

Travel Mate: A Multi-Layered PWA Framework for Local Tourism Regulation, Financial Tracking, and Gig-Economy Integration

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Abstract—Most tourism platforms tend to guide travelers toward costly commercial services, while many local options often go unnoticed. Travel Mate is developed as a Progressive Web Application that connects travelers directly with local guides, homestays, and transport providers. It is built using the MERN stack and also includes a financial tracking feature called FairFare. The platform aims to reduce unnecessary travel expenses and help users explore places that are often overlooked by mainstream tourism services. To build trust between travelers and local providers, identity verification is handled through DigiLocker. Overall, the goal of this platform is to support local businesses while also giving travelers an easier way to plan trips and manage group expenses.

Index Terms—PWA, MERN Stack, Gemini API, FairFare, Local Tourism, Gig Economy, Expense Analytics.

I. INTRODUCTION

The global tourism industry has changed significantly with the rise of digital technology. Today's travelers prefer having more control over their travel plans and often want to move away from fixed, pre-designed travel packages. Even though travel apps and online booking platforms have grown rapidly, there is still a noticeable gap between luxury commercial tourism and real local experiences. Most platforms mainly promote well-known hotel chains and standard transport services, which creates a kind of “tourist bubble” where travelers are disconnected from the true culture of the place they visit. Because of this, two major issues arise: travel costs increase due to dependence on large companies and middlemen, and

local communities do not get enough economic benefits from tourism. Apart from accommodation, managing group travel itself can be quite challenging. One of the biggest issues is handling shared expenses, often described as the “pain of splitting the bill.” Right now, this process is scattered across multiple apps, with no single solution bringing everything together. As a result, travelers often face confusion and minor conflicts while managing payments, and they have to constantly switch between booking platforms, maps, and separate expense-tracking apps. This lack of integration not only makes the overall experience less smooth but also prevents users from getting a clear picture of their spending, which could otherwise help them manage their budget more efficiently.

This research introduces Travel Mate, a unified Progressive Web Application (PWA) designed to make the tourism system more decentralized and inclusive for local providers. Built using the MERN stack (MongoDB, Express, React, and Node.js), the platform acts as a digital link between budget-conscious travelers and local service providers. It mainly focuses on bringing informal local services such as unregistered homestays, bachelor accommodations, and independent cab drivers onto a single platform. This allows users to interact directly with providers, making pricing more transparent and often more affordable by avoiding the extra costs added by large companies.

One of the key aspects of the Travel Mate platform is the inclusion of a secure gig-based system for local youth. It allows individuals aged 18 and above, along with minors who are verified through a legal guardian, to work as certified local guides. Through this,

travelers can get access to genuine local insights, including lesser-known places and small local shops that are usually not part of regular tourist plans. This helps in avoiding overcrowded tourist spots and, at the same time, creates a steady source of income for people in the local community. To address the problem of managing shared expenses, the platform introduces the Fair Fare module. Instead of working like a basic ledger, Fair Fare is connected with the Gemini API, which allows it to go beyond simple record-keeping. By using generative AI, it can offer deeper insights into spending, helping users understand patterns in their expenses, group them into categories like travel, food, and accommodation, and make better decisions about their budget while the trip is ongoing. Overall, the aim is to make the travel experience more transparent, balanced, and financially easier to manage.

II. LITERATURE REVIEW

The tourism industry has seen a clear shift from basic informational websites to more interactive, user-focused platforms. Recent studies point out a few important factors shaping this change, including the effectiveness of full-stack development frameworks, the growing use of Progressive Web Applications (PWAs), and the increasing role of the gig economy in influencing local travel and its economic impact.

A. Full-Stack Architectures and PWAs in Tourism
Modern travel platforms need to handle large-scale usage and support real-time data efficiently. Many studies suggest that the MERN stack (MongoDB, Express, React, and Node.js) has become a popular choice among developers, mainly because it uses JavaScript throughout, making the interaction between frontend and backend smoother. At the same time, there has been a shift from traditional mobile apps to Progressive Web Applications (PWAs), often discussed as a way to deal with “app fatigue.” PWAs provide benefits like offline access and lower storage usage, which makes them especially useful for travelers who may face unstable internet connections during their trips.

B. The Gig Economy and Localized Guided Tours
In traditional tourism models, most of the revenue tends to go to large companies, while local communities

often receive a much smaller share. Studies on the gig economy suggest that peer-to-peer (P2P) platforms can help make this system more balanced. By enabling local youth to work as independent guides, such platforms can offer more genuine and lesser-known experiences that are usually not included in commercial tour packages. This kind of decentralized approach not only supports local income generation but also helps reduce overcrowding at popular tourist spots by encouraging travelers to explore alternative locations.

C. Financial Tracking and AI Integration
Managing shared expenses is often seen as a major challenge in group travel. Research in fintech also highlights the importance of having clear and real-time expense tracking systems to avoid confusion and reduce conflicts within a group. Recently, the use of Large Language Models (LLMs), such as the Gemini API, has started to play a role in this area. Instead of just handling basic calculations, AI-based systems can offer deeper insights, like pointing out unnecessary spending or suggesting more budget-friendly options based on past travel data.

D. Digital Trust and Verification Systems
Security is still one of the main concerns when it comes to adopting P2P rental and guiding services. Many studies point out that strong identity verification is important to build trust between travelers and local service providers. In this context, using government-backed systems like DigiLocker offers a reliable way to verify identities, whether done manually or automatically. This helps ensure that people participating in the gig-based system are properly verified and can be held accountable.

III. METHODOLOGY

The research methodology is organized into four main stages: data acquisition (user onboarding), verification, service regulation, and analytical processing. These stages work together to build a travel environment that is both smooth to use and secure for all users.

A. Registration and Verification Layer (Trust Framework)

To reduce the risks linked with gig-based and peer-to-peer (P2P) services, Travel Mate uses a multi-factor verification system.

Onboarding Protocol: During registration, users choose between two roles either as a “Traveler” or as a “Provider” (such as a guide or host).

Identity Authentication: The platform follows a strict identity verification process that combines both manual checks and digital methods. It mainly relies on DigiLocker integration, which allows the system to securely access government-verified documents through API tokens. This approach helps in reducing the chances of identity theft and prevents fake or misleading listings.

The Supervision Logic: Considering the potential of younger individuals, the system also allows minors to work as guides under a “Supervised Engagement” model. In such cases, a legal guardian or supervisor must be registered, and their identity is verified as well. This creates a clear line of responsibility and ensures accountability.

B. Peer-to-Peer Rental and Transit Regulation (Marketplace Dynamics)

This layer is mainly concerned with organizing and regulating local resources such as private vehicles and bachelor accommodations that are usually unregulated or not fully utilized. The idea is to turn these into a viable and competitive option compared to traditional commercial tourism services.

Resource Mapping: The approach is based on a decentralized marketplace where local residents can list affordable stay options, such as student housing or homestays, along with cab services offered by private vehicle owners who are willing to provide transportation.

Hyper-Local Discovery Heuristics: Unlike traditional systems that mostly promote popular commercial places with high ratings, Travel Mate’s search feature uses geospatial indexing in MongoDB to bring attention to local shops and lesser-known spots.

Congestion Mitigation: By highlighting these lesser-known, locally known places, the platform helps spread out tourist activity instead of concentrating it in a few crowded spots. This, in turn, reduces both environmental pressure and social strain on popular, over-visited landmarks.

C. FairFare: Financial Tracking and Analytics (Data Intelligence)

The FairFare module serves as the platform’s financial core, combining precise data entry with generative intelligence.

Precision Logging: To keep the data as accurate as possible, the system mainly depends on manual entry. This makes it easier to record small, cash-based transactions, which are quite common in rural areas and during budget travel.

Peer-to-Peer Splitting Algorithm: The module uses a custom expense-splitting system where users can either divide costs equally or set their own percentage shares. It also keeps track of each person’s net balance in real time, so everyone in the group has a clear view of who owes what, ensuring transparency throughout the trip.

Generative AI Synthesis: The analytical phase begins with the integration of the Gemini API. In this stage, the system sends the collected and anonymized transaction data from MongoDB to the LLM for further analysis.

Heuristic Insights: The API then analyzes this data to identify unusual spending patterns, group expenses into categories like “needs” and “wants,” and suggest ways to manage budgets better for future trips based on current spending habits.

IV. IMPLEMENTATION

The implementation of Travel Mate is based on a decoupled architecture that focuses on reliability, smooth performance across platforms, and easy integration of AI features. By using a Progressive Web Application (PWA) approach, the system combines the accessibility of a web app with the experience of a native mobile application.

A. Software Environment and Technological Stack

The system is built on the MERN stack, mainly because it supports non-blocking operations and works smoothly with JSON-based data flow. This makes it well-suited for handling real-time travel updates and managing financial data efficiently.

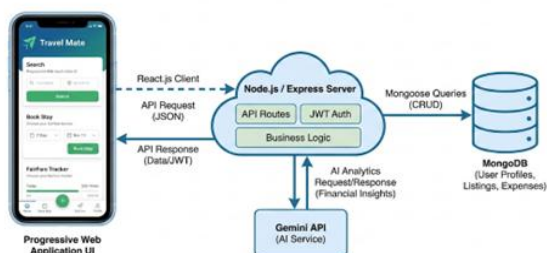
Frontend (React.js & PWA): The user interface is built using React.js, with functional components and hooks used to manage the application state. Since it is designed as a PWA, it uses Service Workers to cache important resources, which allows users to access their trip details and record expenses in FairFare even in areas with weak or no internet connection. In addition, a Manifest file is used so that the app can be installed on mobile devices, giving users a full-screen experience similar to a native app.

Backend (Node.js & Express.js): The backend is developed using Node.js, with Express.js handling the REST API routes. This layer takes care of user authentication through JSON Web Tokens (JWT) and manages communication between the frontend and the database. Since it works asynchronously, the system can handle multiple requests from both travelers and service providers at the same time without slowing down.

Database (MongoDB): A NoSQL database was chosen because it offers a flexible schema. MongoDB is used to store different types of data, including structured user profiles and rental listings, as well as more dynamic and nested data like expense logs in the FairFare module. This flexibility makes it easier to update the system and add new features as the platform evolves.

AI & Analytics Engine (Python & Gemini API): A separate Python-based microservice is used as the intelligence layer of the system. It connects with the Gemini API to handle advanced language processing and data analysis. This service takes raw JSON data from MongoDB, processes it using custom prompts, and then generates detailed financial summaries along with suggestions to better plan future trips.

Travel Mate PWA: System Architecture & API Path



B. Procedural Algorithm and System Logic Flow

The working of the Travel Mate platform follows a structured flow, designed to keep the system secure

while also focusing on a smooth and user-friendly experience:

Multi-Role Onboarding: The system follows a two-way registration process where users are categorized as either “Travelers” or “Providers” (such as local guides or home hosts). Based on this role, access is controlled accordingly providers can manage their listings, while travelers can explore services and use the financial features.

Rigorous Verification Protocol: Security is given high priority through a mandatory verification step. Providers are required to upload a valid government-issued ID, and the system connects with DigiLocker APIs to fetch and verify these details digitally. This helps in reducing the chances of fake listings. In special cases, manual checks by administrators are also possible to ensure that everything remains authentic.

Context-Aware Discovery Engine: The search system uses geospatial indexing in MongoDB to help travelers find nearby stays and local guides based on factors like distance, affordability, and user ratings. It is designed in a way that gives more preference to local options, such as independent cab providers and small shops, instead of large commercial chains, so that local businesses get better visibility.

Transaction and Granular Tracking: The FairFare module works like a real-time expense tracker. During the trip, users manually enter each transaction as it happens. The system supports multiple currencies and uses a peer-to-peer splitting method, automatically updating who owes whom. This helps keep everything clear and avoids confusion about balances within the group.

Gemini-Driven Analytics Phase: Once the trip is completed, the system activates the Analysis Module. At this stage, the Gemini API examines the collected trip data to identify patterns in spending, such as higher expenses on transport or savings from choosing local stays. It then presents the results through a visual dashboard, including expense heatmaps, along with a simple report that gives practical suggestions for managing budgets better in future trips.

V. RESULTS

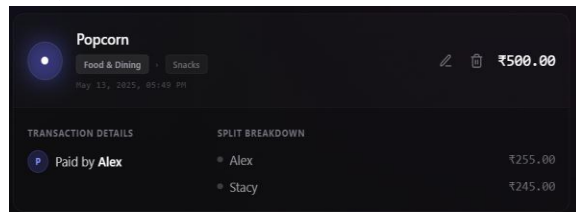
The Travel Mate framework aims to make travel more accessible and balanced for everyone. By shifting attention away from large commercial hubs and toward local shops, the platform helps create a more inclusive travel experience:

Reduces Costs: By allowing travelers to deal directly with local hosts and cab providers, the need for middlemen is removed, which helps avoid extra commission charges.

Improves Authentic Engagement: Local youth guides bring a level of cultural insight and personal experience that is often missing in services offered by professional agencies.

Enhances Financial Clarity: The FairFare module helps remove the usual confusion and awkwardness that comes with splitting expenses in a group.

Data-Driven Decisions: With AI-based analysis, users can clearly see where they went over budget, with expenses broken down into categories like transport, food, and accommodation.



VI. CONCLUSION AND FUTURE SCOPE

A. Conclusion

The Travel Mate platform reflects a shift from traditional, company-driven tourism models to a more decentralized approach that focuses on local communities. As discussed in this research, today's travelers are looking for more transparency and authentic cultural experiences, which are often missing in standardized travel packages. By using the MERN stack along with the Gemini API, this study shows that a single Progressive Web Application (PWA) can help connect organized tourism with the local gig economy in a practical way. The integration of FairFare helps tackle the ongoing issue of managing expenses across different tools, offering a simpler and more affordable solution for travelers, especially in

regions where proper financial systems may not be easily available. The platform also supports local youth (18+) by giving them opportunities to work as verified guides, while bringing structure to local services like independent cabs and homestays. Overall, the project presents a scalable approach to reducing overcrowding in popular tourist areas and encouraging more balanced economic growth within local communities.

B. Future Scope

While the current version of Travel Mate offers a strong base for managing travel, there are still several areas where it can be improved to make it more effective and useful for a wider range of users:

Blockchain Integration for Trust and Ratings: To reduce the chances of fake reviews and make transactions more secure and transparent, future versions of the platform may include a decentralized ledger system. This would keep a permanent and tamper-proof record of guide ratings and rental agreements, helping build greater trust between travelers and service providers.

IoT and Real-Time Congestion Mapping: By using real-time data from user locations, and possibly connecting with local IoT sensors, the platform can track how crowded different areas are. Based on this, it can suggest less crowded, off-beat places to travelers in real time, helping reduce the pressure on popular tourist spots.

Predictive Financial Analytics: Future research can explore more advanced ways of analyzing past spending patterns across different types of users. By using more sophisticated machine learning models, the platform could estimate future trip costs more accurately, allowing users to set more realistic budgets even before their journey begins.

Global Expansion and Multi-Currency FairFare: To make the platform more suitable for international travel, the FairFare module can be enhanced by adding automatic currency conversion through APIs. This would also require expanding the system to handle different financial regulations and travel patterns across various countries.

Native Mobile and Cloud Deployment: Although the platform currently works as a PWA, future plans include developing a dedicated mobile application with a more user-friendly interface. This would allow better use of native features such as faster GPS

tracking and push notifications. In addition, moving towards a cloud-based API architecture will help support remote services and maintain high availability for users across different regions.

Hybrid Intelligence Frameworks: Future research can explore combining the generative features of the Gemini API with other machine learning techniques to build ensemble models. This could improve the accuracy of travel recommendations while still keeping the results simple and easy for users to understand.

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