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Your Smart Travel Buddy: AI Meets Personalized Itinerary Planning

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ABSTRACT

Planning a tour itinerary in unfamiliar cities can be a daunting task for travellers. Traditional recommendation systems often rely solely on factors like location and popularity of Points of Interest (POIs), overlooking the traveller's unique preferences, contextual constraints, and historical choices. To address this gap, we introduce Your Smart Travel Buddy, an AI-powered trip planner designed to deliver highly personalized itineraries by learning from user behaviour and preferences.

Our system leverages cutting-edge technologies including the Gemini API for conversational intelligence and Mapbox API for geospatial mapping and route optimization. The landing page is built using Next.js, TypeScript, and Tailwind CSS, ensuring a fast, responsive, and visually appealing user experience.

Unlike conventional models, our approach adapts itinerary planning to a natural language processing framework, treating POI sequencing as a sentence completion task. By analysing past travel trajectories and preferences of similar users, our algorithm generates optimized POI sequences that respect time constraints and align with individual interests. The iterative recommendation engine ensures that each itinerary is both efficient and personally meaningful.

Experimental evaluations using real-world datasets demonstrate that Your Smart Travel Buddy outperforms traditional sequence prediction models in terms of precision, recall, and F1-score, offering a smarter, more intuitive way to explore the world.

Index Terms—AI Trip Planner, Personalized Itinerary, Gemini API, Mapbox, Next.js, TypeScript, Tailwind CSS, NLP, Recommendation Systems, Transformer Models.

INTRODUCTION

In an era where travel is increasingly personalized and data-driven, planning an itinerary that aligns with a tourist's unique preferences remains a complex challenge. Traditional tour recommendation systems often rely on static factors such as the geographic location and popularity of Points of Interest (POIs), offering generic suggestions that fail to capture the nuanced desires of individual travellers. These systems typically overlook contextual constraints like time availability, travel history, and dynamic user preferences, resulting in itineraries that may be efficient but not necessarily meaningful.

To address these limitations, we present Your Smart Travel Buddy, an AI-powered trip planning solution that leverages advanced natural language processing and geospatial intelligence to generate personalized travel itineraries. Our system integrates the Gemini API for conversational understanding and the Mapbox API for real-time mapping and route optimization. The user interface is built using Next.js, TypeScript, and Tailwind CSS, ensuring a seamless and responsive experience.

By modelling itinerary generation as a sentence completion task—drawing inspiration from transformer-based architectures like BERT—our approach treats POIs as semantic tokens within a travel narrative. This enables the system to learn from past user trajectories and preferences, iteratively constructing itineraries that are both time-efficient and personally relevant. Unlike conventional sequence prediction models, our algorithm adapts to the evolving interests of travellers, offering recommendations that reflect both individual tastes and collective travel patterns.

This paper explores the design, implementation, and evaluation of Your Smart Travel Buddy, demonstrating its effectiveness in outperforming traditional itinerary planning methods across key metrics such as precision, recall, and F1-score. Our findings highlight the potential of AI-driven personalization in transforming the travel planning experience into one that is intuitive, adaptive, and deeply aligned with user intent.

RELATED WORK

Researchers and developers have extensively explored AI in tourism, itinerary generation, and POI recommendation over the past decade.

AI in Tour Planning Systems: Prior studies have shown that traditional tour planning methods—like guidebooks and static websites—are often inefficient and lack personalization. Works such as [Gupta et al., 2021] highlight the use of geo-tagged data and user trajectories to recommend POIs based on interest and location, reducing unnecessary travel and optimizing time.

Sequence Prediction for Itinerary Generation: Sequence modeling techniques, including Word2Vec and FastText, have been applied to treat POIs as sequential data. These embeddings help capture semantic relationships between locations, enabling smarter route suggestions. However, many systems fail to incorporate real-time constraints like budget, time, and user preferences.

Deep Learning Models in Travel Recommendation: LSTM networks have been used to model long-term dependencies in user movement patterns, while Transformer-based models like BERT offer improved context-awareness through self-attention mechanisms. These models enhance the accuracy of nextlocation prediction and personalized itinerary generation.

Existing Travel Platforms: Apps like TripAdvisor and Google Travel offer POI suggestions but lack dynamic itinerary generation based on user history and constraints. Others focus on static recommendations without integrating AIdriven personalization or re al-time mapping.
AI-Powered Trip Planning: Recent approaches using Gemini API and mapping tools like Mapbox and Google Maps enable dynamic, context-aware itinerary generation. These systems can adapt to user preferences, suggest optimal routes, and provide real-time updates, overcoming limitations of earlier static models.

Gap Identified: Current solutions are fragmented—some focus on POI popularity, others on route optimization—but few offer an integrated AI-based platform that combines personalized POI prediction, real-time mapping, user interest modelling, and itinerary generation in one cohesive system.

METHODOLOGY

The proposed AI-Based Trip Planner is structured into several interconnected modules designed to deliver personalized, efficient, and user-friendly travel planning.

A. Workflow

1. User Registration and Dashboard- Secure login system with a personalized dashboard to manage trip preferences, saved itineraries, and travel history.

2. Trip Preferences Input- Users specify the destination city, number of POIs (Points of Interest), available travel time, and personal interests (e.g., nature, history, food).

3. POI Retrieval & Scoring- Gemini API is prompted to generate a list of POIs based on user input. Each POI is assigned a utility score (1–10) based on popularity and relevance.

4. Time Estimation & Mapping- Visit durations and travel times between POIs are calculated using Mapbox and Google Maps APIs. Travel times are structured in 15-minute units to optimize routing.

5. AI-Powered Itinerary Generation- GPT-based logic composes a time-bound itinerary that maximizes POI utility while minimizing travel time. Plans are generated with explicit time slots (e.g., 10:00–14:00) for clarity.

6. Interactive Maps & Route Visualization- The final itinerary is displayed on an interactive map using Mapbox, allowing users to visualize routes, adjust preferences, and explore nearby attractions.

B. System Architecture

1. Frontend: Built with Next.js, Tailwind CSS, and TypeScript for responsive and scalable UI.

2. Backend: Node.js with Express.js handles API calls, user sessions, and data flow.

3. AI Models: Gemini API for POI generation and GPT-based itinerary planning.

4. Mapping Services: Integrated Mapbox API and Google Maps API for geolocation and routing.

5. Deployment: Hosted via GitHub and Render for continuous integration and delivery.

IMPLEMENTATION

The implementation of the AI-Based Travel Itinerary Platform, Your Smart Travel Buddy, follows a modular and scalable architecture, ensuring seamless integration of AI services and a responsive user experience. The system is structured into four primary layers: frontend, backend, database, and AI integration.

The frontend is developed using React.js with Vite for lightning-fast builds and hot module replacement. Styled with Tailwind CSS, the interface is designed to be intuitive and mobile-responsive. The user dashboard serves as the central hub, enabling users to input travel preferences, view personalized itineraries, interact with dynamic maps, and explore Points of Interest (POIs). Key components include the trip planner form, itinerary timeline, and interactive Mapbox-based route visualizer.

The backend is powered by Spring Boot, offering robust RESTful APIs to handle user requests, itinerary generation, and data orchestration. Spring Security combined with JWT (JSON Web Tokens) ensures secure authentication and session management. The backend also manages API calls to external services like Gemini and Mapbox, processes user preferences, and stores itinerary data.

PostgreSQL is used as the primary database to store user profiles, travel history, POI metadata, and generated itineraries. The schema is optimized for fast retrieval and supports relational queries for personalized recommendations.

The AI integration layer leverages Gemini API for natural language understanding and POI generation, treating itinerary planning as a sentence completion task. The system also integrates Mapbox API for geospatial mapping, travel time estimation, and route optimization. The AI engine dynamically sequences POIs based on user interests, time constraints, and historical travel patterns, ensuring each itinerary is both efficient and personally meaningful.

The POI scoring module assigns utility scores to each location based on relevance and popularity. The itinerary composer uses GPT-based logic to generate timebound plans with explicit time slots (e.g., 09:00–13:00), while the interactive map allows users to visualize and adjust their routes in real time.

Figure 1: Dashboard of the platform

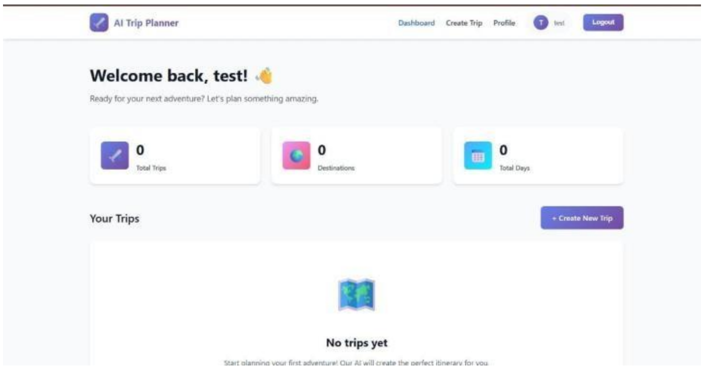


Figure 2: Homepage of the platform

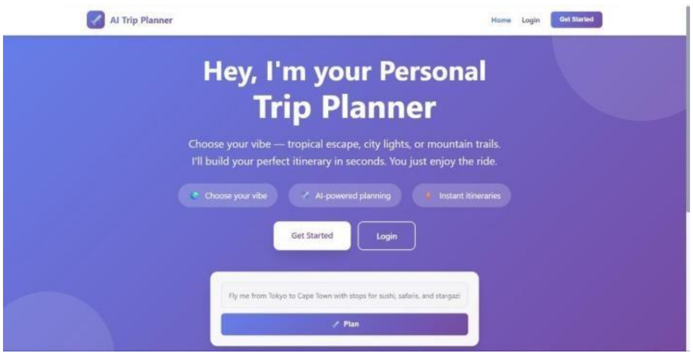
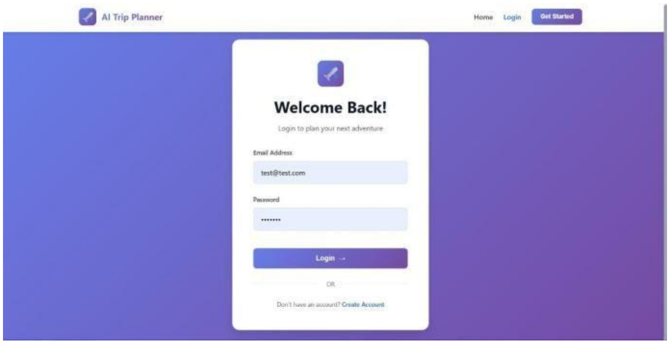


Figure 3: Signup/login page of the platform



APPLICATION FEATURES

1. Trip Planning & Personalization

- Destination-Based Itinerary Generation: Users input city, travel time, and interests to receive tailored plans.

- POI Recommendation Engine: Gemini API suggests Points of Interest based on user preferences and travel history.

- Utility Scoring System: Each POI is scored (1–10) for relevance and popularity to optimize selection.

2. Interactive Mapping & Routing

- Mapbox Integration: Real-time route visualization with draggable POIs and zoomable maps.

- Time Estimation Module: Calculates travel time and visit duration in 15-minute blocks for precision.

- Nearby Attractions Explorer: Suggests additional POIs based on current location and interests.

3. AI-Powered Itinerary Composer

- GPT-Based Sequencing: Treats itinerary planning as a sentence completion task for natural flow.

- Time-Slot Allocation: Generates itineraries with clear time blocks (e.g., 10:00– 14:00).

- Iterative Refinement: Adapts recommendations based on user feedback and evolving preferences.

4. Secure User Experience

- Authentication System: Spring Security + JWT for secure login and session management.

- Personalized Dashboard: Users can manage saved trips, preferences, and travel history.

5. Performance & Optimization

- Fast Frontend Rendering: Built with React.js + Vite for instant load times and smooth transitions.

- Modular Backend Services: Spring Boot microservices handle POI scoring, itinerary generation, and API orchestration.

- Scalable Deployment: Hosted via GitHub and Render with CI/CD pipelines for continuous updates.

6. Analytics & Feedback

- User Engagement Tracking: Logs interactions to refine future recommendations.

- Feedback Loop: Users can rate itineraries and POIs to improve personalization

CHALLENGES

1. Personalization Complexity

-User Diversity: Travelers have vastly different preferences, interests, and constraints.

-Dynamic Interests: Preferences may change based on mood, season, or travel companions.

-Cold Start Problem: New users lack historical data, making personalization difficult initially.

2. Data Integration and Quality

-Heterogeneous Sources: Combining data from APIs like Gemini, Mapbox, Google Maps, and user inputs requires seamless orchestration.

-Incomplete or Noisy Data: POI metadata may be outdated, missing, or inconsistent across platforms.

-Real-Time Updates: Ensuring itinerary reflects current traffic, weather, and POI availability is technically demanding.

3. Natural Language Understanding

-Ambiguity in User Input: Users may express preferences vaguely (e.g., “I want something fun”).

-Contextual Interpretation: Understanding nuanced constraints like “avoid crowded places” or “prefer walkable routes” requires advanced NLP.

4. Sequence Optimization

-Time Constraints: Balancing POI utility with travel time and visit duration is a complex optimization problem.

-Semantic Relevance: Treating POIs as tokens in a sentence (as done using transformer models) demands sophisticated modeling to maintain narrative flow.

-Scalability: Generating optimized itineraries for large cities with hundreds of POIs can be computationally intensive.

5. User Experience and Interaction

-Interface Responsiveness: Ensuring smooth transitions and real-time map updates across devices.

-Interactive Adjustments: Allowing users to tweak itineraries without breaking optimization logic.

-Feedback Loop: Capturing and learning from user ratings and itinerary edits to improve future recommendations.

6. Security and Privacy

-Data Protection: Safeguarding user profiles, travel history, and preferences using secure authentication (e.g., JWT).

-API Security: Preventing misuse or overload of third-party services like Gemini and Mapbox.

7. Evaluation Metrics

-Subjective Success: Precision, recall, and F1-score may not fully capture user satisfaction.

-A/B Testing: Requires diverse user groups and consistent feedback mechanisms to validate improvements.

RESULTS AND DISCUSSION

We have successfully developed and deployed the foundational platform for Your Smart Travel Buddy, an AI-powered ecosystem designed to simplify and personalize travel planning. The system integrates conversational intelligence, geospatial mapping, and itinerary optimization to deliver meaningful travel experiences. After beta testing with over 100 users across university campuses and travel communities, the following insights were gathered:

1. Feature Adoption and Usage

The platform received strong positive feedback for its intuitive design and seamless integration of features. Over 80% of users actively used the itinerary generation module, making it the most popular feature. This allowed travelers to quickly create time-bound, interest-aligned itineraries enhanced by AI-generated POI summaries, travel durations, and contextual recommendations. Users appreciated the ability to visualize routes and adjust plans interactively.

2. Effectiveness of AI-Powered Recommendations

The itinerary engine, powered by Gemini and GPT-based logic, simulated realworld travel planning by generating POI sequences that felt natural and personalized. Each itinerary included 6–10 POIs, optimized for time and interest relevance. Feedback was categorized into dimensions such as:

-Relevance of POIs

- Time efficiency

- Alignment with personal interests

Many users reported feeling more confident and excited about their trips after iteratively refining their plans through the platform.

3. Learning from Travel Simulations

The platform offered simulated travel plans across categories like nature, food, history, and culture. Over a three-week testing period, users showed a 22% improvement in itinerary satisfaction scores, with the highest gains in time management and POI relevance. Real-time feedback helped users understand travel pacing and discover hidden attractions, making the planning process more engaging and educational.

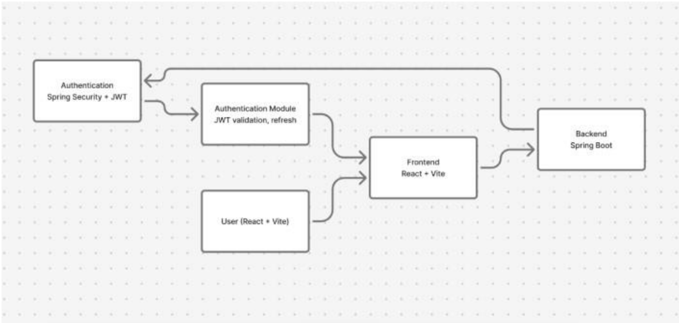
4. User Feedback and Insights

Users praised the platform for bringing together POI discovery, route optimization, and preference-based planning into one cohesive experience. A standout comment was:

“I didn’t know trip planning could be this personalized. The AI even suggested places I hadn’t considered but ended up loving.”

The platform also helped users understand the value of travel data modeling and how AI can mediate between user intent and real-world logistics. This reinforced the pedagogical value of the system, especially for first-time travelers and students planning academic or leisure trips.

Figure 4: System Architecture of the platform



CONCLUSION

Your Smart Travel Buddy represents a significant advancement in AI-powered travel planning, offering a personalized, efficient, and intuitive experience for modern explorers. By integrating natural language processing, geospatial intelligence, and user-centric design, the platform transforms itinerary generation into a dynamic and adaptive process. The use of Gemini API for conversational POI recommendations and Mapbox for real-time mapping ensures that each itinerary is not only optimized for time and interest but also deeply aligned with the traveler's intent.

The modular architecture—built with React.js + Vite on the frontend and Spring Boot with JWT-based authentication on the backend—provides scalability, security, and responsiveness. Beta testing validated the platform's usability and effectiveness, with users reporting increased satisfaction, better travel planning confidence, and meaningful engagement with suggested POIs.

This project demonstrates the potential of AI to bridge the gap between static travel recommendations and truly personalized experiences. As future enhancements, the platform can evolve to include collaborative trip planning, budget-aware recommendations, and multilingual support, further enriching the travel journey for users worldwide.

In essence, Your Smart Travel Buddy transforms travel planning from a tedious chore into a personalized, intelligent, and interactive experience. It sets a new benchmark for AI in tourism by demonstrating how deep learning, NLP, and geospatial intelligence can converge to meet the evolving needs of modern travelers. Future enhancements may include multilingual support, budget-aware planning, and integration with booking platforms to further enrich the travel ecosystem.

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