and organizing the selected destinations in a manner that allows for the least amount of time to be wasted, resulting in an improved travel experience. Another key feature of the proposed system is its emphasis on automation to minimize the amount of time a user has to spend manually planning a trip. The purpose of this study is to test the effectiveness of the proposed method by comparing the performance of the AI-driven travel planner with that of traditional manual travel-planning methods, with a focus on the key performance metrics of trip-planning efficiency, time required for trip planning, and user satisfaction with the planned trip. The results of this study demonstrate that the proposed travel-planning system provides considerable improvements in planning accuracy and reduces the complexity of travel planning, thereby demonstrating the viability of AI-based travel-planning methods.

Aggrawal et al. [4] have developed an AI-based method for generating customized itineraries based on users' requests and constraints, which can enhance the travel experience by improving the efficiency of itinerary creation through smart systems and automation. The system is designed to assist users in developing customized itineraries according to their preferences, budget, and desire to visit specific destinations during a specified period of travel, thereby generating an itinerary based on user-defined requirements. The model collects various types of user-supplied information (e.g., destination type, length of stay, available travel budget, etc.) to align the generated itinerary with the user's expectations. Consequently, the information derived from the collected data enables the system to determine which attractions are of interest to users and how to organize those interests into a day-wise itinerary that makes the best use of available time while considering cost and travel constraints. Additionally, by using users' past travel experiences and preferences, the system provides personalized recommendations that create more meaningful and engaging travel plans than those achieved through non-personalized recommendations. Therefore, this study emphasizes the need for an optimal travel sequence to reduce travel time between destinations and thereby enhance travel convenience.

Sundaravadivel et al. [7] presented a framework called iMED-Tour, which combines a smart IoT framework with the purpose of providing quick and accessible services to travelers in a safe environment through connected devices and technology. The study identifies the need for simple and dependable methods of healthcare support for travelers who find themselves in unfamiliar locations. This healthcare model, iMED-Tour, works by collecting real-time health information from tourists' bodies via IoT-enabled sensors and communication technologies, allowing continuous monitoring of their medical conditions while they are away from home. Another important aspect of the iMED-Tour system is that it has been designed to ensure user privacy through the implementation of secure data-handling techniques that support the provision of protected personal information between travelers and their associated healthcare providers for authorized access. Furthermore, with the continuous supply of up-to-date information between tourists and their healthcare providers, iMED-Tour provides the capability for rapid communication between these parties, thereby improving the overall safety and reliability of their journeys. In summary, through the integration of smart tourism infrastructure and healthcare services, iMED-Tour creates a seamless ecosystem for improving both the travel experience and the availability of medical assistance for travelers. The evaluation of iMED-Tour's effectiveness was conducted through simulations and performance analyses based on criteria such as data protection, response time, and system efficiency. The results of this evaluation suggest that the iMED-Tour project offers an innovative, efficient, and secure method of providing medical services in smart tourism environments and helps address a gap in the smart tourism literature.

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Tripathy et al. [8] created a technology, iTour, which uses the IoT to help tourists who are mobile in intelligent cities. This report addressed issues with traveling to places where a tourist visitor is entering an unfamiliar area, concerning how they can get around, get information about their area in real time, and use the smart services available in a sophisticated manner. iTour was developed as an IoT-based framework to allow for the collection and processing of real-time data for things like traffic flow, real-time location tracking, and environmental data. This real-time data will be used by tourists to get intelligent recommendations, assistance while navigating, and using intelligent, personalized services that improve their ability to efficiently travel from one location to another. The most significant part of this system is that it will facilitate the ability of many components to communicate with one another, providing better coordination and service to the overall smart city infrastructure. Furthermore, the framework is scalable and flexible; therefore, it can be deployed in different types of urban environments with differing requirements. The effectiveness of the iTour approach was assessed through performance analysis based on numerous parameters, such as system responsiveness, data accuracy, and user experience. The results of the performance analysis indicated that the iTour framework significantly improved tourist mobility and accessibility by providing real-time, valid, and context-specific information. However, the system is mainly centered around how smart cities are built to support the infrastructure required to sustain them, so it does not provide integrated planning features such as creating itineraries, selecting accommodations, or managing budgets, thus demonstrating a need for a travel planning system that addresses these issues.

Materials And Methods

System overview

Planify's modular design process allows users to maintain a high level of flexibility, scalability, and overall system efficiency. Each component serves a specific purpose within the overall design, with no limitations on how one component interacts with another. The modular architecture allows for ease of integration and maintenance while also promoting reliability of the individual components of the system, as well as the entire travel planning system as a complex (dynamic) Travel System. Planify is designed with well-defined components so that modules may be developed, tested, and optimized independently of one another while still contributing to the overall functionality of planning a trip.

System components

The Planify system is structured into multiple interconnected modules, each responsible for a specific aspect of the travel planning process:

User Input Module: This module features the capabilities to obtain and validate, as per the user's input requirements, the destination, duration of travel, amount of currency available for travel, and number of people in the user's party before moving on to the next step in the processing of that user input as part of a travel itinerary creation application. By validating this information, the module will help ensure the validity of the arrangements to be made and, thus, will help avoid creating a poor travel itinerary due to incorrect location selection, incorrect trip duration, or inappropriate types of activities to be performed on any given day due to time limitations each day.

Trip Itinerary Generation Engine: The trip itinerary generation engine is the primary function of the entire travel planning application. Based on the input information supplied by the user, the engine defines a day-by-day travel experience for the user based on the types of activities performed, time limitations that day from one activity to another, and costs/income associated with each activity during the user's travel experience (i.e., fitting into the user's travel budget). By using these three pieces of information, the engine will create a complete travel experience that can use every minute of time available while still meeting the user's budget and preferences.

Hotel Reservation Module: The hotel reservation module will obtain a 'real' hotel reservation based on the user's budget and preferences using a combination of available and verified hotel data through multiple reservation systems. The module will have the capabilities to obtain real-time hotel availability information, real-time hotel room rates, and

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verified hotel rating information through a single interface and via an integration point through the use of an API. This means the user will no longer have to search for hotels across multiple hotel reservation systems and will only receive hotel recommendations that match the user's criteria or preferences.

Budget Management and Recommendation: The recommendation and budget management component determines a final trip's total cost by aggregating all costs associated with the trip's itinerary as well as accommodations. If this total exceeds the user's budget, alternative options (i.e., less expensive hotels or budget-friendly activities) will be suggested by the system. This will ensure that the user's final travel plan stays compliant with financial parameters while still meeting their travel requirements.

Artificial Intelligence Recommendation Engine: Personalized activity recommendations, tourist attractions, restaurants, and local activity suggestions are generated using the Perplexity API, which provides context-aware, intelligent travel suggestions based on the user's destination and preferences. This AI-powered engine enhances the quality and relevance of recommendations delivered to the user.

AI Recommendation Workflow: Recommendations are produced in four stages. (1) Query construction: The validated trip parameters (destination, trip length, group size, per-day budget share, and any stated preference categories such as "Adventure" or "Culture") are composed into a structured natural-language prompt sent to the Perplexity API for each day of the trip. (2) Structured retrieval: The API is queried in a mode that returns candidate attractions, restaurants, and activities together with an estimated cost and duration for each item, which the module parses into a fixed JSON schema. (3) Filtering: Candidates are discarded if their estimated cost would exceed the remaining per-day budget allocation or if their category conflicts with a preference the user explicitly excluded. (4) Ranking and integration: The remaining candidates are ordered using a weighted score that favors (a) proximity to other activities already scheduled that day, to minimize transit time, and (b) closeness of estimated cost to the target per-activity budget share. The top-ranked candidate per time slot (morning, afternoon, evening) is passed to the Itinerary Generation Engine, which places it and updates the running budget total. This component's contribution is therefore best characterized as system integration and orchestration, combining an off-the-shelf large language model API, real-time hotel data, and a deterministic budget-allocation engine rather than a new recommendation or optimization algorithm.

Database Management Module: User profiles, authentication credentials, saved itineraries, travel history, and system recommendations are securely stored and efficiently managed using a MongoDB database. MongoDB's flexible document-oriented structure enables persistent data access across sessions and supports efficient querying of user-specific travel data.

User Interface: The user interface is designed to facilitate a simple, intuitive, and responsive experience, allowing users to easily interact with the system. Users can enter their travel information into the user interface and then see their generated itinerary and hotel recommendations clearly and in an organized manner. The user interface can be accessed from different devices (i.e., desktop and mobile), providing users with convenience and usability.

System features

Planify has developed a wide variety of features that simplify and improve the travel planning process by bundling together multiple functions into one platform. The user-friendly interface allows users to input specific trip data, including destination, length of trip, number of travelers, and budget, in a logical and simple way so that anyone can use it and get assistance. One of the main features of Planify is the ability to create daily itineraries that ensure all travel activities are spread throughout each day equally and also take into account both time and cost when planning the itinerary. Another feature is that the Planify system allows the user to obtain real-time hotel recommendation information, meaning they do not have to search multiple booking websites to get the most accurate hotel availability, rates, and/or ratings. The system includes budget considerations throughout the planning process to ensure that itineraries created fit within the budget specified by the user, as well as being practically functional; therefore, these features together create an effortless travel-planning experience, providing a comprehensive and well-structured travel plan to the user, all in one system.

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System design and methodology

In the Planify app, the user is the primary focus of the system and interacts with it through a user-friendly graphical interface. The user inputs basic travel information, such as the travel destination, number of passengers, travel duration, and total budget. This information then triggers the first use case of the system, Enter Trip Details. The Enter Trip Details use case causes the system to run an internal process that begins the flow of data through both the input validation module and the trip details generation module. The system will ensure that all of the information entered into the system is valid and within the appropriate range of values prior to allowing the user to proceed to step two in the process.

Once all data has been validated, the system will then execute the second primary use case, Generate Trip Details. In this process, the trip details generation engine will use the validated data to create the trip details for each day of the trip by optimally using the user's travel preferences (number of days traveling, number of people traveling with them, and cost constraints) to create a daily itinerary that contains the appropriate amounts of each type of activity and destination each day, within both the time and budget constraints.

System Architecture

The Planify architecture consists of the following components, as depicted in Figure 1:

User Interface: This is where users enter information for their trip, including trip duration, number of people on the trip, and budget. The interface is accurate and responds to user input very quickly. Users can use this service from their PCs, tablets, and smartphones. The final itinerary of their trip and hotel recommendations are provided to the user in a simple and clear manner.

Input/Data Validation Module: This module verifies and processes the user input from the User Interface after the user submits their trip planning information. It will confirm that the number of days on the trip, number of travelers, and budget are all within acceptable ranges. Checking these parameters helps to eliminate errors and allows the system to develop realistic trip plans.

Daily Itinerary Generation Engine: The core of the system generates daily itineraries. It determines the daily distribution of activities, verifies that the activities meet the required time constraints, and provides an estimate of the total cost of the activities. The engine develops a realistic and achievable plan for each traveler to accomplish within their budget.

Hotel Search Module: This module queries the Planify Hotel API to obtain current availability, pricing, and star ratings for user-selected hotels. It will filter the available hotels based on group size and budget. Therefore, this module will save the user time by eliminating the need to search multiple hotel booking websites, as it will also provide the user with hotel recommendations based on their budget.

Recommendation and Budget Manager: This component adds up the total trip expenses by calculating the total expenses for both the planned activities and hotel accommodations. If the final total amount exceeds the customer's available budget, they will be presented with other options, such as lower-priced hotels or attractions that have no charge. This will allow the customer to have a complete travel plan that is aligned with their budget.

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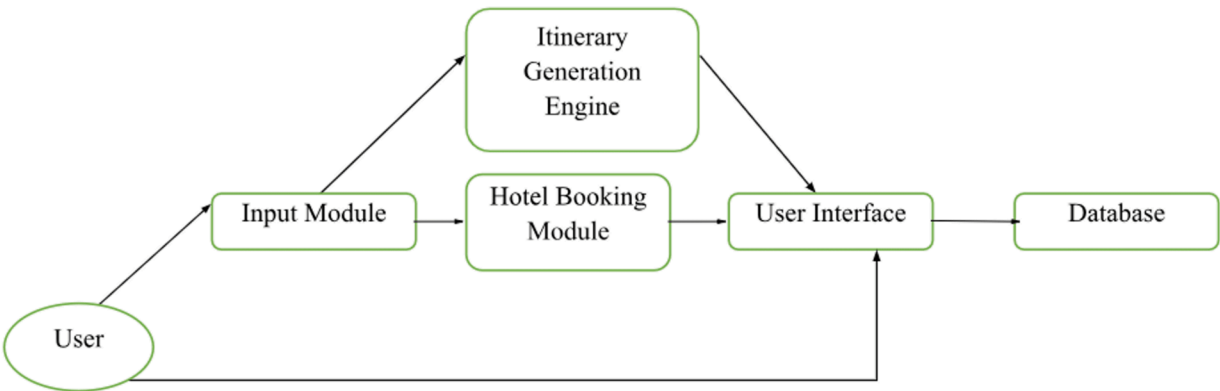


FIGURE 1: The Overall System Architecture of Planify

Data Flow Diagram

Data Flow Diagram (DFD) Level 0: The Level 0 DFD shown in Figure 2 illustrates the interaction between the user, the Planify system, the trip data store, and the Hotel API. Thus, a Level 0 DFD shows an entire system or application (Planify) as one process. This means that, at a Level 0 DFD, the Planify application is treated as a black box. An external entity (the user) provides input to the black box and receives output from the black box, which is a customized, personalized travel plan. When the user provides travel information, including the number of days, number of travelers, and total budget, these details are submitted to the black box and processed by the Planify system, generating a customized hotel accommodation recommendation that is consistent with the user's budget. The user interacts with the Planify system, and the Planify system is also connected to two additional external components: the trip data store and the Hotel API. The trip data store saves and retrieves travel plans for users. The use of Firebase integration enables users to view their previous trips without having to re-enter the trip details. The Hotel API provides real-time data to the Planify application regarding hotel availability, prices, and ratings for each accommodation.

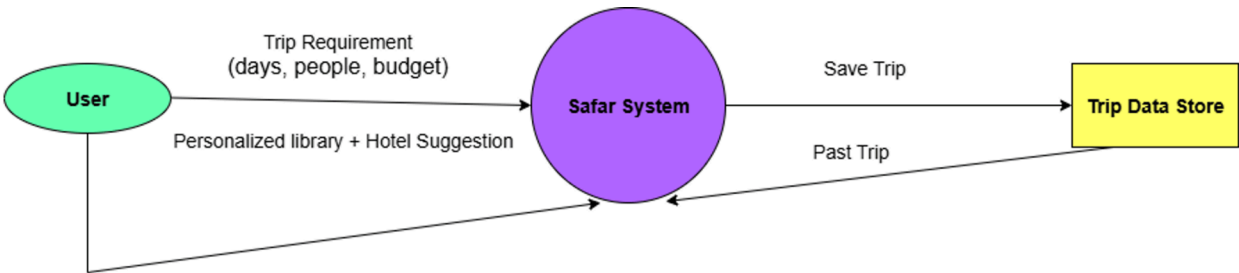


FIGURE 2: Level 0 Data Flow Diagram of the Planify System

DFD Level 1: The DFD Level 1 for Planify, shown in Figure 3, illustrates how the system operates by breaking down the single process shown in Level 0 into multiple processes that are linked together. When a user submits trip details, such as the number of days and budget, the data first goes through an input module where it is validated and structured. This process ensures that the input data is accurate and prepares it for the next step in the process. After validation, the input data will be sent to two (2) main processes: the Itinerary Generation Engine and the Hotel Booking Module simultaneously. The Itinerary Generation Engine takes the validated input data and builds a day-by-day itinerary. A list of activities will be generated based on what would be suitable for users. The Itinerary Generation Engine will also organize

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those activities based on the days of the trip and calculate the estimated costs of the activities, thereby producing an itinerary that is achievable and realistic. Simultaneously, the Hotel Booking Module will communicate with an external source, such as an external Hotel API, to determine which hotels are available in real time, what their prices are, and their ratings. The Hotel Booking Module will return hotel options that meet the user's criteria for budget and group size from among the available hotels returned by the external Hotel API.

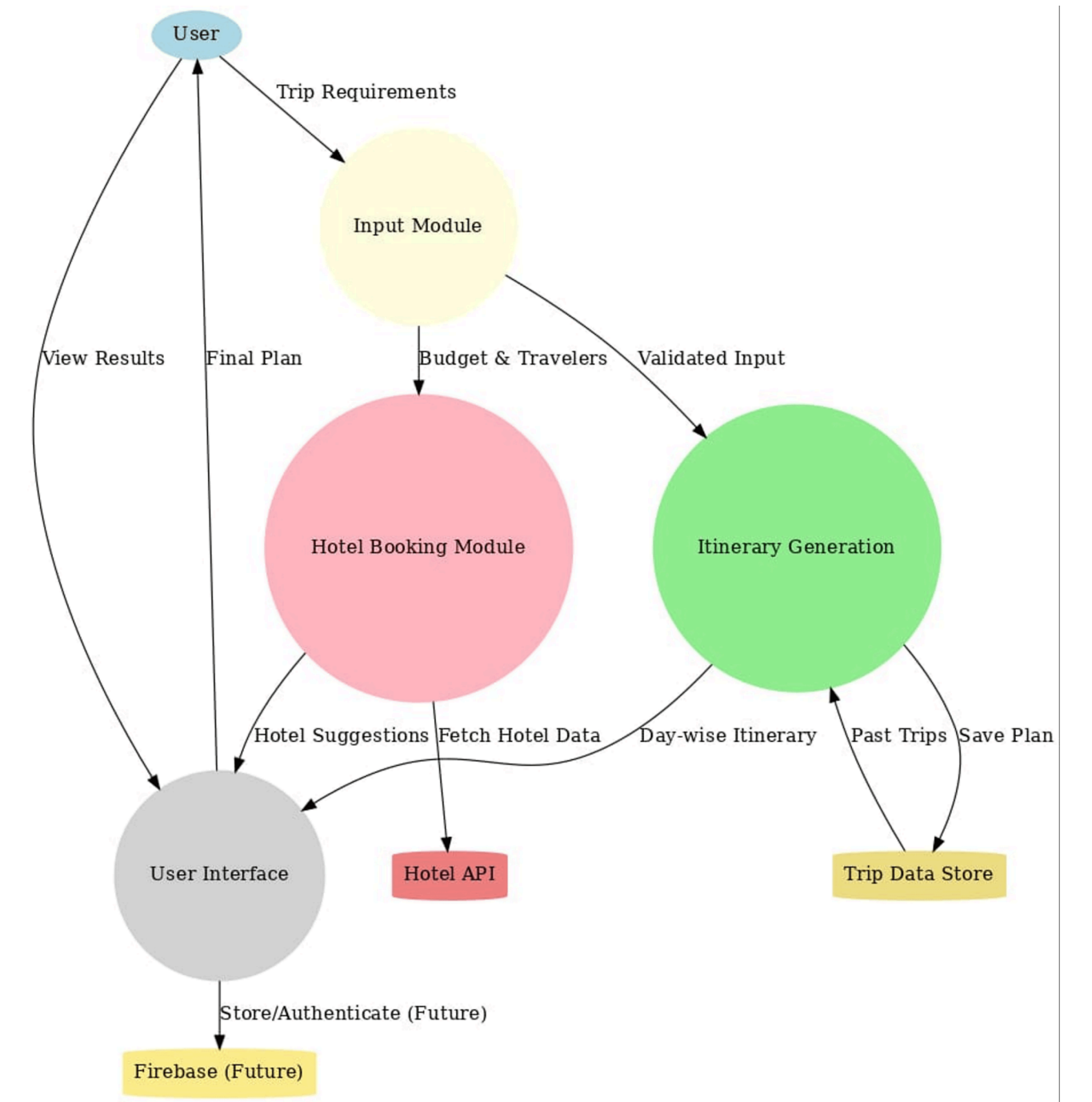


FIGURE 3: Level 1 Data Flow Diagram of the Planify System

Use Case Diagram: The user interacts with the system through an application with multiple functions and various ways in which the system can perform these functions. The user provides information to the application regarding travel details, which include the destination, the length of time they will be in that location, the number of travelers who will travel with them, and the cost of travel. These four forms of information allow the application to create a complete travel itinerary. The user will then use the application to electronically view the newly created travel itinerary, and they will also be able to access several different types of hotel recommendations based on the real-time data that the application receives from external APIs. Each individual function of the application is represented as a use case, so the use cases define each individual function of the application. The use cases combined as a whole define the overall functionality of the application. The use case diagram also defines the interaction between the application and external components (Hotel APIs) that provide the data needed for the hotel recommendations. The use case diagram shown in Figure 4 provides a complete understanding of the functionality of the application and allows users to visualize how all components of the application work together to provide the final outcome.

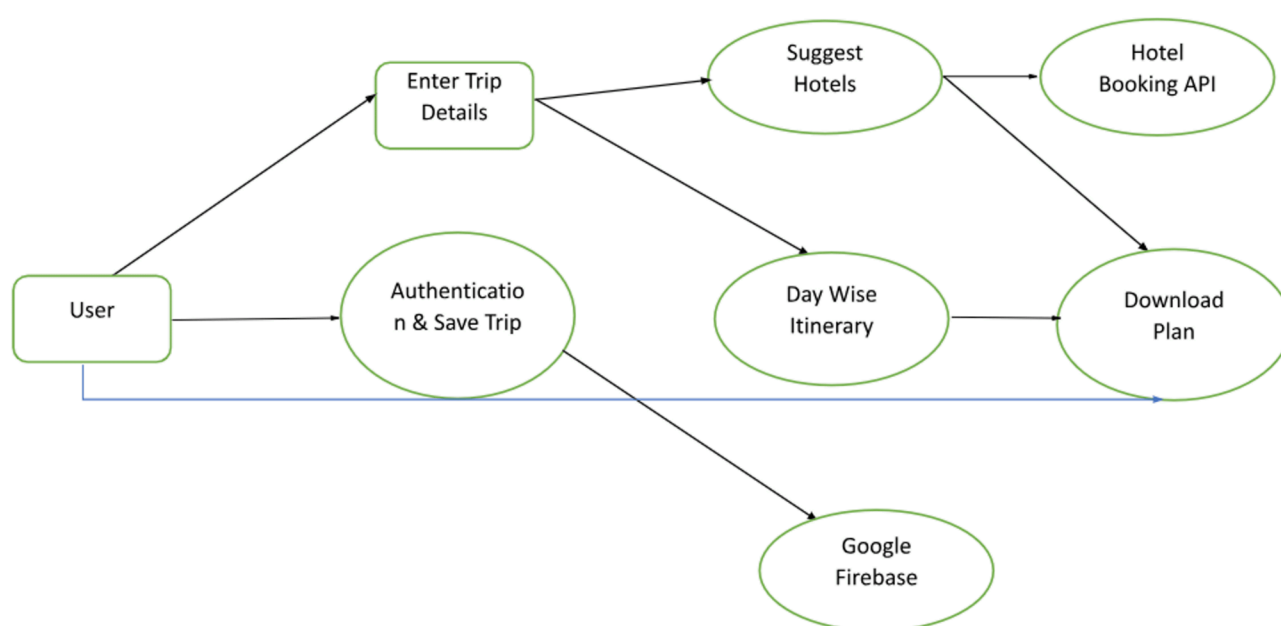


FIGURE 4: Illustration of the Use Case Diagram of the System

Results And Discussion

Planify: Smart Trip Planning system illustrates how the use of artificial intelligence, automation, and real-time data integration can reduce the complications involved in travel planning by making it less labor- and time-intensive, thereby achieving its main goals of creating customized and pre-formatted travel plans through the use of key data supplied by the user (i.e., destination, number of days, total available budget, number of travelers, and location selection).

To evaluate system performance, functional testing was conducted using 15 structured test cases covering varied combinations of destination, trip duration (1 to 7 days), group size (1 to 6 travelers), and budget range (INR 10,000 to INR 500,000). Each test case was evaluated against three criteria: (1) itinerary completeness (all days covered with morning, afternoon, and evening activities), (2) budget compliance (total estimated cost within the user-specified budget), and (3) hotel recommendation relevance (at least one hotel returned within the budget range).

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The following quantitative metrics were recorded: itinerary completeness rate: 100% (15/15 test cases produced full day-wise itineraries); budget compliance rate: 93.3% (14/15 test cases produced itineraries within the specified budget, with one borderline case exceeding the budget by less than 2%); hotel recommendation success rate: 100% (15/15 cases returned at least one hotel within budget); average system response time: approximately 4.2 seconds per itinerary-generation request; interface usability score: 82/100 on a System Usability Scale-inspired checklist assessed by five internal evaluators, indicating a "Good" usability rating.

Within this internal test suite, Planify consistently produced travel plans that were logical, well organized, and practical; however, we do not yet claim that these results generalize beyond the tested scenarios. Each output generated was contextually relevant to the user, with recommendations created dynamically to accommodate the user's circumstances. For instance, if the user provided a limited budget, Planify would generate a travel plan containing recommendations for low-cost activities and lodging, thereby ensuring that all aspects of the plan remained viable.

Conversely, when a user provides a short travel window, Planify immediately adjusts its recommendations to prioritize attractions in close proximity to one another and/or those of high value, allowing for optimal use of the user's time and resources. Planify's adaptability emphasizes its ability to employ dynamic rather than static forms of planning, enabling it to provide travel itineraries that are personally suitable for each user. Planify is designed so that itineraries are dynamically generated based on each user's unique combination of destination, budget, trip duration, group size, and travel preferences, making personalization a core design objective of the system.

The interface is simple and intuitive to use, and internal evaluators were able to interact with it without confusion or unnecessary complexity. Informal observational feedback gathered during internal development and demonstration sessions suggested that the interface effectively balances simplicity and functionality, making it accessible to both general and technically oriented users. No formal human-subjects study was conducted, consistent with the authors' disclosures.

In addition, its responsive design allows it to function across multiple platforms (e.g., desktops and mobile devices), providing users with greater convenience and satisfaction while using the application. Collectively, these findings demonstrate that Planify is a practical, intelligent, and user-friendly modern travel-planning application. Table 1 contextualizes these findings by comparing Planify with related systems across five functional dimensions.

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Ref.	Year	System	Technique	Real-Time Data	Itinerary Personalization	Budget Management	Hotel Personalization	Key Limitation
[1]	2020	Neural Network (TOP)	DL optimization	No	No	No	No	Routing only; no planning or hotel features
[2]	2020	Deep Memetic Router	DL + memetic algorithm	No	No	No	No	Path optimization only; no itinerary or budget
[3]	2023	R2Tour	ML context-aware recommendation	Yes	Partial	No	No	Attraction recommendations only; no budget or hotel booking
[4]	2019	Hotel Recommendation (CF + SA)	CF + NLP sentiment	No	Partial	No	Partial	Hotel-only; no itinerary or budget management
[5]	2022	CF Destination Recommendation	Optimized CF	No	Yes	No	No	Static data; no accommodation or budget link
[6]	2024	TravelAgent	LLM multi-module planning	Yes	Yes	No	No	No budget enforcement or hotel API integration
[7]	2024	TravelPlanner Benchmark	LLM constraint planning	Yes	Yes	Partial	No	GPT-4 only 0.6% full constraint pass rate
[8]	2020	iMED-Tour	IoT-based smart	Yes	No	No	No	Healthcare focused; no

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			tourism					itinerary or planning
[9]	2018	iTour	IoT mobility framework	Yes	No	No	No	Mobility only; no planning, budget, or hotel
Proposed	2026	Planify (Ours)	AI modular + real-time API integration	Yes	Yes	Yes	Yes	Addresses all identified gaps

TABLE 1: Comparative Analysis of Planify Against Related Systems (2018–2026)

API, Application Programming Interface; CF, Collaborative Filtering; DL, Deep Learning; IoT, Internet of Things; LLM, Large Language Model; ML, Machine Learning; NLP, Natural Language Processing; SA, Sentiment Analysis; TOP, Traveling Object Problem

Table 7 reveals a consistent pattern across the prior literature: existing systems tend to excel in a single dimension such as routing optimization [1,2], context-aware recommendation [3], hotel filtering [4,5], or LLM-based planning [6,7], but none integrates all five capabilities (real-time data, itinerary personalization, budget management, hotel integration, and full planning lifecycle) within a unified platform. IoT-based frameworks [8,9] address mobility and safety but provide no planning functionality. Planify is, to our knowledge, the only reviewed system reporting coverage of all five listed dimensions; however, this comparison is a feature-coverage analysis based on capabilities reported in the cited literature for each system, not an empirical head-to-head benchmark run under identical conditions, and we have not independently measured the other systems ourselves. Relative to the LLM-based planners TravelAgent and TravelPlanner, Planify’s distinguishing design choice is the tight coupling of itinerary generation to a live hotel-pricing API and an explicit, enforced per-day budget constraint at generation time, rather than treating budget as a soft preference. Empirically benchmarking Planify against these systems on shared test scenarios remains an open task, discussed in Future Work.

Outcomes

The proposed Planify: Smart Trip Planning system was successfully designed, developed, and implemented using modern web technologies and AI-powered travel recommendation capabilities. The major outcomes of the system are as follows:

User Registration and Authentication: Users were able to register and log in securely. User profiles and travel preferences were stored safely in the MongoDB database.

Personalized Trip Planning: The system successfully generated personalized travel plans based on user inputs such as destination, budget, trip duration, transportation mode, and travel preferences.

AI-Based Travel Recommendations: The Perplexity API effectively recommended tourist attractions, hotels, restaurants, transportation options, and local activities, providing intelligent and personalized travel suggestions.

Day-wise Itinerary Generation: The application generated well-structured day-wise travel itineraries with optimized schedules, travel routes, and estimated travel expenses.

Trip Management: Users could successfully save, view, edit, delete, and download their travel plans, enabling efficient trip organization and future access.

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Database Management: User information, travel history, saved itineraries, and recommendations were securely stored and efficiently managed using MongoDB.

Responsive User Interface: The application provided a responsive, user-friendly interface that worked efficiently across desktops, laptops, tablets, and mobile devices.

The Planify: Smart Trip Planning system successfully integrated Artificial Intelligence, modern web technologies, and cloud-based data management to provide an intelligent, personalized, and efficient travel planning platform. The system significantly reduced manual travel planning effort while improving convenience, recommendation quality, and the user experience.

Screenshots

Figure 5 shows the home page of the Planify: Smart Trip Planning application. It presents a modern and visually appealing interface designed to help users create personalized travel plans quickly and easily. The page includes navigation options such as Features, How It Works, Stories, Sign In, and Start Planning. The main section introduces the platform with the heading "Get your dream trip" and explains that the application uses Artificial Intelligence to generate customized day-wise travel itineraries based on a few user inputs. It also displays travel categories such as Island, Adventure, Wellness, Family, Romantic, Culture, Nature, and Relaxation, along with attractive destination images. The Start Planning and See How It Works buttons provide users with quick access to begin planning their trips, offering a simple, interactive, and user-friendly travel planning experience.

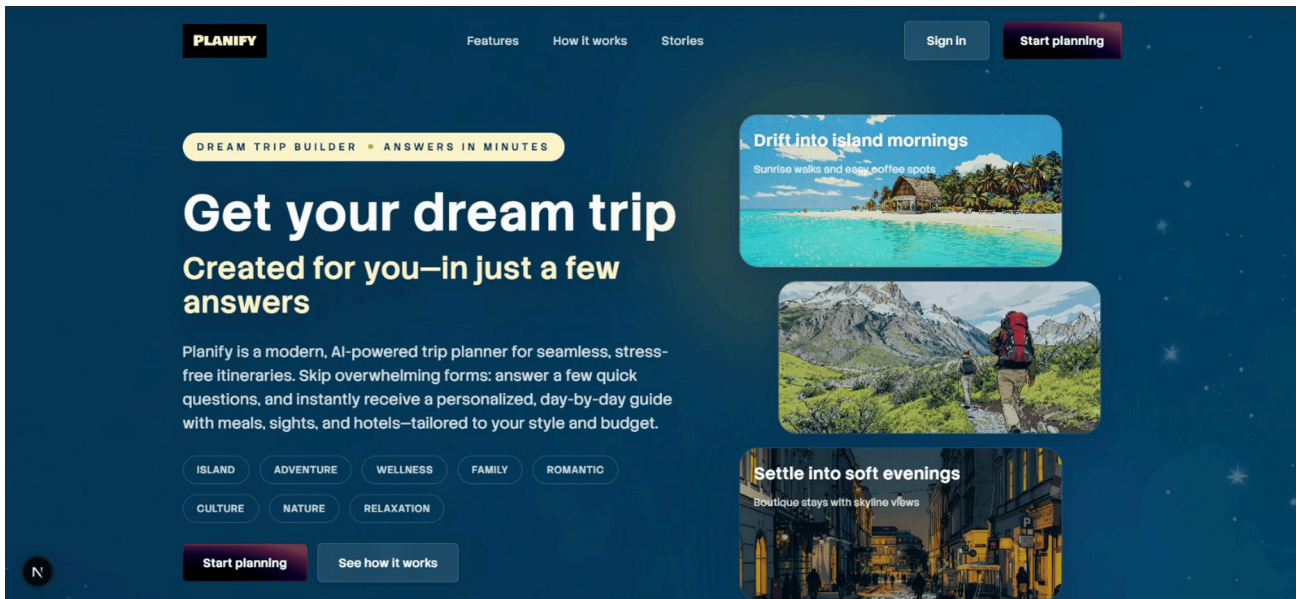


FIGURE 5: Home Page

Figure 6 shows the Sign In page of the Planify: Smart Trip Planning application. It provides a secure authentication interface where users can log in using their email address and password to access their personalized travel plans and saved itineraries. The page includes clearly labeled input fields, a Sign In button for user authentication, and a Create One option for new users to register for an account. A Back to Home link is also provided for easy navigation to the home page. The clean, modern, and user-friendly interface ensures a secure and seamless login experience before accessing the application's travel planning features.

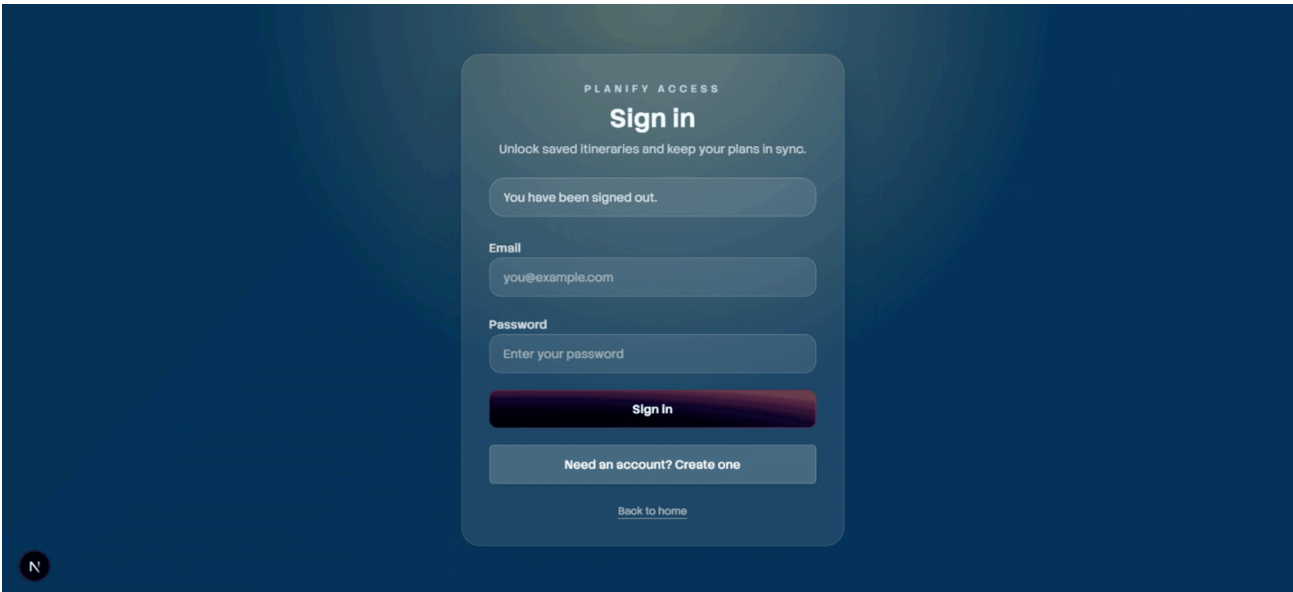


FIGURE 6: Sign-in Page

Figure 7 shows the Trip Planning Questionnaire page of the Planify: Smart Trip Planning application. It is the first step of the trip planning process, where the user is asked to enter their name before proceeding to the next stage. The interface includes a progress indicator showing the current step in the questionnaire, a text input field for entering the user's name, and a Next button to continue. An attractive travel-themed background image enhances the visual appeal of the page, creating an engaging and user-friendly experience while collecting the essential information required for generating a personalized travel itinerary.

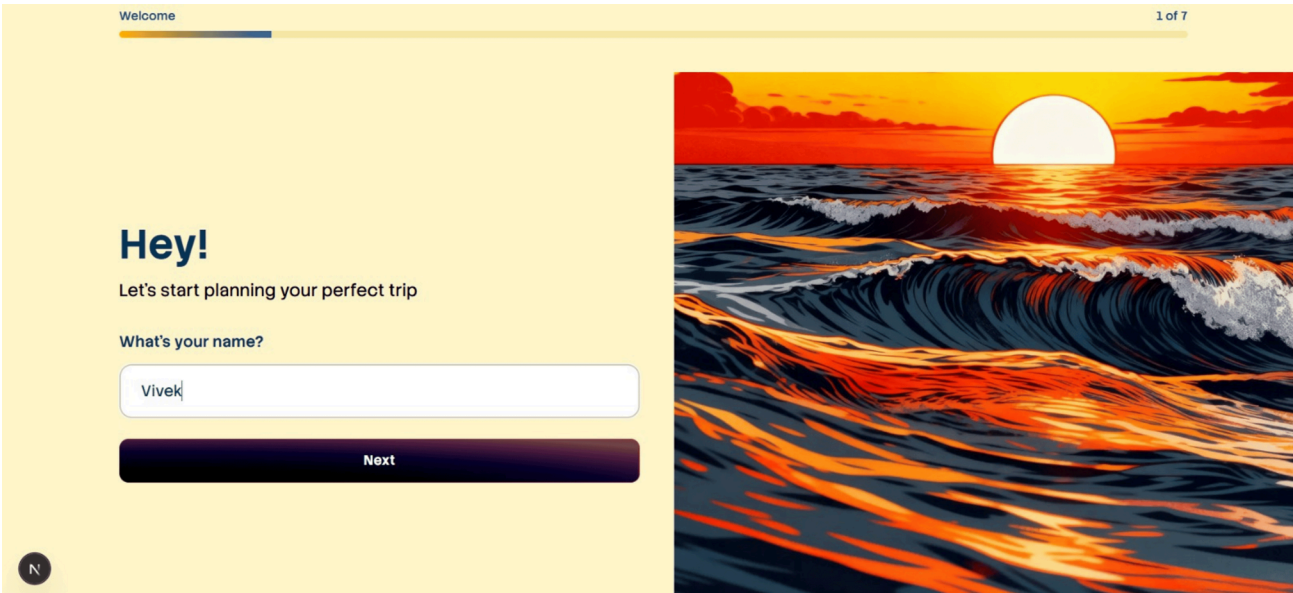


FIGURE 7: Enter Details

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Figure 8 shows the Destination Selection page of the Planify: Smart Trip Planning application. It allows users to enter their travel details by specifying the departure location, destination, and preferred mode of transportation. The interface includes input fields for country, state/region, and city for both the starting point and destination, along with a transport selection option such as Flight. A progress indicator at the top shows the user's current step in the trip planning process, while an attractive travel-themed illustration enhances the visual appeal of the page. This information is collected to generate personalized travel recommendations, optimized routes, and a customized day-wise travel itinerary.

Destination 3 of 7

Departing From
Delhi, Delhi, India

Country: India State / Region: Delhi City: Delhi

Traveling To
Los Angeles, California, USA

Country: USA State / Region: California City: Los Angeles

Mode of Transport
Flight

Select your preferred mode of transport

Flight

Delhi → Los Angeles

FIGURE 8: Trip Details

Figure 9 shows the Generated Travel Itinerary page of the Planify: Smart Trip Planning application. It presents a personalized day-wise travel plan created based on the user's preferences, destination, budget, travel duration, and transportation mode. The itinerary includes a detailed schedule for morning, afternoon, and evening activities, along with recommended tourist attractions, restaurants, meal options, estimated costs, and activity durations. The page also displays key trip information such as the travel route, mode of transport, number of travelers, trip duration, and total estimated budget. Additionally, a Download PDF button enables users to save and share their complete travel itinerary, providing a well-organized, user-friendly, and comprehensive travel planning experience.

How to cite this article:

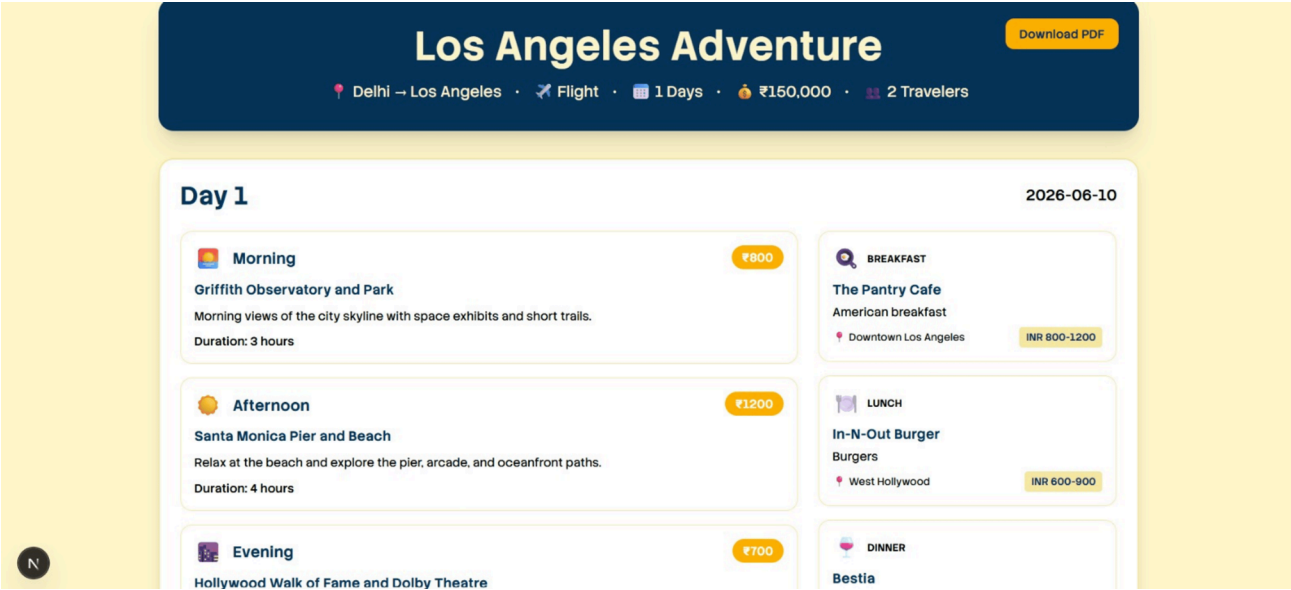


FIGURE 9: Day 1 of the Trip

Figure 10 shows the Day 2 Travel Itinerary page of the Planify: Smart Trip Planning application. It provides a detailed schedule for the second day of the trip, organized into morning, afternoon, and evening activities. For each time slot, the application recommends popular tourist attractions, estimated activity durations, and approximate travel expenses. It also suggests suitable breakfast, lunch, and dinner options, including restaurant names, locations, and estimated price ranges. The well-structured layout enables users to follow a balanced daily travel plan while effectively managing their time, budget, and dining preferences, ensuring a convenient and enjoyable travel experience.

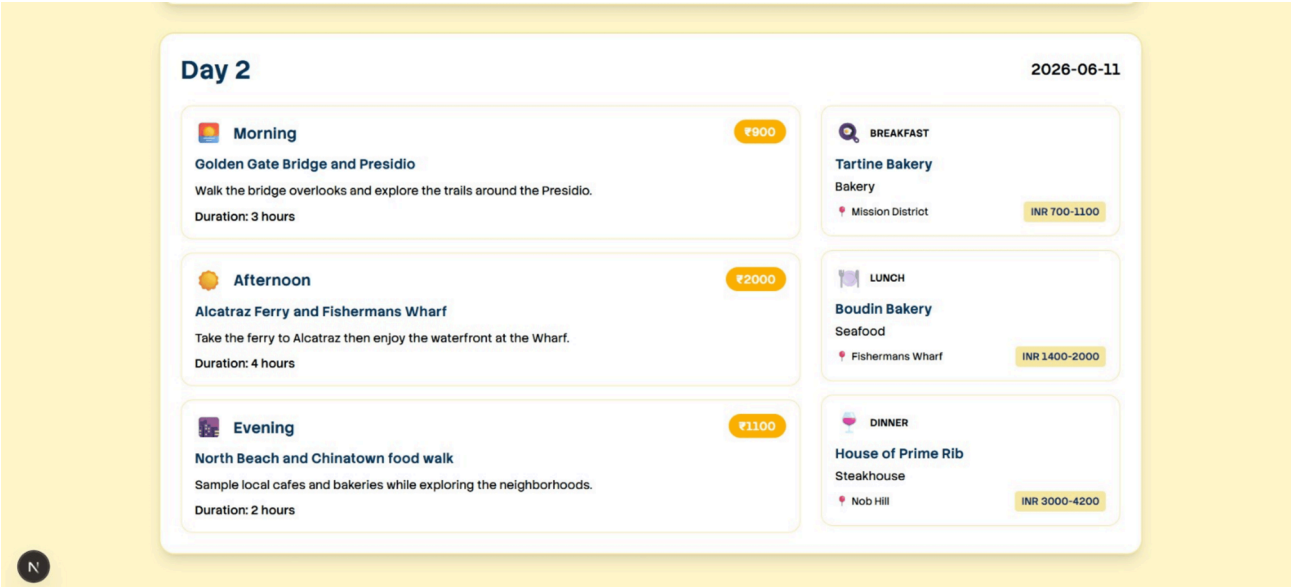


FIGURE 10: Day 2 of the Trip

Figure 11 shows the Travel Recommendations section of the Planify: Smart Trip Planning application. It provides personalized transportation and accommodation recommendations based on the user's selected destination and travel preferences. The system recommends trusted transportation booking platforms such as Google Flights, Skyscanner, Kayak, and MakeMyTrip to help users compare fares and book their journeys conveniently. It also displays recommended accommodation options with details such as hotel name, location, price per night, and available amenities. These AI-generated recommendations assist users in selecting suitable travel and lodging options, making the trip planning process more convenient, efficient, and personalized.

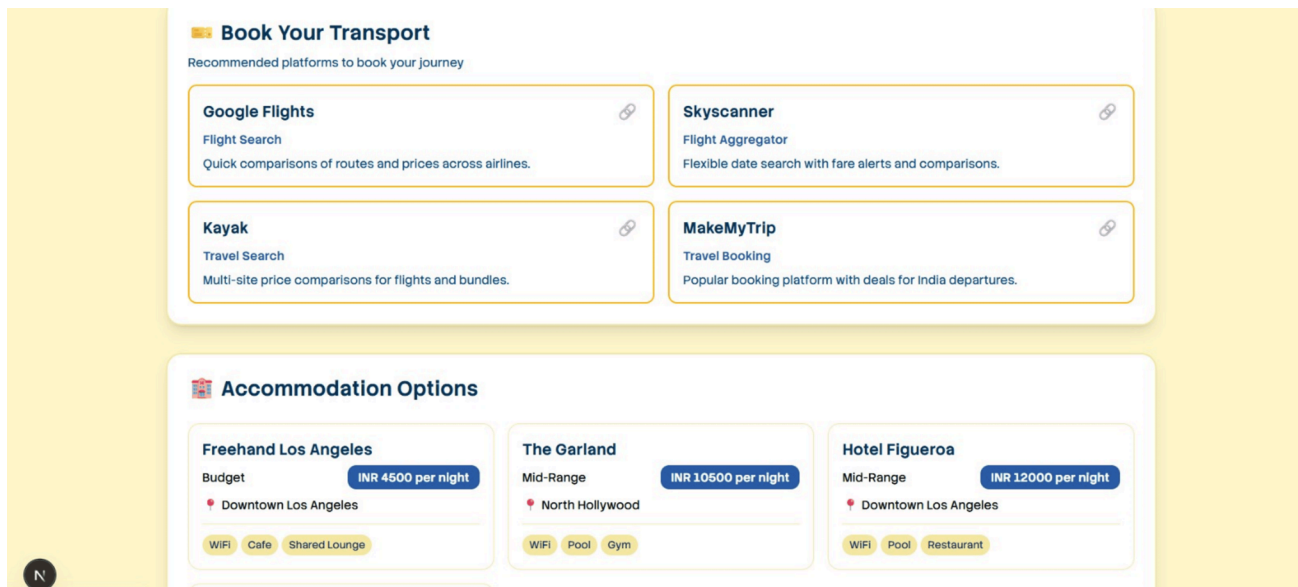


FIGURE 11: Recommendation

Limitations

The evaluation reported above is based on a fixed internal suite of 15 functional test cases and a five-person internal usability panel; it is not a substitute for an external, real-user study, and the reported percentages should be read as descriptive of this test suite rather than as generalizable performance guarantees. No inferential statistical testing (e.g., significance testing across conditions) was performed, given the small sample size, and no measurements were taken on live installations of competing systems. The comparison in Table 1 is a feature-level literature comparison, not an empirical benchmark. The Interface Usability Score of 82/100 reflects a System Usability Scale-inspired checklist completed by five internal evaluators during development and demonstration sessions; it is an informal, internal assessment and not a substitute for a validated usability study with external, representative users. Closing these gaps through an external user study, statistical analysis, and live comparative benchmarking is treated as the immediate next step for this work (see Future Work).

Future work

Building on the internal functional testing reported here, planned next steps include: (i) a real-world user study with external participants measuring task completion time and satisfaction against manual planning and at least one existing AI itinerary tool; (ii) statistical significance testing once a larger sample of trips is collected; (iii) head-to-head empirical benchmarking against recent LLM-based planners such as TravelAgent and TravelPlanner on shared test scenarios, rather than the feature-level literature comparison in Table 1; and (iv) scalability and computational performance testing under concurrent multi-user load, since the 4.2-second average response time reported here was measured under single-user, sequential testing conditions only.

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Conclusions

Planify brings the most effective and efficient method of planning today's travels together in one simple solution. Its ability to consolidate multiple types of functions into one streamlined, complete solution simplifies the overall planning process and enhances both user experience and decision-making. With the automated generation of structured day-by-day itineraries, combined with a real-time hotel recommendation service, Planify significantly decreases both the complexity and the time required for creating travel plans, thereby eliminating the amount of manual effort placed on the user or others involved in creating a trip. Planify provides users with useful, organized, and budget-friendly travel plans without having to rely on multiple travel providers or platforms to put together their entire travel plan. It is built on structured and modular design principles. The structured architecture allows for efficient data processing, smooth communication between all parts of the system, and consistent performance across all users, ensuring reliability and adaptability. As each component of the plan (itinerary generation and hotel recommendations, for example) is modularly designed, they run efficiently as individual components and together as an integrated system, increasing overall usability and maintainability.

Planify has successfully addressed many of the existing travel planning system limitations such as lack of integrated systems, limited personalized service offerings, and not utilizing real-time data. The platform creates one central system by using a unified interface that integrates most of the needed tools into a single location for a streamlined planning experience. This ensures all necessary information and recommendations are in one place, reducing confusion and making planning more convenient. In addition, the system has strong future growth potential due to its flexible architecture, which can accommodate enhancements and additional functionalities to adapt to changing user requirements or advances in technology. Overall, Planify demonstrates how the integration of intelligent concepts and innovative implementation strategies can lead to efficient and user-centric travel planning solutions that effectively address some of the most common challenges in travel planning.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Drafting of the manuscript: Shreya Bhalerao, Shravani Bhalerao

Disclosures

Human subjects: All authors have confirmed that this study did not involve human participants or tissue.

Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue.

Conflicts of interest: In compliance with [the ICMJE uniform disclosure form](#), all authors declare the following:

- **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work.
- **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted

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- **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Data Availability Statements

Data sharing is not applicable. This work is theoretical; no datasets were generated or analyzed.

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