Indian Journal of Science and Technology, Vol 9(48), DOI: 10.17485/ijst/2016/v9i48/107997, December 2016
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Enhanced Travel Planning System for Group of users using Hybrid Collaborative Filtering

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Abstract

Objectives: This paper proposes a recommender system for travel planning build on the user personalized regard for both single and group of users by using the adaptable user interface and feedback mechanism**. Methods:** One of the major problems is that all the previous recommendation system based on traveling simply recommends the most common travel routes and places and they do not provide an appropriate and interested travel schedule to the user. **Findings:** First, the adaptable user interface is used to modify or remove the unsatisfied travel schedule of the user with the specific schedule. Next, the feedback mechanism provides better accuracy rate for the next schedule of the new user. **Applications:** The group recommendation is elicited out of the personal recommendation system which uses the scheduling reasoning algorithm to provide the user with the perfect travel plan. The proposed hybrid collaborative filtering technique for group recommendation system resolves the data sparsity problem. Along with this, the K-Means clustering algorithm is used to cluster the users and to group them according to their interest efficiently.

Keywords: Grouping, Personalization, Similarity, Travel Planning System

1. Introduction

Because of massive improvement in information technology, the internet has greatly influenced the travel service industry. Various developments on the internet have made numerous travel information available for the traveler to plan their travel schedule with the limited time period. It becomes a tedious job for the traveler to plan their travel schedule, as huge amount of information are available on the internet with travel route, accommodation, hotel and restaurant. This has given rise to recommendation system related to travel planning for the traveler. Recommender systems typically produce recommendation through various filtering approaches. The most commonly used filtering approach is filtering based on content and collaborative.

1.1 Content based Filtering

Filtering based on content method used in personalized travel planning recommendation system consist of, the services which matches with the user's profile along with the service system database forms the recommendation system for the particular user in regard with location, accommodation, restaurant, travelling mode, etc.., In content based filtering the system creates the users profile using two types of information : 1. The history of the users iteration with the recommendation system. 2. The model of the users' preference. Content filtering commonly revolves around the particular user's interest and the only advantage of content based filtering is that, it acquires the user's interest as it may varies time to time and makes the updation to the recommendation system. So as to improve the systems performance rule based reasoning has been used .The main disadvantage of the content based filtering method is that, it commonly revolves around the interest of the particular user. Sometimes the user may prefer the services for gift purpose and thus the system may provide the wrong recommendation to the user, but it may not happen with the travel system as the user may mostly search for their own use, in some other

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cases the system may recommend the services which the user is already known with. The major disadvantage with the content based filtering is the user may be new to the travelling system and hence the recommendation system may have less/no information about the user's interest and this leads to the poor recommendation system.

1.2 Collaborative Filtering

Collaborative filtering method is based on the similarities among the users, it finds out the users with the same kind of interest and recommends the user with that information eg: recommendations made in shopping websites, the major disadvantage of the collaborative filtering method is the users should have rated the item so that it can be recommended the TRS (travel recommendation system, 2003) uses the collaborative filtering for recommending various accurate attractions to the user.

1.3 Hybrid Filtering

The hybrid filtering combines the activity of both content based filtering and collaborative filtering, and thus simultaneously resolving both the filtering activities to provide better recommendation results to the user. It can include various data processing and filtering techniques it also have some disadvantages which were seen in content based filtering method in recommending items to the user. The hybrid filtering method is incorporated in ptps (personalized travel planning system,2013) which consider all aspects of user such as poi, attraction, accommodation ,restaurants , time framework etc..,

1.4 Various Criteria used for Developing Personalized Tour Packaging Recommendation Systems

Various factors are considered while developing a tour packaging recommendation system to improve the level of recommendation made to the user such as attraction, accommodation, restaurants, time framework etc, where all these factors are considered in ppt. This paper attempts to recommend an enhanced travel plan for group of users. The paper first considers each individual users requirements which is used to provide the travel schedule planning with time framework and schedule planning adjustment concept. And the relevant database is updated using the feedback mechanism which records the user schedule and choices as a base for future recommendation. In addition to this the paper proposes the result adjustment concept where the user is allowed to change or modify the unsatisfied item which increases the user satisfaction. For aggregating members rating to make group recommendation, hybrid cf technique is used, which solves the data sparsity traditional issue and scalability in algorithm of collaborative filtering.

1.5 Travel based recommendation system

Various travel support systems has been moved from offline mode to online mode to help the traveler for planning their travel at finger tip with various travel information available at the internet. Various studies (using table1) have proved that recommendation system may provide better suggestion to the travelers, facilitation traveler's decision making. This helps the traveler to overcome the overloaded travel information in the internet. Numerous studies has combined various techniques to develop the recommendation system to provide travel routes and attraction sites along with various services such as accommodation and restaurant which satisfies the users requirement.[1,2] Here the **PTPS** considers all categories of user's requirement[1]. These system's remains to be an upgraded version of **TRS** (travel recommendation system) which supports the user to plan travel by providing various travel recommendation such as travel routes and attraction[3]. In this case PTPS faces numerous challenges in satisfying the traveler's requirement, Such as schedule planning, feedback mechanism and schedule adjustments.

Table 1. Categorization of recommendation system based on the hardware device

Systems	Hand held devices	Computers
PTPS	-	✓
TRS	-	✓
GRSK (Group Recommendation System kernel)	-	✓
MYMYTILINE	✓	-
NOGUERAET AL	✓	-
MTRS (mobile travel recommendation system)	-	✓
MOBIREC	-	✓

1.6 Scheduling System

Numerous scheduling algorithms are used along with the travel based recommendation system to provide the user with the travel schedule. Ptps uses schedule reasoning algorithm which works with the adjustable time framework[1]. The adjustable time framework which allows traveler to modify the travel schedule provided by the system using the feedback mechanism. Discrete symbiotic organism search algorithm helps the user with task scheduling which helps in various organism search process in cloud computing environment[4].

1.7 Similarity Computation for Generating Group Recommendation

Recommendation system for group of users has become an most necessary system in recent days. Various studies have developed recommendation system for individual and group of users under various sectors GRSK has developed recommendation system of single and group of users for tourism sector , the taxonomy used to develop this system can be used to recommendation system under various sectors . The similarity computation is carried out using different methods (using table 2) such as demographic group preference, content based group preference[5,6]. The system has been used to recommend tourism only for a particular location Valencia (Spain)[7]. GRS is used to solve the sparsity problem to the maximum which remains

To be the major problem in group recommendation system, it uses the support vector machine learning model to compute the similarity between the items which outperforms the latent factorial model which is very efficient in sparse condition[8]. In most of the researches, cf is the most favorable filtering technique for prediction process[9]. This system solves the sparsity problem and dynamic changes on available data; it shows better performance than RHCF method. This[10] system improves the collaborative filtering by using the Pearson correlation similarity (pcc) in multiple levels. Here the system does not provide any explanation for recommendation[11]. The system works efficiently in heterogeneous condition and improves the homogeneous by 30% for group product recommendation by using partial information[12,13].

2. Proposed Methodology

Each framework has its own methodologies and approaches that are carried out by their self. They stick with the methods that are given and produce the output to the end user. Same as like in other frameworks in the proposed framework also some methods are used in order to get the desired output. The system follows some algorithms in order get the best output.

2.1 Enhanced Travel Planning System

Here we proposes a Enhanced Travel Planning System (ETPS) where the user provides their interest to the system using the user interface such as starting point, budget, number of travel days, individual or group travel, area of interest, hotel and restaurant. The system provides various recommendation and schedule plan for the user required number of days. If the user is satisfied with the travel plan provided by the system the user data are stored back to the database using the feedback mechanism. Else if the user is not satisfied with the travel plan schedule then the user can modify their travel schedule using the feedback mechanism until it satisfies their requirement. Here we are using the work flow scheduling algorithm were the complete travel schedule along with the security is provided to the user through the user mail id and phone number. If the user has preferred for group travel then the users are grouped together based on their inter-

Table 2. Recommendation system based on personalization

	PTPS	TRS	GRSK	MTRS	TRAVELLER
Attraction	✓	✓	✓	-	✓
Accommodation	✓	-	-	-	-
Restaurants	✓	-	-	-	-
User requirements	✓	-	✓	✓	✓
Time frame work	✓	-	-	-	✓

est. The various module used in this system are provided in the subsections.

2.2 Travel Planning Module

The travel planning module consists of the travel planning match module and the recommendation module. The travel planning match modules consist of the matching results which are retrieved from the database. The retrieved results are arranged in order based on the popularity. The recommendation modules consist of various recommendation sites which match with the user requirement. The travel planning module includes the complete time schedule which includes the breakfast time, lunch time, dinner time and number of hours it takes at each individual location. The system also provides the number of travel days it requires for a particular location automatically according to the user budget. It also provides the hotels in respect to the user's preference with the food type. The system provides the hotels which matches with the users preference.

2.3 Database

The database consists of the geographical locations and the user profile. The geographical location consists of the distance between different locations which is used for calculating the traveling time from one location to another location. It contains the user profile for future improving the future recommendation of the user, which may also be used for improving the popularity of the particular location which is used for recommending locations to various users.

2.4 Grouping

The users are grouped if the user shows interest in group traveling while they provide their various interests. The basic interface for travel planning is shown in the figure 1. Here the users are grouped based on their interest regarding locations, they are grouped automatically when they show interest in group traveling and prefer same kind of locations. The results of user grouping are shown in graphical format the location which is preferred by maximum users is shown so that the user can join the group according to their interest. The user requirement page is shown in the figure 2.This grouping is carrying out using k-means clustering algorithm.

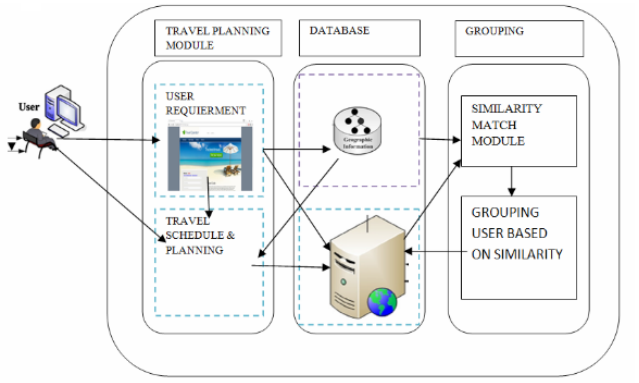

Figure 1. Basic interface.

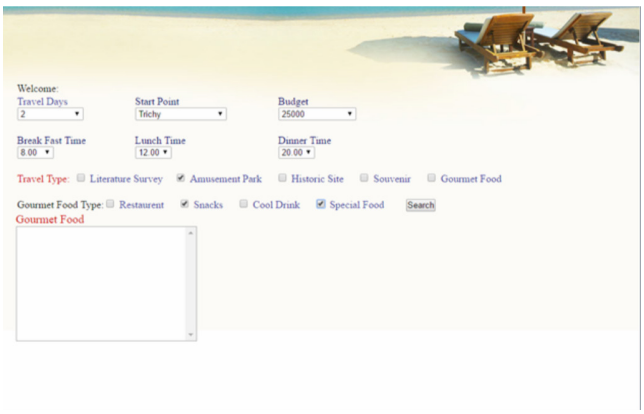

Figure 2. User requirement search page.

3. Travel Scheduling and Grouping Pseudocode

1. User Input their requirements in the search area from staring point, attraction, accommodation, hotel, individual or group tourism.

2.The system recommends various locations based on the users requirements

3. The system checks with the database calculate the dwelling time at each location and provide the time framework to the user.

The dwelling time is calculated for the number of days the users have provided. The dwelling time is the time which is spent in each location.

4.If the user is satisfied with the schedule provided the user's data are stored back to the database through feedback mechanism.

5.Else the user can modify the search result through the feedback mechanism until it satisfies their requirements.

6.If the user requested for group tourism, the users are grouped based on their similar interest regarding to the location using the k-means clustering algorithm

Assignment step: Assign each observation to the cluster whose mean yields the least within-cluster sum of squares (WCSS)[14]. Since the sum of squares is the squared Euclidean distance, this is intuitively the "nearest" mean.

$$S_i^{(t)} = \{x_p : \| x_p - m_i^{(t)} \|^2 \le \| x_p - m_j^{(t)} \|^2 \ \forall_j, 1 \le j \le k\} \quad (1)$$

where each x_p is assigned to exactly one $s^{(t)}$, even if it could be assigned to two or more of them.

Update step: Calculate the new means to be the centroids of the observations in the new clusters.

$$m_i^{(t+1)} = \frac{1}{| S_i^{(t)} |} \sum_{x_j \in S_i^{(t)}} x_j \quad (2)$$

Since the arithmetic mean is a least-squares estimator, this also minimizes the within-cluster sum of squares (WCSS) objective.

7. The security is maintained using the user's mail-id and mobile number, where the user is intimated about their travel schedule through mail.

4. Experimental Setup

We conducted two experiments to explore comparison of popularity and evaluation of group recommendation. In experimenting comparison of the popularity a group of 50 users were asked to use the system[15]. The users provided their various requirements and the travel schedule is provided to the user if the user is satisfied with schedule provided by the user then the schedule is stored in the database under the user profile, for providing better recommendation to the user in future. The user's data is used to compare the popularity of the locations. The comparison of the popularity is used for the evaluation for the group recommendation for the users.

4.1 Grouping Evaluation

The group evaluation is carried out for the user who has shown interest for group travel. The group evaluation is used to show the user that how many users have opted for a particular location. The graphical results are shown here for different kind of location such as hill station, historical monuments, temples etc..., is shown in figure 3,4 the grouping technique is evaluated by collecting user interest from 50 users. Those 50 users are separated into three groups based on their age evaluated separately. The users are divided as evaluation 1 from age group 50 and above, evaluation 2 from age group 30 and above, and the last evaluation 3 is done with age group 15 and above. And the results are shown in table 3.

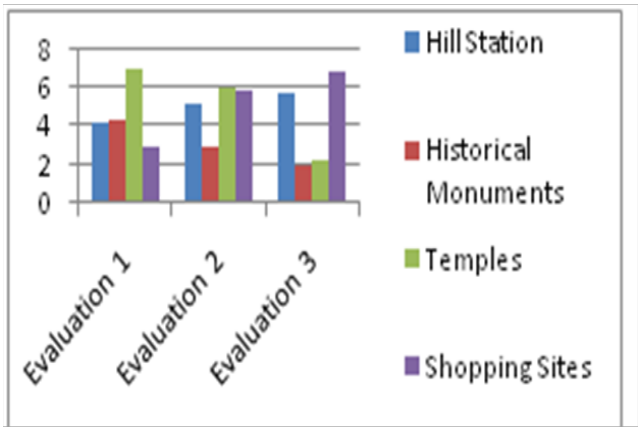

Figure 3. Comparison of Popularity.

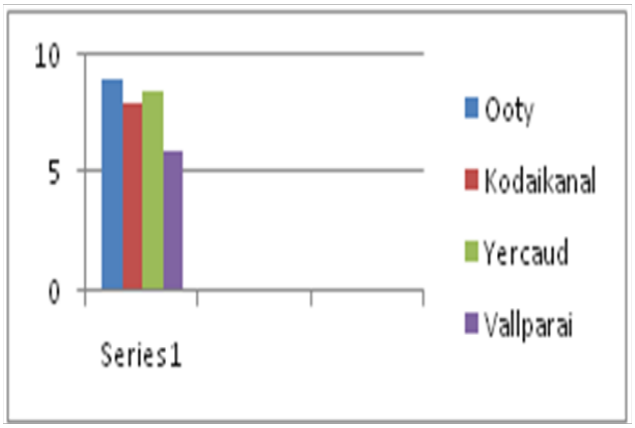

Figure 4. Evaluation for Group Recommendation.

The users are also provided with the number of users with similar interest in specific with the location so that the user can join the group according to their interest as shown in figure3. The group of users who has shown interest in hill station, within Tamil Nadu is evaluated and the results are shown in table 4.

Figure 5shows the comparison between recall precision and f-measure using the formula. Where TT defines true which means user accepted recommendations and FF defines user not accepted recommendation FT mentions the recommendation list does not contains the user

Table 3. Location evaluation based on group recommendation

LOCATIONS	EVALUATION 1	EVALUATION 2	EVALUATION 3
HILL STATION	4.2	5.2	5.7
HISTORICAL MONUMENTES	4.3	3	2
TEMPLES	7	6	2.3
SHOPPING SITES	3	5.9	6.9

not accepted places and TF means does not contains the user interested places in the recommendation list. The comparison results are presented in table 5.

$$\text{Precision} = TT/(TT + FF) \quad (3)$$

$$\text{Recall} = TT/(TT + FT) \quad (4)$$

$$\text{F -measure} = 2*[(\text{precision}* \text{ recall})/\text{precision} + \text{recall})] \quad (5)$$

Table 4. Specific locations evaluation

LOCATIONS	EVALUATION
OOTY	9
KODAIKANAL	8
YERCAUD	8.5
VALLPARAI	6

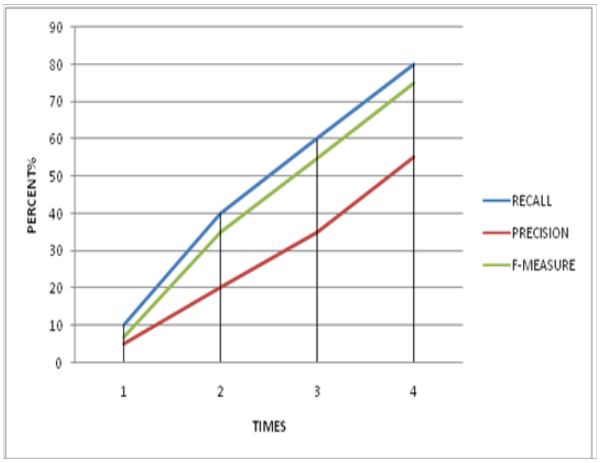

Figure 5. Evaluation of recall,precision, f-measure.

Table 5. Evaluation of recall, precision and F-Measure

S.NO	RECALL	PRECISION	F-MEASURE
1	10	5	7
2	40	20	35
3	60	35	55
4	80	55	75

5. Results and Discussion

The enhanced travel planning system for group of users has been developed which provides the personalize travel schedule for the user using hybrid collaborative filtering which solves the sparsity problem and groups the user based on the similarity of interest regarding locations. The enhanced travel planning system developed performs better than the previous set of travel recommendation system in providing user satisfying travel plan and grouping users.

The home page contains the various options to get the users personalized interest. The system responds the user with various recommendation results based on the user's interest. If the user is satisfied with the recommendation schedule the data are stored back to the database for better recommendation during the next search. If the user is interested in group tourism then the users are grouped based on their interest in locations. The user's data are secured through mail id and phone number of the user.

6. Conclusion and Future Work

The enhanced travel planning system for group of users has been developed which

provides the personalize travel schedule for the user using hybrid collaborative filtering which solves the sparisty problem and groups the user based on the similarity of interest regarding locations. The enhanced travel planning system developed performs better than the previous set of travel recommendation system in providing user satisfying travel plan and grouping users. The Results are shown in graphical format for grouping user, where it shows the users with higher similar interest

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