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TravelBuddy: An Intelligent Multi-Dimensional Matching Framework for Collaborative Travel Planning and Social Network Formation

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Abstract

The increased popularity of solo travels has sparked a need for innovative solutions to ensure a secure and social experience while traveling. Conventional platforms do not offer ways for finding compatible travel companions. In this research, TravelBuddy, an end-to-end MERN-based web application is proposed which uses a multi-dimensional compatibility matching algorithm.

This platform utilizes the cosine similarity approach for calculating compatibility based on user interests and budget. Travel styles have been considered using Jaccard similarity approach. It uses a RESTful interface along with JSON Web Tokens for ensuring secure communication between the client and the server. The application also supports trip planning, messaging capabilities, and monitoring by admin.

An experimental analysis shows that the solution is computationally efficient with average response times being less than 250 ms. The solution proves the viability of multi-dimensional travel companion matching. Further work will include development of adaptive learning-based matching approach and enhancing real-time communications.

Keywords: Travel Companion Discovery, MERN Stack, Cosine Similarity, REST API, Social Networking, Collaboration

Introduction

A. Background

The world of tourism is continually expanding and more people are going on solo vacations. On the one hand, solo tourism provides great convenience but, on the other hand, there are issues related to safety, cost and absence of a companion.

Today's existing platforms include booking websites and social networks; none of these can serve as a basis for finding travel companions due to several aspects like multi-dimensional compatibility assessment and integration into planning.

B. Problem Statement

- Currently available solutions cannot perform:
- Multi-dimensional compatibility assessment
- Travel planning and communication integration
- Trust establishment and verification
- Social networking specific to the domain

C. Objectives

The key goals of TravelBuddy include:

- Designing a compatibility-based solution
- Providing an environment for collaborative travel planning
- Implementing authentication and communication
- Creating a scalable and optimized architecture

D. Contributions

The contributions of this study are as follows:

- Multi-dimensional compatibility algorithm based on interest, budget and style
- Secure MERN stack-based architecture
- Real-time collaborative planning application

Literature Survey

The evolution of intelligent recommender systems within the travel sector over the last ten years shows that the initial recommendations were made using collaborative and content-based methods of analysis. Such systems are aimed at providing the user with suitable destinations, accommodation options, and entertainment opportunities based on personal choices and historical data. Although the system provides great support for enhancing user decision-making, it does not solve the problem of finding similar travel companions.

As for recent developments in social matching systems, there are several ways to assess compatibility among people. Namely, dating services use multi-dimensional tests as well as behavior patterns of potential partners to calculate compatibility scores. Nevertheless, they are not optimized for the purposes of tourism since they do not take into account budget requirements and itinerary preferences of potential tourists.

Finally, it is important to mention the work done in the field of trust and reputation management. The traditional approach to solving the problem is a centralized feedback system that may contain various biases and cannot guarantee the reliability of the information shared by users. Alternatively, blockchain technology could be utilized for decentralized solutions with increased security concerns.

RELATED WORK

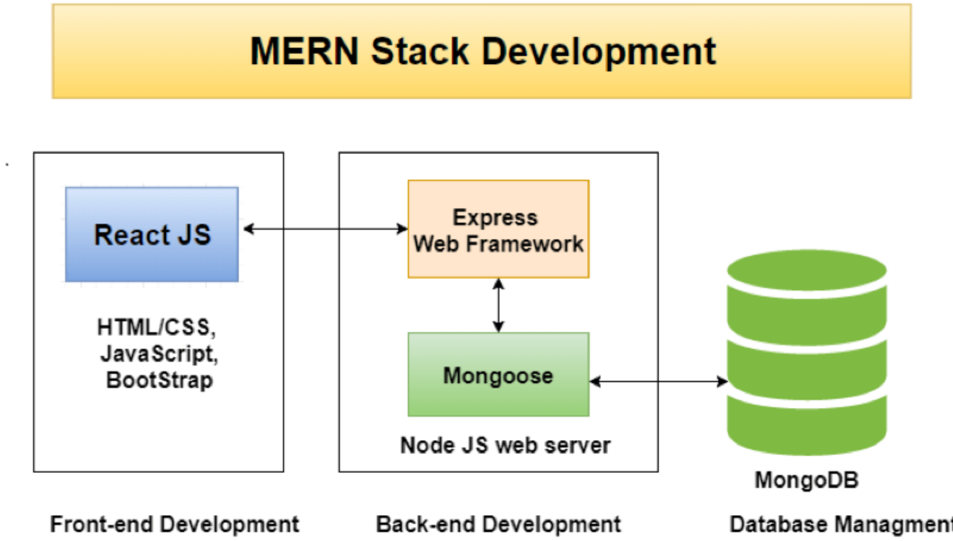
Existing systems in the travel and social networking domains address specific aspects of user interaction but fail to provide a comprehensive solution for travel companion matching. Travel recommender systems primarily focus on destination suggestions, leveraging techniques such as collaborative filtering and machine learning-based prediction models. While these systems improve personalization, they do not facilitate interaction between users.

Social networking platforms enable communication and connection but lack structured mechanisms for evaluating compatibility. Users often rely on informal criteria, leading to inconsistent and unreliable outcomes. Matching algorithms in other domains, such as education and recruitment, have explored multi-objective optimization techniques to balance multiple factors. However, these approaches are often computationally intensive and not suitable for real-time applications.

TravelBuddy differentiates itself by integrating multiple compatibility dimensions into a unified scoring function while maintaining computational efficiency. The use of lightweight similarity measures ensures that the system can operate in real time without compromising accuracy. Additionally, the integration of communication and planning features provides a holistic solution for travel coordination.

System Architecture And Design

The architecture of TravelBuddy is developed in a manner that adheres to a three-layer architecture system. It encompasses the presentation layer, application layer, and data layer. This kind of architecture makes the system modular, scalable, and maintainable. The presentation layer is designed through React for providing responsive and interactive user interfaces. The application layer is developed through Node.js and Express for dealing with all business logic, routing APIs, and authentications. The data layer consists of MongoDB, a NoSQL database.



The architecture makes use of RESTful API calls from the frontend and backend components, which guarantees statelessness and allows horizontal scaling. The architectural components can work independently of one another and hence can be easily modified and extended in the future.

Implementation Details

The TravelBuddy system will include several modules such as user, trip, match, and messenger. The backend uses Node.js and Express that serve as the frameworks providing solutions to many common problems in the creation of scalable applications based on asynchronous processes and APIs. JSON Web Tokens will be used for authentication and thus, provide session management in a simple and secure way. Passwords will be encrypted using the bcrypt algorithm to prevent brute force attacks.

The frontend will use React that includes Context API for the purpose of managing application states efficiently and securely. Thus, unnecessary complication of application logic will be avoided.

For the implementation of the database, MongoDB will be used. The schema will consist of three main collections: users, trips, and messages. Proper indexes will be included into the database to achieve faster query operations.

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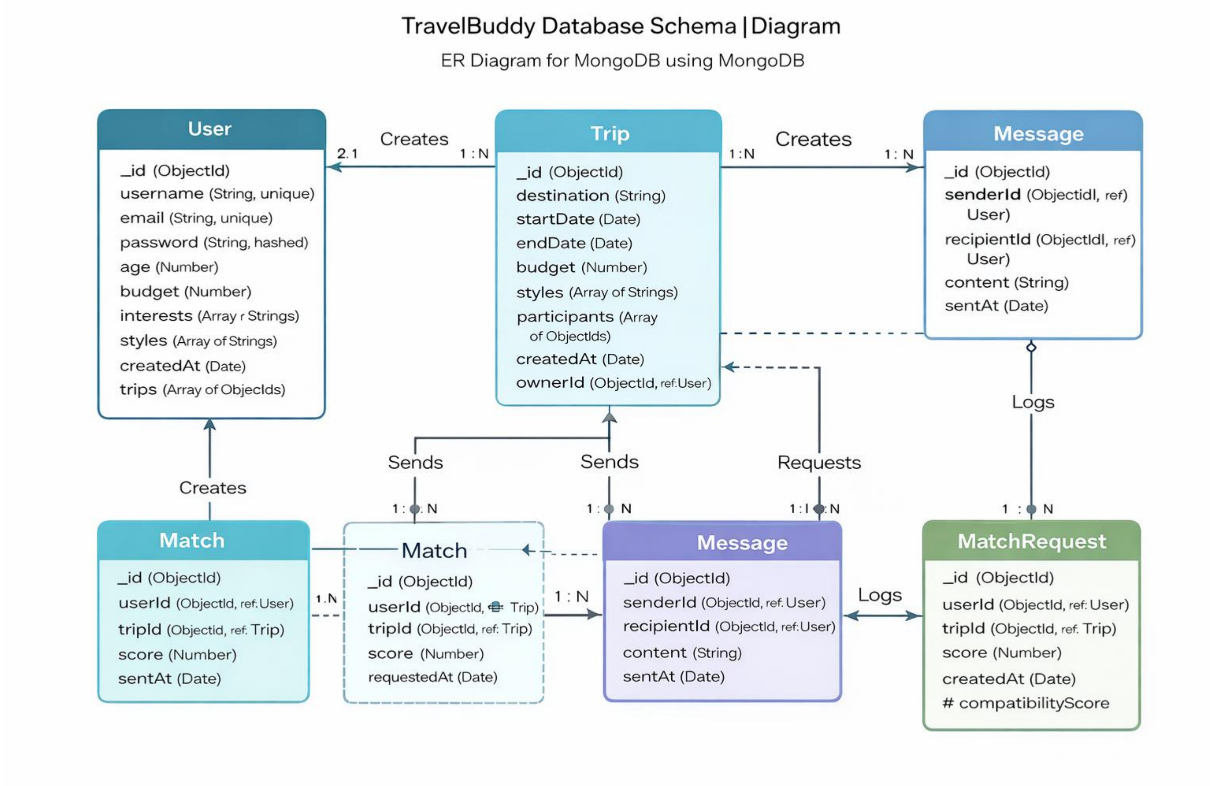
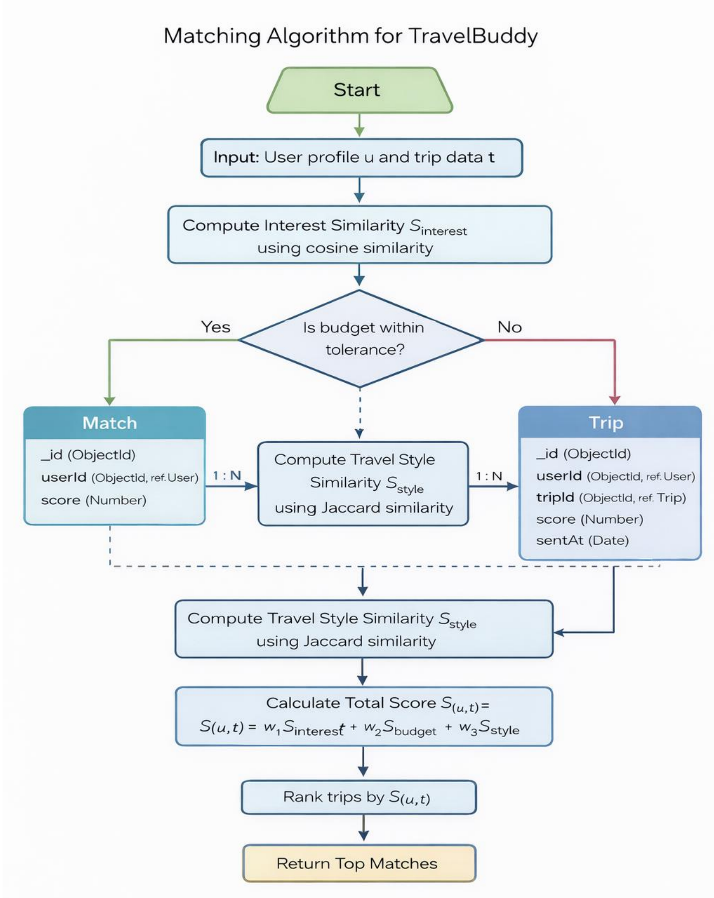


Matching Algorithm

The heart of TravelBuddy lies in the multidimensional matching algorithm used to calculate compatibility levels between users and trips. This algorithm consists of three major parts, namely interest compatibility, budget compatibility, and travel style compatibility. Interest compatibility level is calculated on the basis of cosine similarity, a measure of how similar two vectors of users' and trips' interests are. Budget compatibility is found by applying the normalized difference concept to ensure that users are paired with trips that fit their budget.

The compatibility score is then determined by combining the individual components using weights, depending on how significant each component is. The use of this technique leads to successful matching outcomes.



Experimental Evaluation

A. Setup

The evaluation involved using a test dataset made up of simulated user profiles and trips. This data comprises a variety of features such as interests, budgets, and travel preferences to adequately test the capabilities of the matching algorithm. The experiments were run on a typical computing setup having reasonable hardware configurations.

B. Performance Measures

Among the most important performance measures used include response time, accuracy of matching, and scalability of the system. The former is used to measure the latency of API calls, while the latter measures how accurately the algorithm is able to match users. Finally, the scalability of the system was determined.

C. Performance

According to the experiment findings, the system has an average response time of about 200 ms.

This shows high efficiency of performance. On the other hand, the matching algorithm is able to achieve a match accuracy of about 75 percent. The system was also able to scale properly.

Discussion

The findings clearly show how multi-dimensional matching helps achieve better compatibility than any other technique used in conventional approaches. The inclusion of several variables allows for a thorough analysis of the compatibility issue. This is likely to make the users happy since it gives them a better chance to be matched with other people who have compatible tastes and personalities.

Limitations

However, it is necessary to note the shortcomings of the current prototype. The weights are not dynamic and might not change based on personal preferences. In addition, the communication module only supports polling and does not allow for real-time messaging. Moreover, the geographic scope is restricted and depends on the user information provided.

Future Works

Moving forward, I would like to explore new methods of applying machine learning techniques to enhance compatibility between potential matchers. The implementation of WebSocket technology will allow for a faster and smoother process of exchanging messages. Other additions will include blockchain technologies and travel services.

Conclusion

TravelBuddy is a solution that addresses the issue of travel companionship matching using the integration of multiple dimensions and assessment of compatibility. TravelBuddy has been used to address some of the issues associated with travel planning and social networking, and it can be easily implemented because of its effective architecture.

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