END SEM REPORT

IT414 -Data Warehousing and Data Mining

TOPIC – TRAVEL RECOMMENDER SYSTEM

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Certificate

This is to certify that project entitled **"Travel Recommender system"** has been presented by Bhavitha Naramamidi [211IT044], Pari Poptani[211IT045], Rounak Jain[211IT055], students of VI semester B.Tech (I.T), Department of Information and Technology, National Institute of Technology Karnataka, on 21st March 2024, during the even semester of the academic year 2023-2024, in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Information Technology.

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***Abstract*—Tourism is a major factor of a country's economy. A platform that offers individualised information about tourism destinations is still lacking, though. Personalised travel recommendation systems can help customers in travel planning under a user budget because it may be so confusing and difficult to process a lot of information on the travel place. If a system exists that can give tourists personalised, accurate information about nearby restaurants, shops, hotels and attractions, it will be a great benefit for travel. In this paper, we propose a Travel Recommendation system , which can automatically generate good recommendations for travel planning. On the basis of user's preferences as well as Budget and time. For travel Recommendation ,it finds users with similar preferences by comparing the user's previous ratings with those of their nearby. These neighbours' top picks will be highlighted. The ultimate goal of a travel recommendation system is to enhance the travel experience for the user by providing relevant and personalised recommendations that meet their needs and preferences.**

***Index Terms*—Composite Recommendation, User Preferences, Collaborative Filtering, Content-based Filtering, Hybrid Recommendation, User Ratings**

I. Introduction

In the present day's fast running world, people are always looking for new and exciting travel experiences ,but a lot of options, planning where to go and what to do can be confusing. By analyzing data about past travel experiences, preferences, and other factors, travel recommendation systems can suggest personalized travel plans for individuals. Now-a-day the popularity of recommendation systems is growing, and people are drawn to them because they help them find fascinating things among a sea of information. Electronic shops, travel agencies, and digital libraries all use recommendation systems. In any decision-making process, excursions, eateries, hospitals, and in general, can be helpful in predicting the right products for particular consumers. Recommendation systems have benefits for both customers and merchants during a commercial engagement. As per user preferences, we suggest a system where users get recommendations for tourist hotspots .Travel recommendation systems can analyze user data including past travel experience, location, budget, and interests to make suggestions for places to go, hotels to stay at, and things to do that match the user's preferences. Large datasets can be used by these algorithms to analyze patterns and generate highly individualized suggestions for travelers. A machine learning-based travel recommendation system not only helps travelers by offering individualized recommendations, but it also helps the travel industry by raising client happiness and increasing sales. The travel industry can offer more effective and efficient services that are tailored to each customer's needs and tastes through the use of machine learning. In this system, machine learning algorithms are used to analyze data, identify patterns, and make predictions, allowing the system to make highly accurate and relevant recommendations.

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II. Literature Survey

There has been a lot of work on recommendation systems since a couple of years like Movie Recommendation systems, Course Recommendation Systems, Tour Recommendation Systems etc. Of late, a lot of research has been going on how to improve these systems to provide the best user experience as well as making things more practical and sensible. Here are a few past works that have been done on Tour Recommendation.
The work "Personalized Travel Recommendation System By Using User-Based Filtering Filtering Method" [1] by Tin Nilar Win , Dr. Wint Pa Pa Kyaw uses a filtering based method to suggest places to the user based on his past experiences and interests. These recommendations are based on the users' rating profile, personal interests, and specific demands for their travel destination by using a user-based filtering approach. Recommendation system automates some of these strategies with the goal of supplying affordable, personal, and high-quality recommendations.
Charnsak Srisawatsakul ,Waransanang Boontarig's "Tourism Recommender System using Machine Learning Based on User's Public Instagram Photos" [2] suggests tourist places by learning from the user's instagram posts and profile. It doesn't ask a single question to the user. They presented a prototype of a travel recommender system using a filtering method. Google's machine learning was used to extract the terms from the user's Instagram photos and travel attractions photos. Recommendations are then provided to the user by considering the similarity between those terms. This method makes an easier life for the user when interacting with the system compared to the previous content-based recommendation system
C. C. Aggarwal " Recommender Systems " [3] concluded that there are 5 basic models of the recommender systems . This model is making a recommendation based on the rating of user-item from multiple users. On the other hand, the content-

based recommender system analyzes the attribute information of the users and items which focus only on a single user rather than those of all users.

Cheng et al. [4] ‘s ”Personalized travel recommendation by mining people attributes from community-contributed photos” built a recommender system of personalized travel by leveraging 4 million freely available community-contributed photos. The results suggested that attributes gathered from photos are promising and could be used as travel logs for creating a recommendation.

“CompRec-Trip: A composite recommendation system for travel planning ” [5] by Min Xie; Laks V.S. Lakshmanan; Peter T. Wood proposes a novel system “Comp RecTrip” tha prepares a composite trip recommendation. The system leverages rating information from underlying recommender systems, allows flexible package configuration and incorporates users' cost budgets on both time and money. It also has a rich GUI that allows the user to get customized recommendations and take into account local information.

Designing the Content Analyzer of a Travel Recommender System Carla Binucci, Felice De Luca, Emilio Di Giacomo, By Giuseppe Liotta, Fabrizio Montecchiani [6] .The architecture of Cicero, focusing on its Graphic User Interface (GUI) and Algorithmic Engine. The GUI allows users to select a region and define a set of Topics of Interest (TOIs). The Algorithmic Engine, on the other hand, extracts Points of Interest (POIs) from the selected region, creates a Knowledge Base, and computes relevance scores for each POI with respect to the chosen TOIs. The system's effectiveness has been experimentally evaluated, showing promising results in terms of accuracy and robustness. Additionally, a proof-of-concept recommender system (CRS) has been developed to showcase how Cicero's Knowledge Base can be utilized for personalized content recommendations.

III. Objectives

- To create a good tourist recommendation system
- To merge personal preferences and general place ratings
- To improve on existing solutions and come up with something out of the box
- To develop a system scalable to vast realm of geography, cultures and interests

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IV. PROBLEM STATEMENT

People are always looking for new and exciting travel experiences.But a lot of options, planning required like where to go , what to do ,what time will be taken and all about cost , it can be confusing and irritating. So we need to design a recommendation system. People are at many times confused about which places to visit. There are two constraints namely budget and time which have to be satisfied. Apart from these, the user's interests and preferences also have to be taken care of. We are developing a model that fulfils all these parameters by merging user's ratings and general public ratings. A sequence of places to visit has to be recommended to the user. The system would provide personalised recommendations to each user based on their preferences, such as the type of destination, duration of the trip, budget, accommodation, and activities of interest.

Now the dataset to work on is slightly changed. Apart from cost, time and average place ratings, we also have the active user's preferences/ ratings in picture. We are suggesting a hybrid approach of recommended systems to recommend Places of Interest to the users. A hybrid approach involving content-based and collaborative filtering can be applied to the dataset to get k-recommended places. Collaborative filtering will be for those places for which the user has not rated before. The recommendation will be based on his interests and neighborhood user's interests. Content-based filtering will take those places which the users have already rated before and items will be extracted from the user profile. A hybrid model of both the filtering techniques will overcome the disadvantages of both used separately. The specific user's ratings as well as general ratings together will impact the recommendation.

V. PROPOSED METHODOLOGY

The proposed methodology for the Travel Recommendation System encompasses a hybrid approach that combines collaborative and content-based filtering techniques to generate personalized recommendations for travelers. The methodology consists of the following key steps:

A. Data Collection and Preprocessing

Gather user data, including past travel experiences, preferences, ratings, and demographic information.Collect information on tourist destinations, accommodations, activities, and attractions, along with corresponding ratings and attributes.Preprocess the collected data to handle missing values, normalize ratings, and convert unstructured text data into a structured format suitable for analysis.

B. User Profiling

Create user profiles based on past travel experiences, ratings, and preferences. Analyze user profiles to identify preferences, interests, and travel behavior patterns. Incorporate demographic information and contextual factors (e.g., budget, time constraints) into user profiles to personalize recommendations.

C. Collaborative Filtering

Utilize collaborative filtering techniques to identify similar users and recommend items based on their preferences.Implement algorithms such as Singular Value Decomposition (SVD) or matrix factorization to identify latent factors and generate personalized recommendations. Calculate similarity scores between users based on their past interactions with items (e.g., tourist destinations, accommodations).

D. Content-Based Filtering

Extract relevant features from user profiles and item attributes to identify similarities between users and items.Utilize techniques such as TF-IDF (Term Frequency-Inverse Document Frequency) to represent user preferences and item characteristics in a vector space. Compute similarity scores between user profiles and items based on their feature vectors to generate personalized recommendations.

E. Hybrid Recommendation System

Integrate collaborative and content-based filtering scores to generate hybrid recommendations. Combine collaborative filtering recommendations, which capture user similarities, with content-based filtering recommendations, which capture item similarities. Apply weighting or blending techniques to prioritize recommendations based on user preferences, contextual factors, and recommendation accuracy.

1) Evaluation and Validation: Evaluate the performance of the recommendation system using metrics such as precision, recall, and accuracy.Conduct user studies or surveys to gather feedback on the effectiveness and user satisfaction with the recommendations.Validate the recommendations against user feedback and real-world travel experiences to assess the system's practical utility and relevance.

F. Optimization and Enhancement

Continuously optimize and refine the recommendation algorithms based on user feedback and performance metrics.Explore advanced machine learning techniques, such as deep learning or reinforcement learning, to improve recommendation accuracy and relevance.Enhance the system's scalability, robustness, and adaptability to accommodate diverse user preferences, cultural differences, and evolving travel trends.By following this proposed methodology, the Travel Recommendation System aims to provide personalized and accurate recommendations that enhance the travel planning experience for users, promote tourism engagement, and drive economic growth in the tourism industry.

VI. IMPLEMENTATION DETAILS

As discussed earlier, we are proposing a hybrid recommender system technique that generates accurate recommendation lists by integrating content-based and collaborative filtering scores. The architecture of the proposed system consists of input data, recommend-er techniques, and output. The system takes item data and user data as input data. The architecture follows splitting data and then training the data with recommend-er. For evaluation purposes, we use test data. As a final step, we apply a hybrid method to test data. Individual output values of both recommend-er are combined to generate a final ranked list of recommendations for the user as an output. The final recommendation list will be sorted based on scores of hybrid recommenders.

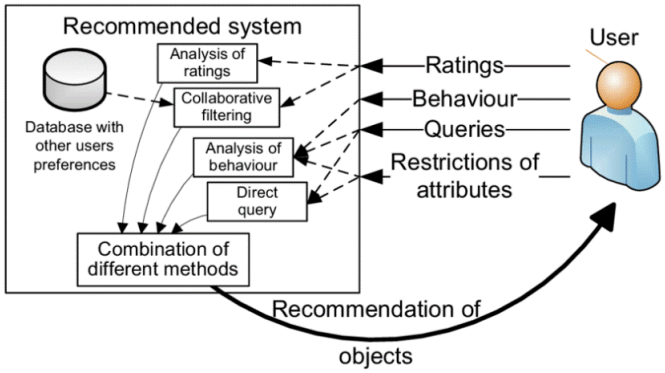

Fig. 1. Architecture for Collaborative Filtering in recommender system

A. Collaborative Filtering

This approach recommends places to users which they have not rated before. It is based on the user's interests and neighbourhood similar user's interests. This introduces diversity in the recommendation. Based on the threshold value the filtering the data. It reduces the dimensionality of the dataset and handles the sparsity of matrices very well compared to memory-based ones and is helpful to achieve better results. The cold start problem is the disadvantage of collaborative filtering. When a new item is added due to lack of rating the item cannot predict ratings for users.

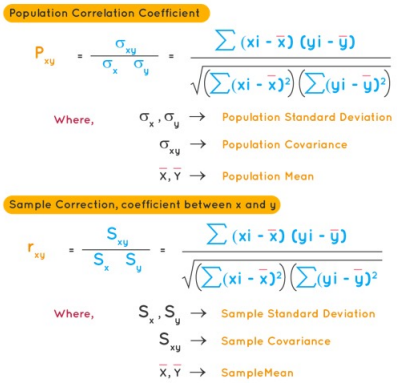

Fig. 2. Cosine similarity In Collaborative Filtering

B. Content Filtering

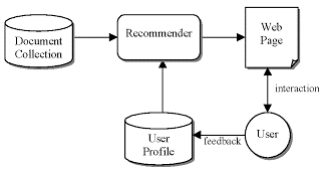

Fig. 3. Architecture for Content Filtering in recommender system

Content-based filtering takes those places which the users have already rated before and relevant items will be extracted

from the user profile to the item profile. Here, we used TF-IDF. This converts unstructured text into vector structure. As all items are represented in the same Vector Space Model it is easy to compute the cosine similarity between items. The main drawback is in this recommendation system there is no diversity in recommended items. This method is not good while working with complex data.

$$\cos(\theta) = \frac{\mathbf{A} \cdot \mathbf{B}}{\|\mathbf{A}\|\|\mathbf{B}\|} = \frac{\sum_{i=1}^{n} A_i B_i}{\sqrt{\sum_{i=1}^{n} A_i^2} \sqrt{\sum_{i=1}^{n} B_i^2}}$$

Fig. 4. Correlation coefficient for Content Filtering in recommender system

C. Hybrid Recommendation System

To overcome the cold start and sparsity problems of collaborative and content filtering methods respectively and to combine the best features of both methods, we have used a technique called Hybrid recommender, which merges two or more recommendation systems together to produce better outputs. This results in increased recommendation accuracy primarily because there is a lack of domain dependencies in collaborative filtering and in content- based filtering there is a lack of user preferences. The advantages of both systems make it a better method for the recommendation. This extends collaborative filtering with content about items and content-based filtering with preferences and rating data.

VII. RESULTS

We have tried both collaborative and content filtering mechanisms on different user inputs. In content based filtering, results are generated based on the user's past ratings and preferences i.e results are personalised.

	userId	itemId	rating	timestamp	category	distance	duration	nearby_places	title	url	p_rating	count
8	9	1	NaN	878089716	Wildlife	6 Kms	1-2 Hours	None	Jaipur Zoo	/rajasthan/jaipur/jaipur-zoo	2.2	158
17	9	2	3.0	890881335	Heritage	6 Kms	1-2 Hours	None	Nahargarh Fort	/rajasthan/jaipur/nahargarh-fort	4.6	652
26	9	3	3.0	889502324	Heritage	13 Kms	2-3 Hours	Jaigarh Fort (1 km by walk), Srijagat Siromani...	Amer Fort / Amber Fort	/rajasthan/jaipur/amer-fort-amber-fort	5.0	783
35	9	4	3.0	879525876	Pilgrimage	6 Kms	1-2 Hours	None	Birla Mandir	/rajasthan/jaipur/birla-mandir	4.9	482
44	9	5	NaN	879485532	Heritage	6 Kms	30 Mins	None	Hawa Mahal	/rajasthan/jaipur/hawa-mahal	4.2	890
...	...	...	...	...	...	...	...	...	...	...	...	...
243	1	28	NaN	883748450	Museum	14 Kms	2 Hours	None	Anokhi Museum Of Hand Printing	/rajasthan/jaipur/anokhi-museum-of-hand-printing	1.7	560
252	1	29	4.0	875747401	Heritage	5 Kms	30 Mins	None	Amar Jawan Jyoti	/rajasthan/jaipur/amar-jawan-jyoti	5.0	348
261	1	30	NaN	876861185	Heritage, Pilgrimage	14.5 Kms	2 Hours	None	Digamber Jain Mandir Sanghji	/rajasthan/jaipur/digamber-jain-mandir-sanghji	3.7	48

Fig. 5. DataFrame containing information related to each place and their user Rating

In collaborative filtering , user's interests and source are taken as input and results are displayed based on distance , interest and other purposes.

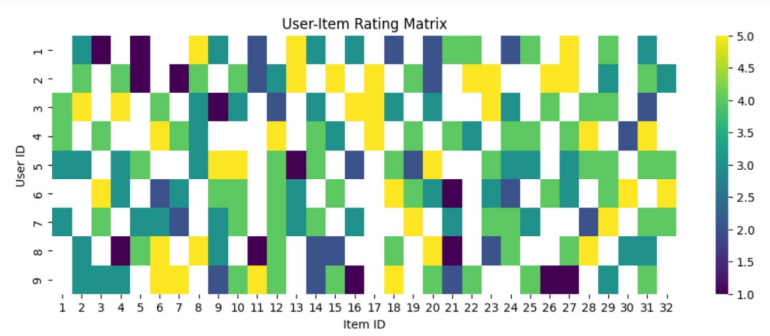

Fig. 6. Heatmap of Ratings between users and places

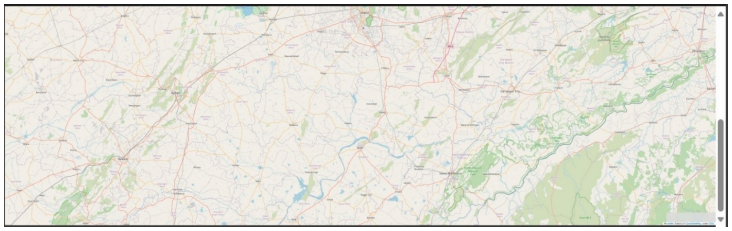

Fig. 7. Map location Based on content filtering

Recommended places :

	title	category	score
18	Central Park	park	3.579438
20	Jawahar Circle Garden	park	3.510569
7	Kanak Vrindavan Garden	park	2.723296

Fig. 8. Recommended places Based on content filtering

A. Collaborative – based filtering

The recommendations are based on collaborative filtering, which suggests places that users similar to the active user have liked but the active user hasn't visited yet. The algorithm predicts ratings for all places the user hasn't rated, calculates the similarity between the active user and other users, and then suggests places based on the ratings of similar users. The recommendations are personalized to the user's preferences and aim to provide new and potentially interesting places to explore.

B. Content – based filtering

The recommendations are generated using a content-based approach, where places are recommended to the user based on the similarity between the categories of places and the user's interests. The algorithm calculates similarity scores for each place based on the cosine similarity between the user's vector representation of interests and the vector representation of each place's category. The top N places with the highest similarity scores are then recommended to the user as places they might be interested in exploring based on their stated interests.

```
Enter userid: 5
The user's favorite places are:
['City Palace / Sawai Man Singh II Museum', 'Akshardham Temple', 'Jaigarh Fort', 'Rambagh Palace', 'Albert Hall Museum']
The recommended places for you are:
['Amer Fort / Amber Fort', 'Garh Ganesh Temple', 'Jama Masjid / Akbari Mosque - Amer', 'Gatore ki Chhatriyan', 'Digamber Jain Mandir Sa
```

Fig. 9. Output for Collaborative filtering

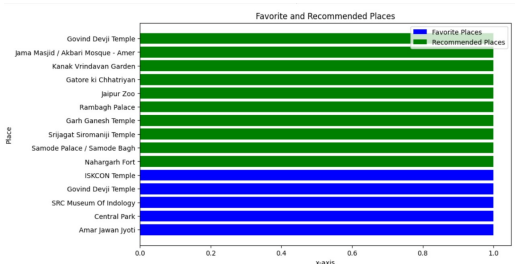

Fig. 10. Output for Favourite and recommended places

The code generates a map visualization where each marker represents a recommended place. The markers are positioned at the latitude and longitude coordinates obtained through geocoding. Users can interact with the map to view the locations of the recommended places and get more information by hovering over the markers. This visualization can be useful for users to explore the spatial distribution of the recommended places and plan their visits accordingly.

The output presents the hybrid recommendations for the user based on their preferences and past interactions. Places are recommended based on their relevance to the user's selected category and their collaborative filtering scores. The recommendations are sorted in descending order of their weighted scores, which consider both collaborative and content-based filtering factors. Users can consider these recommendations to explore places aligned with their interests and preferences, encompassing a diverse range of categories such as wildlife, heritage, pilgrimage, parks, and museums.

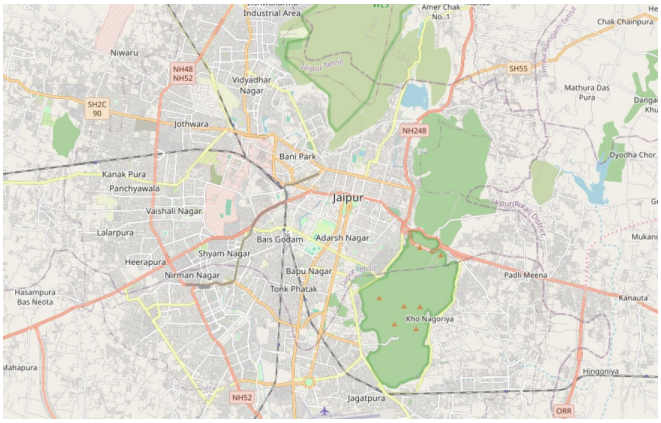

Fig. 11. Map Visualisation

	title	category	score
0	ISKCON Temple	Pilgrimage	1.826303
1	Samode Palace / Samode Bagh	Heritage	1.772410
2	Sargasuli Tower / Isar Lat	Heritage	1.749218
3	Garh Ganesh Temple	Pilgrimage	1.686885
4	Rambagh Palace	Heritage	1.679535
5	Jaipur Zoo	Wildlife	1.622341
6	Gatore ki Chhatriyan	Heritage	1.550935
7	Jama Masjid / Akbari Mosque - Amer	Heritage, Pilgrimage	1.339350
8	Anokhi Museum Of Hand Printing	Museum	1.334172
9	Govind Devji Temple	Heritage, Pilgrimage	1.249410

Fig. 12. Category and Score for Hybrid filtering

```
Enter userid: 7
Enter number of recommendations 10

Select your preferred category:
1. wildlife
2. heritage
3. pilgrimage
4. park
5. museum
Enter your preferred category: 2

Hybrid Recommendations:
1. ISKCON Temple
2. Samode Palace / Samode Bagh
3. Sargasuli Tower / Isar Lat
4. Garh Ganesh Temple
5. Rambagh Palace
6. Jaipur Zoo
7. Gatore ki Chhatriyan
8. Jama Masjid / Akbari Mosque - Amer
9. Anokhi Museum Of Hand Printing
10. Govind Devji Temple
```

Fig. 13. Output for Hybrid filtering

VIII. CONCLUSION

We conclude that we have developed a sophisticated and effective tool for providing personalised as well as general tour recommendations to users. By combining the strengths of both collaborative and content filtering approaches, the system can deliver highly accurate and relevant recommendations to users based on their preferences and past interactions with the system. The project has achieved its objective of improving the user experience and increasing the likelihood of user engagement and satisfaction with the recommended tours.

```
/usr/local/lib/python3.10/dist-packages/scipy/spatial/distance.py:636: RuntimeWarning: invalid value encountered in scalar divide
  dist = 1.0 - uv / np.sqrt(uu * vv)
Enter userid: 3
Enter user interests: park
Hybrid Recommendations for User 3
Top recommendations with sources:
Name: Moti Dungri Ganesh Temple | Source: Collaborative | Google Maps Link: https://www.google.com/maps/search/?api=1&query=Moti Dungri Ganesh T
Name: Nahargarh Fort | Source: Collaborative | Google Maps Link: https://www.google.com/maps/search/?api=1&query=Nahargarh Fort
Name: Amer Fort / Amber Fort | Source: Collaborative | Google Maps Link: https://www.google.com/maps/search/?api=1&query=Amer Fort / Amber Fort
Accuracy for Collaborative Recommendations: 60.0
Accuracy for Content-Based Recommendations: 0.0
Accuracy for Hybrid Recommendations: 60.0
/usr/local/lib/python3.10/dist-packages/scipy/spatial/distance.py:636: RuntimeWarning: invalid value encountered in scalar divide
  dist = 1.0 - uv / np.sqrt(uu * vv)
```

Fig. 14. Output for accuracy in Hybrid filtering

Moreover, the system can be easily scaled and customised to meet the specific needs of different tourism businesses and organisations. Overall, the composite hybrid tour recommendation system project has demonstrated the power of combining multiple approaches in developing innovative and effective solutions in the field of tourism and hospitality. The project has significant potential for further development and expansion, and can serve as a model for future research and development in this area.

IX. Future Works

A. Incorporating User Preferences and Ratings

Enhance the recommendation system to incorporate specific user preferences and ratings for tourist spotsDevelop algorithms to dynamically adjust recommendations based on individual user feedback and experiences.Integrate user-generated content, such as reviews and ratings, to personalize recommendations and improve recommendation accuracy.

B. Refinement of Composite Recommendation System

Extend the composite recommendation system to consider a broader range of factors, including user interests, travel motivations, and cultural preferences.Explore advanced optimization techniques to improve the efficiency and effectiveness of the composite recommendation algorithm.Implement adaptive algorithms that adjust recommendation strategies based on real-time user interactions and feedback.

C. Personalized Composite Recommendation Sequencing

Develop algorithms to generate personalized composite recommendation sequences that prioritize user preferences and constraints.Utilize machine learning techniques to learn and adapt to individual user behavior patterns and preferences over time.Incorporate contextual factors, such as seasonal trends, weather conditions, and local events, into the recommendation sequencing process.

D. Hybridization of Recommendation Techniques

Investigate hybrid recommendation approaches that combine collaborative filtering, content-based filtering, and composite recommendation techniques. Design algorithms to seamlessly integrate multiple recommendation models and leverage the strengths of each approach to enhance recommendation accuracy and coverage. Experiment with ensemble learning methods to aggregate recommendations from diverse sources and optimize recommendation performance.

E. User-Centric Recommendation Evaluation

Conduct user studies and experiments to evaluate the effectiveness and user satisfaction with personalized recommendations.Gather qualitative feedback from users to understand their preferences, decision-making processes, and satisfaction levels with the recommended travel plans.Utilize user-centric metrics, such as user engagement, conversion rates, and repeat bookings, to assess the impact of recommendations on travel behavior and decision outcomes.

F. Integration of Emerging Technologies

Explore the integration of emerging technologies, such as artificial intelligence, natural language processing, and augmented reality, to enhance the recommendation system's capabilities.Develop interactive and immersive user interfaces that leverage virtual reality and augmented reality to provide personalized travel experiences and virtual tours.Investigate the use of blockchain technology to ensure data privacy, security, and transparency in collecting and sharing user preferences and travel-related information.By pursuing these avenues for future works, the Travel Recommendation System can evolve into a more sophisticated and personalized platform that meets the diverse needs and preferences of travelers, enhances their travel experiences, and contributes to the growth and sustainability of the tourism industry.

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