HYBRID RECOMMENDATION TECHNIQUE FOR AUTOMATED PERSONALIZED POI SELECTION

Phuengjai Phichaya-anutarat* and Surasak Mungsing

Information Science Institute of Sripatum University (ISIS)
Sripatum University, Chatuchak, Bangkok 10900, Thailand

ABSTRACT

Many e-Tourism services have been developed for supporting tourists’ trip planning in the past decade. Points of Interests (POI) selection are still one of the major steps for personalized trip planning for most tourists. The aim of this paper is to propose an alternative recommender technique to assist the tourist in order to select appropriate the Point of Interest (POI) according to the personalized tourist’s preferences and interests that simultaneously obtained from the available user profile and POI database. By utilizing the combination of three well-known techniques; namely the Content Based (CB), Collaborative Filtering (CF), and demographic techniques which called Hybrid approach in the present paper, the amount of selected POIs assigned with personal interest score can then be sought properly. The subsequent process is to create the clusters following the required tourist criteria which can overcome the computational time efforts of tourist selection providing the appropriate trip area. This is the advantage of the proposed technique differed from the other previous investigators.

Keywords: Personalized POI selection, Hybrid recommender technique, Content Based, Collaborative Filtering, Demographic

1. INTRODUCTION

Due to the enormous growing of tourism and number of travelers or tourist during the last decade, motivated for the development of e-Tourism services such as the services provided for selecting POIs, selecting tourist attraction, selecting accommodation, providing travelling information, online ticket booking, online reservations, which were influenced by Information and Communication Technologies (ICTs) and the internet. Many tourists
realize the advantages of ICTs and internet for selecting POIs which is the most interesting places to visit because of a limited amount of time and budget available (trip constraints) and then plan a route between them. However, it is not easy for a tourist to search the information what exactly he really wants from a large amount of information available on the internet [5]. Tourism is an activity strongly connected to personal preferences and interests of people [3], different tourists have different preferences and interests. Because of this, recommendation systems have been used for reducing complexity when searching information over the internet. In general, recommendation system directly help user to find content, product, or services (such as books, movies, music, TV program, and web sites) [8].

The main characteristic of the recommender system is that tourist can personalize their interaction to each individual user [4]. Personalized recommendation system have been gaining interest in tourism to assist users with their travel plan, selecting POIs and plan a route between them. In personalized tourism recommendation system domains, a variety of approaches have been used to perform recommendation in these domains, including content-based, collaborative, demographic and knowledge-based or hybrid approaches and many other [6].

Therefore, it can be concluded that without system support properly or good intelligent recommender system, filtering irrelevant attractions, comparing alternative information, and selecting the best option can be difficult or impossible. This motivates the researchers to develop the systems or algorithms for serving the user’s needs. Traditionally, these mentioned systems are usually added the related information of items to the information flowing towards the user, as opposed to removing information items. It is worth to notice that a recommender system compares the user’s profile to some reference characteristics, and seeks to predict the rating that a user would give to an item they had not yet considered.

The main objective of this paper can briefly be explained as follows. Firstly, application of content-based, collaborative filtering, and demographic techniques which are all combined to be a single one of hybrid recommendation technique in order to suggest the appropriate POIs to personal tourist. Secondly, further application of clustering technique based upon some tourist’s required criteria specifically to the previous obtained POIs selection leads to the final result of personalized POIs selection automatically. With the best authors’ knowledge, the latter is the additional technique which has not been applied in tourism problem and not found in the published literature. Its main advantage is reducible spent time in selecting the appropriate trip area in accordance with highest preferences and interests of tourist, who has some individual constraints and also never visit in that attractions or trip destination.

2. PRIOR RELATED WORKS

In the recent years, there is a wide variety of applications on the recommendation system that can generally be found in the scientific literatures. Some of them have been focused on the travel and tourism problems to filter irrelevant information and to provide personalized and relevant services to tourists. Schiaffino and Amandi [10] presented an expert software agent in the tourism domain named Traveller, which takes advantage of collaborative filtering, content-based user profiles, and together with demographic
information to recommend tours and package holidays to users. With obtained results, they concluded that the precision of the recommendations made is higher for the hybrid technique than with each method used separately. Lee et al. [5] proposed the ontological recommendation multi-agent for travel, specifically in Tainan City, which can recommend the tourist a personalized travel route. The results showed that the proposed approach based on the use of ant colony optimization for the context decision agent can effectively recommend a travel route matched with the tourist’s requirements.

A related work that involved with developing a personalized recommendation system was given by Kabassi [4], who reviewed and discussed the theories from the research areas of machine learning or decision making for the improvement of the personalization procedure in tourism recommendation systems. All these have focus on providing some guidelines or development steps. Garcia et al. [3] dealt with a recommender system for tourism in which the system is able to offer recommendations for a single user or a group of users. For the single user recommendations, they are computed according to the user preferences by using a hybrid recommendation technique that is the mix of three basic recommendation techniques: demographic, content-based and general likes filtering. In case of a group of users, group preferences are obtained from the individual preferences through the application of the intersection and aggregation mechanisms. From the test results, it showed that the intersection mechanism gives better results due to bringing together the preferences of all the group members.

Shinde and Kulkarni [11] proposed a novel personalized recommender system with utilizing centering-bunching based clustering (CBBC) algorithm in which the system is consisted of two main phases. They can be explained as follows. In the first phase, opinions from the users are collected in the form of user-item rating matrix, and further clustered offline using CBBC into predetermined number clusters and stored in a database. In the second phase, the recommendations are generated online for active user using similarity measures by choosing the clusters with good quality rating, which leads to get further effectiveness and quality of recommendations for the active users.

To propose a decision support system for tourist attractions, Fang-Ming et al. [2] developed a recommendation system based on integration of the Engel-Blackwell-Miniard (EBM) model, Bayesian network, and Google Maps. By combining the EBM model with a Bayesian network, a decision support system that called the Intelligent Tourist Attractions System (ITAS) can be constructed in which the Bayesian network is used to predict the probability of individual travelers’ preference of attractions. With the help of geographic data from Google Maps, recommended routes and tourist attractions are demonstrated through an interactive user interface.

Batet et al. [1] introduced a recommender system in e-Tourism for helping tourists to select appropriate destinations. The system is designated within the following three main goals. The first is to provide an easy and ubiquitous access to the desired information about tourist attractions. The second is to provide proactive recommendations of attractions by means of a hybrid recommendation system. Finally, the third is to implement a high degree of dynamicity and flexibility in which the system can adapt to changes in the activities and incorporate new information at execution time. However, it is interesting to note that the user profile and preferences, the location of the tourist and the activities, and also the opinions of previous tourists are considered simultaneously in the hybrid recommendation system.
Utilizing the advantages of the new smartphones and tablets that included the features of graphics capabilities, built-in sensors and ubiquitous connection to the internet, Noguera et al. [7] presented a novel mobile recommender system that brings together a location-sensitive hybrid recommender engine and a custom-made 3D GIS architecture capable of running interactively on modern mobile devices. Additionally, their proposed solution has been implemented and validated by the testers and then, the testers have provided a very positive review of the application, pointing out the simplicity of its use and the usefulness of the real-time location-based recommendations.

However, there are various techniques on the application of recommendation system remained to be discovered in several scientific or technical literatures so that the interested reader should consult the expositions in Ricci et al. [9] for more detailed information. Recently, Park et al. [8] reviewed 210 articles on recommender systems from 46 journals published between 2001 and 2010 in which the 210 articles are classified and categorized into eight application fields and eight data mining techniques. Furthermore, information about trends in recommender systems research and future direction on recommender systems is also provided in their work.

3. PROBLEM DESCRIPTION

As stated in the first section previously, since the objective of this paper is to propose how to select an appropriate the point of interests according to the personalized tourist’s preferences and interests. The emphasis is then placed on the description of hybrid recommendation technique in order to obtain the most interesting POIs effectively with the maximum total satisfaction of tourist. It is, however, the fact that tourist is not possible to visit every tourist attractions due to some certain limitations such as time budget and distance, etc. Thus, selecting the most valuable POIs that is of the greatest interest to the tourist is not an easy task. To avoid difficulties, a variety of techniques have been used successfully in the past to perform recommendations [8]. Nevertheless, each technique has some limitations inherently which leads some researchers to present different hybrid techniques to overcome such problems [4,11].

As is mentioned above, this paper aims to propose the use of positive aspects of hybrid recommendation technique with the requirement of tourist’s criteria based clustering. Regarding hybrid recommendation technique, it combines three different recommendation techniques which are content-based, collaborative filtering, and demographic techniques. Before proceeding further to the next section, the following paragraphs briefly describe these techniques depending on the strategy followed to suggest recommendations as shown below [1, 7, 10].

In the first, the content-based technique, it is based on the intuition that each user or tourist exhibits a particular behavior (preference and interest) under a given set of circumstances in which this behavior will be repeated until the condition of similar situations satisfactorily. In the content-based recommender, it can learn a model of the user interests based upon the features present in items the user rated as interesting either by implicit or explicit feedback. Thus, to perform this kind of recommendation, a user profile contains those features that characterize a user interests, enabling agents to
categorize items for recommendation based on the features they exhibit. Considering the user profiles that obtained from content-based recommenders depend directly on the learning methods employed. For simplicity, it is then required to build a user profile that stores the degree of interest (i.e., a score) on each of the different criteria. However, such information can be extracted by fill-in forms but, as the set of characteristics can be quite large. As explained, it is known that this process is not adequate because long questionnaires result in inconveniences for the participants in a survey. Therefore, many systems do not only consider the explicit information offered by the users but also the implicit information given by their interaction with the system. Additionally, the problem found in this technique is that the recommender system only recommends items closely related to those the user has liked in the past; no novel items are suggested.

To consider the second technique which is the collaborative filtering, it is based on the idea that people within a particular group tend to behave alike under similar circumstances. The behavior of a user can be predicted from the behavior of other like-minded people. This requires several ratings from the users before the system may begin to make recommendations. As a result, a user profile comprises a vector of item ratings, with the rating being binary or real-valued. It can further be noted in this technique that it is to predict the score for an item which has not been rated by the active user in order to recommend this item. Comparison between the ratings of the active user and those of other users using some similarity measure, the system determines users who are most similar to the active one, and makes predictions or recommendations based on items that similar users have previously rated highly. Remarkably, one of the disadvantages of this technique used in isolation is that the recommender system cannot recommend an item until several users have rated it. In the conclusion of this technique, recommendations are made by matching a user to other users that have similar interests and preferences, and suggesting items these other like.

In the final technique that called demographic technique, it assigns each user to a demographic class based on their user profile. Thus, it is mainly aimed at categorizing users based on their personal attributes as belonging to stereotypical classes that is then used to form justifications for recommendation since users have received recommendations according to the group in which they were classified. Therefore, a user profile is a list of demographic features representing a class of users. This representation of demographic information in a user profile can vary greatly. It is, however, notable that this demographic technique makes nearest-neighbor or other classification and clustering tools.

4. CONCEPT AND DESIGN APPROACH

The automated personalized POI selection and clustering approach presented in the following section can recommend tourists POIs with personal interest score in the appropriate trip area, which is represented by a selected personalized POI cluster (trip area) as illustrated in Fig.1. The approach consists of two significant databases in which the first is Point of Interest (POI) and the second is user profile.

In part of POI database, since one considers POI database that contains POIs, every POI have to be characterized by its corresponding GPS coordinates, type and
category. Point of interest can be explained by the definition of a place that tourist prefers and/or interests or not to visit in each trip destination which may be tourist attraction, sightseeing, shopping mall. All these depend on individual of personalized tourist. However, each of POI that belongs to exactly one GPS coordinates and one type (e.g., temple, museum, churches, market, etc.). Nevertheless, a POI can be identified more than one category (e.g., archaeology, religious, nature, local place, floating market, etc.), for examples, in Thailand, Temple of the Emerald Buddha (WatPhra Si Rattana-Satsadaram) in which the GPS coordinates is N13 45.069 E100 29.555, type is meant to temple, and categories are archaeology and religious. Another example is DamnoenSaduak Floating Market where N13 31.190 E99 57.602 presents GPS coordinates, type is market, and categories are both floating market and local place. However, system administrator can mark at most three POIs as “not to be missed”. Additionally, if these POIs are of selected trip area so that POIs should already be included in the initial trip. Thus, all POI data is provided and also kept up-to-date by the system administrator.

**Figure 1** Automated Personalized POI Selection and Clustering Approach
For another part which is the user profile database that summarizing each tourist’s interests and preferences will be collected in correspondence with a user model. This consists of at least three main data: (i) demographic (e.g., age, gender, income, education, address, etc.), (ii) interests and preferences in terms of rating (score) of type and category that is to be used to suggest POI by consideration of type’s rating and category’s rating of each tourist with high score, and finally, (iii) tourist’s experience including high preference evaluated score for each visited POI. Nothing that all data can be obtained from (i) a small questionnaire and (ii) tourist’s experience in which the previous one have to be used in the first interaction with at least once time and it may be improved by the tourist or the last one (automated transforming and updating).

The remaining part is the details of automated personalized POI selection and clustering that have two main functions, which are POI selection using hybrid recommendation technique and trip area selection using clustering technique. Finally the expected outcomes are selected personalized POI and trip area (cluster). Its more detailed functions can be described in Fig.2 separately.

Since personal data and together with trip destination have completely been provided by tourist, further process which is the automated personalized POI selection and clustering will start with hybrid recommendation technique to finding POIs selection including their corresponded scores. These are satisfied with tourist’s preference and interest. It is remarkable that the content-based, collaborative filtering and demographic techniques are all combined to be the hybrid technique.

In content-based technique, it will search and identify POIs which have a similar class of type and category with containing high scores. After that these results will be prepared in the next process for POIs selection using hybrid recommendation technique.

For the collaborative filtering technique, it provides searching from other tourists that have the similarity of interests and preferences with respect to the current tourist. This is based upon consideration of other tourists which have been selected POIs previously and also given the scores in the same trip destination. If the search of that tourist(s) who has/have similarity with current tourist and then, those selected POIs in this trip destination will be prepared for the next POIs selection in hybrid recommendation technique.

The last recommendation technique called demographic, similar demographic that have the similarity of interests and preferences with respect to the current tourist will be searched on considering those tourists who have been selected POIs with supposing the scores in the past. In this trip destination, those selected POIs will be used for selecting POIs in hybrid technique.

Finally, POIs that obtained from the above techniques will be classified to the current tourist’s preferences and interests. This is Step 1 shown in Fig.2. Subsequently, selected POIs will be assigned by personalized score as mentioned in the personal data, which is found in Step 2.

Clustering technique will be made by Steps 3 and 4 as demonstrated in Fig. 2. Based on distance consideration in trip constraints given by current tourist, clusters can be obtained in Step 3. Summation of score in each cluster (Step 4), the highest score value is selected to be the appropriate trip area in trip destination.
Figure 2 Representative Detailed Structure
5. CONCLUSION AND FUTURE WORKS

The proposed design is a hybrid recommendation technique applicable to the aforementioned problems of tourism or travelling according to the tourists’ personal preferences and interest. The proposed automated selection of POIs system can provide the appropriate trip area to tourists who may lack of POI information details or who have never visited or travelled to those places before.

This proposed technique confirms our belief that time for searching POIs that satisfies tourists can be performed rapidly. The system can efficiently overcome with tourists’ highest personal requirements and interests. Significantly, the mentioned technique has not been found in literatures in the field of tourism problem. Furthermore, details of mathematical formulation in each algorithm of recommendation techniques will be given and discussed in the future paper. In addition, further application may also be extended simultaneously to design tourist’s trip plan, which is an ongoing work of the author.

REFERENCES


