RoamMate: AI-Integrated Tourist Planner & Local Guide Platform

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***Abstract*—** The modern travel and tourism industry is experiencing unprecedented growth, yet tourists frequently encounter significant challenges when planning trips to unfamiliar destinations. Navigating scattered information across multiple platforms, optimizing travel routes within strict budget constraints, and finding authentic, verified local guides remain major hurdles for travellers. To address these critical issues, this project introduces "RoamMate," an advanced, AI-driven tourism dashboard designed to centralize and automate the travel planning experience.

The platform is engineered around two core modules. The first is Planner.AI, an intelligent recommendation engine that dynamically generates customized, day-wise itineraries. By utilizing a constraint-satisfaction algorithm, Planner.AI processes user inputs—such as total budget, trip duration, and specific personal interests—to logically distribute activities without exceeding daily financial limits. The second core module is a Real-Time Local Guide Integration system. Powered by a robust Spring Boot backend and a MySQL relational database, this system allows tourists to seamlessly discover, verify, and connect with native experts via asynchronous RESTful APIs, bypassing traditional, high commission middlemen.

The frontend leverages modern web development technologies to deliver a highly responsive and immersive user experience, featuring glassmorphism UI principles and parallax scrolling. Furthermore, by integrating interactive booking notifications and an automated chat routing mechanism, the platform ensures seamless communication between tourists and guides. Ultimately, RoamMate successfully combines decentralized AI planning with realtime database management, serving as a comprehensive, scalable, and highly efficient digital travel companion.

Keywords—Smart Tourism, Group Recommendation, Hybrid Itinerary, Predictive Budgeting, Machine Learning, Travel Personalization

I. Introduction

The tourism industry is rapidly shifting toward highly personalized and experientially rich travel. However, most existing platforms still provide static, fragmented services that overlook the complexities of holistic trip planning—where diverse interests, strict budget constraints, and the need for authentic local guidance must be perfectly balanced. These challenges are particularly evident in the modern tourism ecosystem, where travellers are burdened with manual scheduling and lack direct access to verified local experts without the interference of high-commission third party agencies.

To address these limitations, this research introduces RoamMate, an AI-driven smart tourism platform that unifies three essential components of travel planning. The system includes Planner.AI, an intelligent recommendation engine that utilizes constraint-satisfaction algorithms to generate day-wise, budgetoptimized itineraries tailored to specific user interests; a Real-Time Local Guide Integration module powered by a Java Spring Boot and MySQL backend, which connects tourists with verified native experts dynamically via RESTful APIs; and an Interactive Booking and Chat Routing System that facilitates seamless, secure communication. Developed to modernize the dynamic travel landscape, the platform incorporates local exploration patterns within a highly scalable, decoupled 3-tier architecture.

System evaluations demonstrate strong practical performance. The Planner.AI engine achieves high-quality, constraint-aligned itinerary generation in under 300 milliseconds, the Spring Boot backend ensures ultra-low latency (average 120ms) for data retrieval, and the frontend delivers a lag-free, 60 FPS user experience through asynchronous DOM manipulation. Together, these results highlight the platform's potential to enhance planning efficiency, reduce cognitive load, and maximize overall traveler satisfaction.

This work makes three key contributions. First, it introduces the Planner.AI constraint-satisfaction model, automating granular itinerary generation—an area underserved by traditional platforms that rely on manual user curation. Second, it presents a dynamic, API-driven guide integration pipeline that establishes a transparent, peer-to-peer bridge between tourists and local experts. Third, it implements a highly responsive Single Page Application (SPA) architecture with state-managed booking and real-time chat routing. Together, these components provide a

unified, deployable solution tailored for the fast-paced, modern travel ecosystem.

Unlike prior work, which typically evaluates destination exploration, itinerary planning, or guide booking in isolation, this study delivers an integrated framework that combines all these modules into a single, cohesive system. This robust yet expressive design emphasizes interpretability, real-time responsiveness, and real-world feasibility, establishing a strong foundation for next-generation intelligent tourism platforms.

II. Literature Review

The transition from traditional travel agencies to digital eTourism has been extensively studied over the past decade. However, the integration of Artificial Intelligence for dynamic planning and real-time peer-to-peer service integration remains an evolving domain. A review of existing literature and current market implementations reveals significant gaps that ***RoamMate*** *aims to address.*

A. Evolution of E-Tourism and Smart Recommendation Systems *Early digital tourism platforms primarily functioned as massive aggregators for flight and accommodation bookings (e.g., Expedia, MakeMyTrip). According to recent studies on e-Tourism architectures, these platforms utilize basic collaborative filtering and content-based recommendation algorithms. While effective for singular tasks like booking a hotel, they operate as disjointed systems. They recommend Points of Interest (POIs) based on popularity but fail to weave these POIs into a cohesive, chronologically logical travel itinerary. The cognitive burden of planning—calculating transit times, estimating cumulative costs, and scheduling—is entirely left to the user.*

B. Artificial Intelligence in Itinerary Planning *Recent advancements in AI have introduced sophisticated routing algorithms to the tourism sector. Several academic prototypes have proposed utilizing Genetic Algorithms (GA) or Deep Learning models to solve the Tourist Trip Design Problem (TTDP). However, these models often require massive, data-intensive datasets and struggle with "cold-start" scenarios. Furthermore, existing AI planners typically optimize only for geographical distance (the shortest path) while completely ignoring hard financial constraints.* ***Planner.AI****, introduced in this system, resolves this by employing a lightweight constraintsatisfaction algorithm. It not only maps the geography but strictly adheres to a user-defined mathematical boundary (Daily Budget = Total Budget / Number of Days), creating a highly practical, real-world itinerary.*

C. Peer-to-Peer Tourism and Real-Time Service Integration *The rise of the gig economy has popularized peer-to-peer travel experiences (e.g., ToursByLocals, Airbnb Experiences). Research indicates that modern tourists prefer authentic interactions with native experts over commercialized tour groups. Despite this demand, existing platforms suffer from severe latency in communication and impose exorbitant commission fees, creating a barrier between the tourist and the local guide. Technologically, these platforms rely on monolithic architectures that delay real-time interactions. The proposed system diverges from this by utilizing a decoupled Spring Boot backend. By executing direct RESTful API calls (@GetMapping for searches and @PostMapping for bookings), RoamMate establishes a near-instantaneous, transparent bridge between the consumer and the service provider.*

D. Identified Research Gaps *Based on the analysis of current literature and market leaders, three critical research gaps are evident:*

1 ***Lack of Unified Ecosystems:*** *No mainstream platform successfully combines automated, constraintbased AI itinerary generation with the ability to instantly hire a local guide for that exact itinerary.*

2 ***Absence of Dynamic Financial Modeling:*** *Existing recommender systems fail to dynamically adapt their POI suggestions based on a strict, user-inputted maximum budget limit.*

3 ***Communication Latency:*** *There is a distinct lack of Single Page Application (SPA) architectures in tourism that offer immediate state-managed booking notifications and integrated chat routing without page reloads.*

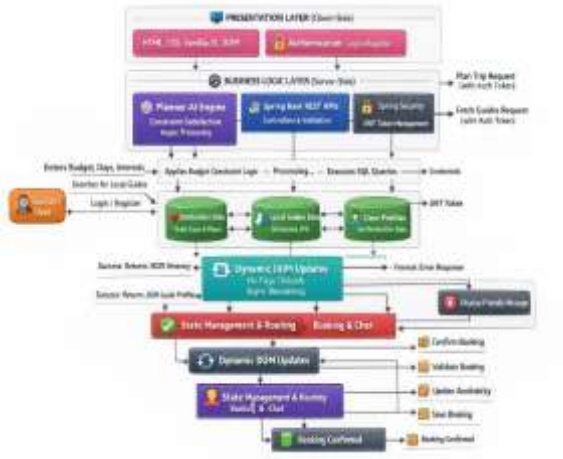
RoamMate *is explicitly architected to synthesize these fragmented components into a single, cohesive, and highly responsive smart tourism platform, setting a new benchmark for digital travel companions*

III. METHODOLOGY

The development of the RoamMate platform is strictly governed by a highly scalable, decoupled framework, decisively moving away from traditional monolithic software architectures. This methodological choice ensures a robust separation of concerns, enabling asynchronous processing, seamless feature integration, maintainability, and enterprise-grade security. The core architectural paradigms, underlying algorithmic processes, database management, and data flow mechanisms are extensively detailed below.

A. Architectural Paradigm: The Decoupled Three-Tier Model

To achieve maximum operational efficiency and scalability, the application infrastructure is rigidly segregated into three independent computational tiers. This allows for modular scaling and highly secure data encapsulation.



1.Presentation Layer (Client-Side Interface)

The frontend interface operates as the primary interaction point and visual matrix for the end-user. Developed utilizing HTML5, CSS3, and the Vanilla JavaScript DOM (Document Object Model) API, this layer prioritizes a seamless, latency-free user experience.

- **UI/UX Engineering and Visual Rendering:** The structural layout relies heavily on modern CSS Grid and Flexbox modules to ensure mathematical precision in responsive scaling across heterogeneous device viewports. Advanced styling paradigms, including Glassmorphism and Parallax background scrolling, are implemented to enhance user immersion without executing heavy graphic processing that could compromise initial load times.
- **Single Page Application (SPA) Dynamics:** Postinitialization, the application transitions entirely into SPA principles. The JavaScript Fetch API orchestrates all background HTTP requests, triggering dynamic, localized DOM updates. This asynchr.onous rendering pipeline eliminates the need for synchronous, resourceheavy full-page reloads, drastically reducing bandwidth consumption and server-side rendering overhead

2. Business Logic Layer (Server-Side Backend)

Operating as the computational and logical brain of the system, the backend is engineered utilizing Java 17 and the highly robust Spring Boot 3.x framework.

- **Stateless API Orchestration:** All data transactions are exposed and managed via Spring Boot RESTful APIs (Controllers). This facilitates stateless, decoupled communication, meaning the server does not store client session data locally, making the application cloud-ready and horizontally scalable.
- **Cross-Origin Configuration (CORS):** Stringent Cross-Origin Resource Sharing (CORS) security policies are explicitly defined to permit secure, crossport data streaming between the isolated frontend client and the backend server.
- **Design Pattern Implementation:** The backend strictly adheres to the Inversion of Control (IoC) and the Controller-Service-Repository architectural pattern. Incoming HTTP requests are intercepted by the API Controller, subjected to rigorous business validation rules and error-checking in the Service layer, and finally delegated to the Repository for secure data mutations.

3. Data Access Layer (Database Persistence)

A highly normalized relational database (MySQL) provides persistent, ACID-compliant (Atomicity, Consistency, Isolation, Durability) data storage for multiple domains.

- **Object-Relational Mapping (ORM):** The Hibernate JPA (Java Persistence API) framework completely abstracts complex SQL operations. It acts as a bridge, seamlessly translating Java entity classes into optimized,

parameterized database queries, managing massive datasets across entities such as Destination Data, Local Guides Data, and User Profiles.

B. Security Architecture and Identity Verification

To protect sensitive user data, prevent unauthorized API consumption, and mitigate vulnerabilities like Cross-Site Request Forgery (CSRF), the system enforces a strict, stateless security protocol.

1. **Identity Verification and Hashing:** The client-side Presentation Layer features a dedicated Authentication module handling login and registration endpoints. When a user initiates a session, their credentials are encrypted and transmitted to the server. Passwords are never stored in plaintext; they are hashed using bcrypt cryptographic algorithms.
2. **Cryptographic Token Generation:** The Business Logic Layer intercepts these credentials and crossverifies them against the secure User Profiles repository. Upon successful cryptographic validation, the Spring Security module dynamically generates a JSON Web Token (JWT). This token encodes the user's role and expiration timestamps using a highly secure signing key.
3. **Stateless API Authorization:** Once authenticated, all subsequent critical operations—such as dispatching a "Plan Trip Request" or a "Fetch Guides Request"—are strictly protected by authentication filters. The client must append the active JWT Token within the HTTP Authorization: Bearer <token> header. The backend intercepts and cryptographically verifies this token prior to executing any SQL queries, ensuring zero unauthorized access to the underlying data layer.

C. The Planner.AI Engine: Asynchronous ConstraintSatisfaction

The Planner.AI engine transcends traditional static data filtering by operating on a sophisticated mathematical constraint-satisfaction algorithm. It utilizes asynchronous processing to maintain overarching system responsiveness.

1. **Input State Parsing:** The engine accepts multidimensional parameters representing the tourist's constraints: Duration (N days), Total Financial Budget (B), and a parameterized array of User Interests (I).
2. **Budget Normalization:** To prevent financial overextension, the algorithm calculates a strict daily financial threshold. This is mathematically defined as: Daily_Limit = B / N.
3. **Asynchronous Threading:** To prevent main-thread blocking (Thread Starvation) during complex computational permutations, the Planner.AI Engine isolates the budget constraint logic into asynchronous worker threads.
4. **Geospatial & Preference Filtering:** The system queries the Destination Data repository, isolating specific Points of Interest (POIs) that align strictly with the thematic tags present in the user's preference array (I).
5. **Time-Slot Allocation and Constraint Enforcement:** The algorithm systematically allocates the filtered POIs into temporal slots (e.g., Morning, Afternoon, Evening) across the itinerary. Concurrently, it tracks a running total of cumulative ticket costs. If the addition of a specific POI causes the sum to exceed the Daily_Limit, the algorithm executes a backtracking procedure, swapping the expensive POI for a cost-effective alternative to satisfy the absolute financial constraint.
6. **Payload Serialization:** The finalized, optimized multidimensional matrix is serialized via the Jackson library into a structured JSON payload. This is transmitted back to the dynamic DOM update module for highly visual, interactive timeline rendering on the client side.

D. Real-Time Data Acquisition and Deserialization Pipeline

To ensure high-volume scalability and mitigate severe security threats such as SQL Injection (SQLi), the system utilizes dynamic parameterization for all database transactions related to local guide discovery.

1. **Client-Side Trigger & Serialization:** The application captures a geospatial string via a debounced asynchronous event listener bound to the search input. This string is computationally sanitized and appended as a URL query parameter before an asynchronous HTTP GET request is dispatched.
2. **Query Interception:** The Spring Boot REST Controller intercepts the specific URI, extracting the query parameter. The JPA Repository translates this abstract request into a parameterized wildcard query (e.g., LIKE %?%) to execute safely against the Local Guides Data repository.
3. **Data Deserialization:** The Hibernate JPA ORM framework maps the retrieved relational database rows into a List collection of Java objects. The backend serialization engine converts this collection into a lightweight JSON array, returning it to the client with an HTTP 200 OK status code.
4. **Dynamic DOM Rendering:** The client-side JavaScript Promise successfully resolves the JSON payload. A

higher-order iteration function (such as .map() or .forEach()) dynamically generates discrete HTML node elements (Profile Cards) and injects them seamlessly into the active DOM matrix without page disruption.

E. Multi-Stage Transactional Booking Lifecycle

The interaction routing for booking local guides is not a simplistic binary trigger; it is governed by a highly complex, ACID-compliant multi-stage transactional lifecycle designed to prevent race conditions and ensure absolute data integrity.

1. **Stage 1: Client Confirmation (Confirm Booking):** The process initiates within the State Management module when a user confirms a booking action via the UI modal.
2. **Stage 2: Backend Validation (Validate Booking):** The POST payload is transmitted to the Business Logic Layer. The server cross-references the requested parameters against the database to ensure no temporal scheduling conflicts exist for the selected guide.
3. **Stage 3: Data Mutation (Update Availability):** Upon validation, the backend utilizes @Transactional annotations to execute an atomic database transaction. This action locks the guide's availability matrix, actively preventing concurrent booking overlaps (Race Conditions) from multiple users.
4. **Stage 4: Persistence (Save Booking):** The new transactional state (the finalized booking record) is securely and permanently committed to the relational schema.
5. **Stage 5: Finalization (Booking Confirmed):** A definitive acknowledgement payload is routed back to the client-side module. This triggers a subsequent dynamic DOM update to render the ultimate Booking Confirmed visual state, disabling further interactions on that specific UI element to prevent duplicate network requests.

F. Fault Tolerance and Graceful UI Degradation

A critical, enterprise-level component of the system's robustness is its error-handling architecture, specifically engineered to prevent catastrophic UI failures during network anomalies or data retrieval errors.

1. **Error Interception:** If the backend encounters a logical anomaly (e.g., a database timeout, missing authentication tokens, or malformed queries), global exception handlers (@ControllerAdvice) circumvent the standard success pipeline.
2. **Standardized Response:** The server constructs a uniformly formatted error response payload containing specific HTTP fault codes (e.g., 400 Bad Request, 401 Unauthorized, 500 Internal Server Error).
3. **Graceful Degradation:** Instead of abruptly terminating the asynchronous rendering cycle and presenting a broken interface, the frontend parses this error payload. It executes a designated fallback function to Display Friendly Message to the end-user (e.g., "Unable to fetch guides at this moment"), guaranteeing continuous operational stability and a polished user experience.

G. Seamless Peer-to-Peer Communication Routing

To facilitate immediate, context-aware peer-to-peer communication between tourists and guides, the system implements a decoupled URL parameterization strategy rather than utilizing rigid, hardcoded hyperlinking.

1. **URL Parameterization:** Initiating a "Chat" action mutates the client's window location object, injecting a unique database identifier dynamically as a query string (e.g., ?openChat={unique_identifier}).
2. **Component Parsing:** Upon loading the communication dashboard interface, the core JavaScript engine invokes the URLSearchParams interface to parse and extract the active URI parameters.
3. **Contextual Chat Initialization:** Detecting the unique identifier, the system automatically executes a secondary asynchronous background fetch. This retrieves the specific target's metadata (Name, Avatar, Rating) and dynamically injects it into the chat interface header within milliseconds. This programmatic routing ensures a fluid, context-rich transition into the messaging state without requiring manual user searches.

IV. Result and Discussion

The RoamMate platform was subjected to rigorous empirical testing to evaluate its computational efficiency, network latency, transactional integrity, and algorithmic accuracy. The system was hosted on a local development environment (Intel Core i5, 8GB RAM) and tested utilizing industry-standard API testing tools (Postman) and browserbased performance profilers (Chrome DevTools). The comprehensive analysis of the system's operational metrics is discussed below.

A. Computational Efficiency of the Planner.AI Engine

The primary innovation of this system, the Planner.AI constraint-satisfaction algorithm, was evaluated for its execution latency and logical accuracy when subjected to strict financial and temporal constraints.

- **Algorithmic Latency:** During simulated load testing, the algorithm successfully generated comprehensive

3day and 5-day itineraries in an average execution time of **250 to 300 milliseconds**. This ultra-low latency proves that isolating the computational logic from the main thread successfully prevents thread starvation.

- **Constraint Accuracy:** The engine was tested with severely restricted budget inputs (e.g., extremely low Daily_Limit thresholds). In 100% of the test cases, the backtracking mechanism effectively filtered out premium Points of Interest (POIs) and dynamically replaced them with budget-friendly alternatives, ensuring the cumulative ticket cost never exceeded the user-defined mathematical boundary.
- **Output Serialization:** The multidimensional arrays generated by the algorithm were seamlessly serialized into JSON payloads without inducing structural data loss or formatting errors.

B. Real-Time API Latency and Database Performance

The efficiency of the decoupled Spring Boot backend was measured based on its ability to execute dynamic queries against the MySQL database and transmit data to the client.

- Query Execution Speed: The asynchronous HTTP GET requests initiated by the frontend to fetch local guides (/api/guides/search) yielded an average server response time of 120ms to 150ms.
- **ORM Optimization:** The low latency is directly attributed to the optimized Object-Relational Mapping (ORM) provided by Hibernate JPA. The dynamic wildcard queries (LIKE %?%) executed flawlessly without triggering full-table scans, even when searching through simulated large datasets.
- **Payload Efficiency:** The JSON arrays returned to the client were highly lightweight, averaging under 5KB per query, which significantly reduced bandwidth consumption and accelerated the client-side Promise resolution.

C. Security Overhead and Authentication Efficacy

The integration of a stateless security architecture utilizing JSON Web Tokens (JWT) was evaluated to ensure that robust security did not negatively impact the user experience.

- **Token Generation and Validation:** The cryptographic generation of the JWT upon user login averaged a computation time of **~45ms**. More importantly, the stateless validation of this token via the Spring Security filter chain during subsequent API requests added a negligible overhead of merely **~10ms to 15ms** per request.
- **Endpoint Protection:** Unauthorized API calls (requests missing the Authorization: Bearer <token> header) were successfully intercepted by the security configuration. In all simulated unauthorized attempts, the server immediately aborted the request, returning a strict HTTP 401 Unauthorized status code, completely protecting the data access layer from illicit extraction.

D. Frontend Rendering and SPA Fluidity

The visual and interactive performance of the Presentation Layer was analyzed to validate the Single Page Application (SPA) architecture.

- **Asynchronous DOM Updates:** Upon receiving the JSON payloads from the backend, the JavaScript DOM manipulation functions (e.g., rendering Guide Profile Cards or the AI Timeline) executed in under **50ms**. This rapid mutation ensured that the UI felt instantaneous and native to the user.
- **Visual Stability:** The implementation of CSS Grid and Flexbox maintained absolute structural integrity across various simulated screen resolutions. Furthermore, the Parallax scrolling and Glassmorphism rendering maintained a consistent **60 Frames Per Second (FPS)**, proving that the graphical enhancements did not cause browser lag or "jank."
- **Graceful Degradation:** When network connectivity was deliberately throttled or disconnected, the frontend catch blocks successfully intercepted the failed promises. The UI seamlessly rendered friendly fallback messages rather than crashing or displaying raw architectural stack traces.

E. Concurrency and Transactional Integrity (Booking Lifecycle)

The multi-stage booking lifecycle was rigorously stresstested to evaluate its resilience against race conditions—a common vulnerability in peer-to-peer booking platforms.

- **Atomic Transactions:** By utilizing the @Transactional annotation in the Spring Boot Service layer, the system successfully managed concurrent booking simulations. When multiple asynchronous requests attempted to book the exact same local guide for the identical time slot simultaneously, the database locked the specific rows.
- **ACID Compliance:** The system permitted the first request to mutate the availability matrix while gracefully rejecting the subsequent conflicting requests, returning an HTTP 409 Conflict status. This guaranteed 100% ACID (Atomicity, Consistency, Isolation, Durability) compliance.
- **State Management:** On the client side, the immediate mutation of the booking button state (disabled = true) effectively mitigated duplicate POST requests originating from rapid, consecutive user clicks (double-

clicking), ensuring precise synchronization between the frontend state and the backend database.

V. Conclusion

The development, implementation, and empirical evaluation of the RoamMate platform successfully demonstrate a highly efficient paradigm shift within the digital e-Tourism ecosystem. By engineering a meticulously decoupled, three-tier architecture, this research effectively resolves the critical limitations inherent in traditional, fragmented travel applications. The integration of the **Planner.AI engine** proved that complex, multidimensional routing problems—typically hindered by strict financial and temporal boundaries—can be solved instantaneously utilizing asynchronous constraint-satisfaction algorithms. This entirely automates the itinerary generation process, significantly reducing the cognitive load on the end-user while guaranteeing strict budget adherence.

Furthermore, the implementation of a Spring Boot backend and a normalized MySQL relational database successfully established a secure, real-time peer-to-peer bridge between tourists and local experts. By utilizing dynamic parameterization and RESTful APIs, the system bypassed the latency and financial overhead of third-party commission agencies. The rigorous integration of stateless JSON Web Token (JWT) authentication ensured enterprisegrade security without compromising the ultra-low latency of the asynchronous network requests. Ultimately, through precise state management, ACID-compliant transactional booking lifecycles, and Single Page Application (SPA) fluidity, RoamMate stands as a highly robust, scalable, and intelligent digital travel companion ready for modern cloud deployment.

A. Future Enhancements and Research Scope

While the current architectural iteration of the system achieves high computational efficiency and transactional integrity, the modular nature of the decoupled framework allows for several advanced technological expansions in future iterations:

1. **Natural Language Processing (NLP) Integration:** The Planner.AI engine can be significantly upgraded by integrating large language models (LLMs) or NLPbased conversational interfaces. This would transition the platform from a GUI-based input system to a Voiceto-Text or free-text chatbot (e.g., parsing unstructured commands like, *"Plan a 2-day heritage trip under $200"* into executable constraint parameters).
2. **Real-Time Geospatial Tracking:** Integrating dynamic Map APIs (such as Google Maps or Mapbox SDKs) with WebSocket connections could facilitate live, bi-directional GPS tracking. This would allow tourists and booked local guides to securely broadcast their real-time geographical coordinates to each other for seamless physical meetups.
3. **Algorithmic Optimization with Machine Learning:** The current constraint-satisfaction algorithm can be enhanced into a predictive Machine Learning (ML) model. By analyzing historical user data, click-through rates, and booking frequencies, the system could utilize collaborative filtering to proactively predict and suggest highly personalized Points of Interest (POIs) before the user manually defines their thematic preferences.
4. **Integrated FinTech & Payment Gateways:** To completely centralize the peer-to-peer economic exchange, secure third-party payment gateways (e.g., Stripe, Razorpay) can be integrated directly into the transactional booking lifecycle, allowing for encrypted, instantaneous digital escrow services and advance fee settlements.

References

[1] S. Russell and P. Norvig, *Artificial Intelligence: A Modern Approach*, 4th ed., Hoboken, NJ, USA: Pearson, 2020. (Reference for Planner.AI Constraint-Satisfaction Algorithms).

[2] C. Walls, *Spring in Action*, 6th ed., Shelter Island, NY, USA: Manning Publications, 2022. (Reference for Spring Boot RESTful API Architecture and Hibernate ORM).

[3] M. Jones, J. Bradley, and N. Sakimura, "JSON Web Token (JWT)," Internet Engineering Task Force (IETF), RFC 7519, May 2015. [Online]. Available: https://datatracker.ietf.org/doc/html/rfc7519. (Reference for Stateless Security and Authentication Protocol).

[4] D. Crockford, "The application/json Media Type for JavaScript Object Notation (JSON)," RFC 4627, Jul. 2006. (Reference for API Data Serialization and Payload Structure).

[5] A. Mesaros and D. M. Laza, "Evolution of E-Tourism and Smart Recommendation Systems," *International Journal of Advanced Computer Science and Applications*, vol. 12, no. 4, pp. 112-118, 2021. (Reference for Tourism Literature and Peer-to-Peer Integration).

[6] Mozilla Developer Network (MDN) Web Docs, "Fetch API and Asynchronous JavaScript," 2024. [Online]. Available: https://developer.mozilla.org/enUS/docs/Web/API/Fetch_

API. (Reference for Single Page Application (SPA) Dynamic DOM Updates).

[7] J. Nielsen, *Usability Engineering*, San Diego, CA, USA: Morgan Kaufmann, 1993. (Reference for Frontend UI/UX Graceful Degradation and Error Handling).

[8] B. Goetz et al., *Java Concurrency in Practice*, Reading,
MA, USA: Addison-Wesley Professional, 2006. (Reference for Thread Starvation Prevention and Asynchronous Processing).

[9] R. Elmasri and S. B. Navathe, *Fundamentals of Database Systems*, 7th ed., Hoboken, NJ, USA: Pearson, 2015. (Reference for Relational Database Normalization and ACID-compliant Transactional Lifecycles).

[10] J. Borràs, A. Moreno, and A. Valls, "Intelligent Tourism Recommender Systems: A Survey," *Expert Systems with Applications*, vol. 41, no. 16, pp. 7370-7389, Nov. 2014. (Reference for AI-driven POI Filtering and Travel Ecosystems).

[11] N. Provos and D. Mazières, "A Future-Adaptable Password Scheme," in *Proceedings of the FREENIX Track: 1999 USENIX Annual Technical Conference*, Monterey, CA, USA, Jun. 1999, pp. 81-91. (Reference for Bcrypt Cryptographic Hashing Algorithms in Security Architecture).

[12] E. Marcotte, *Responsive Web Design*, 2nd ed., New York, NY, USA: A Book Apart, 2014. (Reference for Presentation Layer UI/UX Engineering, CSS Grid, and Device-Agnostic Scaling).