



Global Journal of Computer Sciences



Volume 05, Issue 1, (2015) 30-35

www.awer-center/gjcs

Personalizing trip recommendations: A framework proposal

Tamer Uçar*, Department of Software Engineering, Bahcesehir University, Istanbul, Turkey.

Adem Karahoca, Department of Software Engineering, Bahcesehir University, Istanbul, Turkey.

Suggested Citation:

Uçar, T. & Karahoca, A. (2015). Personalizing trip recommendations: A framework proposal. *Global Journal of Computer Sciences*. 5(1), 30-35.

Received 23 December, 2014; revised 13 February, 2015; accepted 26 March, 2015.

Selection and peer review under responsibility of. Prof. Dr. Doğan İbrahim, Near East University, Cyprus.

© 2015 SPROC LTD. Academic World Education & Research Center. All rights reserved.

Abstract

Personalized trip planning is a very common problem in tourism domain. There are several studies in this area each one of all aims to provide recommendations based on user preferences. Recommendation engines mostly use two common methods: content based filtering and collaborative filtering. As a combination of these two methods, hybrid approaches are also popular for recommendation systems. This study provides a deep analysis about recent studies in trip recommendation domain. Applied techniques and mentioned methodologies in literature is discussed at all points. Insights about the proposed systems are provided clearly. Besides a literature survey, this study also proposes a novel travel recommender method based on a tourism datasource. A hybrid approach involving demographic, content-based and collaborative filtering techniques are proposed in order to eliminate drawbacks of each approach. Recommendations will be based on many factors including users' demographic information, past travel locations and favorite seasons. Based on such inputs, recommender engine predicts possible travel locations along with various flight options. Possible challenges and future trends are concluded as a result of this study.

Keywords: Recommender systems, trip recommendation, personalized recommendation, information filtering.

*ADDRESS FOR CORRESPONDENCE: **Tamer Uçar**, Department of Software Engineering, Bahcesehir University, Istanbul 34353, Turkey. *E-mail address:* tamer.ucar@eng.bahcesehir.edu.tr / Tel.: +90-212-381-0575

1. Introduction

Internet usage influences several sectors in today's life. Searching online for aspecific information is a very common task for many people. But those searches can be sometimes very confusing. Retrieving the best result among a list of search results might be troublesome. Recommender systems are gaining popularity for filtering and providing relevant information about a person's search on a specific topic. A recommender system (RS) tries to predict a rating value of an item for a target user. To preform that prediction, such systems use their member profiles and member behaviors on the system [1].

Recommender systems are widely used on information search related areas. Tourism domain is one of these fields. Recommender systems in tourism domain are mostly used for proposing travel destinations, trip and activity recommendations and hotel suggestions in a destination within a given set of user defined constraints. Those constraints can be related with time or budget or a similar valuable resource. To generate suggestions correctly, there are many methods implemented by different researchers. But generally most of those systems require a set of parameters which are used to define user requirements and constraints. After obtaining these parameters, system connects relevant items in its inventory with target user [2].

In this study, most popular and recent methods are considered for implementing a recommender system on tourism domain. Also a framework is proposed for a tourism recommender system to make predictions for trips.

This paper is organized into four sections. Section 2 briefly describes and categorizes recommender systems. Recent studies are mentioned in Section 3 and Section 4 includes a proposal about a new recommender system architecture for a tourism domain.

2. Recommender Systems

A recommender system can be defined as an information filtering system which is built for predicting a possible connection between a user and an item or a service [3]. Recommendations can be directly requested by a user or can be generated automatically. Recommendations may be used in several e-commerce web sites. A famous example of this type of recommendation is performed by applying an item basket analysis task (people who bought this product also bought that).

Recommendation systems can be classified into four main categories: collaborative filtering, content-based filtering, demographic filtering and hybrid filtering.

2.1. Collaborative Filtering

This method is also called as social filtering. Recommendation system treats users as neighbors and generates suggestions by correlating a user to other users with similar interests and preferences. As a result of this process, users having similar interests and preferences are connected to each other. In order to generate concrete recommendations, items or services must be rated by many users [4].

2.2. Content-Based Filtering

This method requires a user profile involving target user's past searches, ratings or preferences about items or services. Similar items matching with target user's profile will be suggested as recommendation. A detailed user profile is a very valuable asset in content-based filtering [5].

2.3. Demographic Filtering

In this approach, recommendations are based on users' demographic profiles. Demographic profiles are generated by analyzing item view counts versus each user's demographic information such as country, age, gender, etc. This type of filtering is mostly used in marketing applications [5].

2.4. Hybrid Filtering

Hybrid filters can contain combinations of the previously mentioned techniques. Such an approach is useful for eliminating drawbacks of each method. For example, collaborative filtering requires other member's ratings on items. For a newly established system, such information won't be available. Including a content-based filter will analyze user preferences and therefore such an approach will avoid generating immature suggestions in the early phases of the system [6].

In the following section, recent recommender system studies on tourism domain are highlighted.

3. Recent Studies on Tourism Domain

There are many recommender system implementations available on tourism domain. This section briefly describes the latest researches on tourism area.

In 2008, authors developed a recommendation system which generates a user profile by considering users which are having similar interests on items. Recommendations were generated based on this user profile [7].

In other study, researchers developed a system which generates personalized recommendations of touristic attractions. A tourism ontology was used along with a Bayesian network for generating predictions [8].

An expert travel agent was developed with hybrid approach containing both content-based and collaborative filtering methods that were used in the implementation of the proposed system [9].

In another research, a hotel recommender system was developed. A hotel ontology was constructed and fuzzy logic was used to generate recommendations that were rated by actual users to provide feedback to improve the rule base of the system [10].

Another recommender engine study covers generating trip recommendations for tourist groups. In this study, both demographic and content-based filtering methods were implemented [11].

In 2012, Engel–Blackwell–Miniard model and Bayesian network was used to implement a decision support system. Proposed recommendations were displayed on Google Maps to provide more detailed information for tourists [12].

In the implementation of the hybrid recommendation system for a tourism, both content-based and collaborative filtering methods were executed [13].

Location based collaborative filtering method was applied on mobile platform to provide on-tour attraction recommendations for tourists [14].

Also another research group aimed to construct a personalized recommendation system which generates trip plans by considering time constraints of people having similar interests [15].

In Table 1, the flow of the trip planning researches are classified.

Table 1. List of recent studies about trip recommender systems

Year	Title	Authors	Methods
2008	SAMAP: An user-oriented adaptive system for planning tourist visits	Castillo et al.	Multi-agent model with Ontology
2009	A Bayesian network and analytic hierarchy process based personalized recommendations for tourist attractions over the Internet	Yuxia Huang, Ling Bian	Bayesian network, analytic hierarchy process, Attraction Ontology
2009	Building an expert travel agent as a software agent	Silvia Schiaffino, Analia Amandi	Collaborative filtering with content-based recommendations
2011	On the design of individual and group recommender systems for tourism	Garcia et al.	Demographic and content-based filtering
2011	Sem-Fit: A semantic based expert system to provide recommendations in the tourism domain	Crespo et al.	Fuzzy Engine, Hotel Ontology
2012	Design and implementation of an intelligent recommendation system for tourist attractions: The integration of EBM model, Bayesian network and Google Maps	Fang-Ming et al.	Engel-Blackwell-Miniard (EBM) model with Bayesian network
2013	A hybrid recommendation approach for a tourism system	Lucas et al.	Collaborative filtering with content-based approach
2013	iTravel: A recommender system in mobile peer-to-peer environment	Wan-Shiou Yang, San-Yih Hwang	Location based collaborative filtering
2013	User-adapted travel planning system for personalized Schedule recommendation	Hsiu-Sen Chiang, Tien-Chi Huang	Content-based filtering

The following section contains a new recommender engine architecture which is designed by analyzing the mentioned recent studies.

4. A new recommender engine architecture for a tourism domain

A recommender engine can be built by using various filtering methods. As it has already mentioned, each method contains advantages and disadvantages. Possible disadvantages of filtering methods can be avoided by combining them to form a hybrid solution.

If we analyze previous recommender engine studies on tourism domain, most of the researchers are focused on generating personalized recommendations by collecting user needs, requirements and time constraints. To suggest better recommendations, payment (budget) constraints and users' travel habits (including trip frequencies and destinations based on seasonality) should be also taken into consideration. To extract such valuable information, a trip recommender system can built as an extension of an existing travel portal.

Suggesting items based on user rating is a very straightforward approach. This approach can be enhanced by using a travel portal's database which contains users' previous travel data, interests, and habits. As illustrated in Figure 1, a data source containing travel destinations, hotels, flights and past user activities about these items can be used to apply data mining algorithms for generating more personalized rules. The following modules are required for implementing a recommender engine for tourism domain as illustrated in Figure 1.

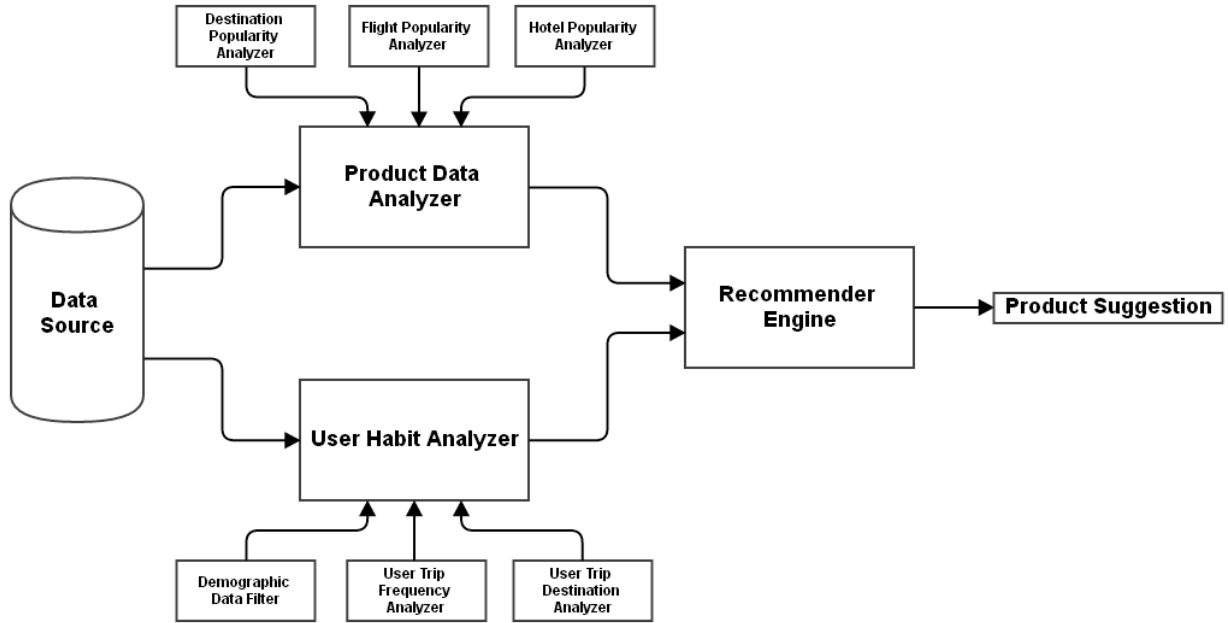


Figure 1. System architecture for Tourism product recommendation framework

4.1. User Habit Analyzer

This module aims to create a user profile based on users' demographic data, previous travel frequencies, travel destinations and seasons. User income is also an important attribute for this module.

4.2. Product Data Analyzer

This module performs a popularity analysis of travel destinations, hotels, and flights based on seasons. The popularity of these items are analyzed with respect to the user profiles generated from User Habit Analyzer module.

4.3. Recommender Engine

Outputs which are obtained from user habit and data analyzer modules will be processed in this module. Target user will be associated with a travel destination. After picking the destination, hotel and flight options will be proposed as an output of the recommender engine.

5. Conclusion

Recommender systems are currently being used in many areas including tourism domain. There are numerous researches made for proposing personalized trip recommendations based on user preferences. In this study, we proposed a trip recommender system which can be built on top of an existing travel portal. Data containing target user's past travel destinations, hotel and flight choices can be used to generate more personalized suggestions. Thus, the overall recommendation performance will be improved dramatically.

As a future study, the proposed recommender system can be also converted to a smart campaign planner. After obtaining user needs and analyzing inventory items (such as travel

destinations, hotels and flights), a campaign can be built and proposed to users having similar interests to visit a destination in a specific season.

References

- [1] Adomavicius, G., Sankaranarayanan, R., Sen, S., & Tuzhilin, A. (2005). Incorporating contextual information in recommender systems using a multidimensional approach. *ACM Transactions on Information Systems (TOIS)*, 23(1), 103-145.
- [2] Ricci, F. (2002). Travel Recommender Systems, *IEEE Intelligent Systems*, 55-57.
- [3] Basu, C., Hirsh, H., & Cohen, W. (1998, July). Recommendation as classification: Using social and content-based information in recommendation. In *AAAI/IAAI* (pp. 714-720).
- [4] Breese, J. S., Heckerman, D., & Kadie, C. (1998, July). Empirical analysis of predictive algorithms for collaborative filtering. In *Proceedings of the Fourteenth conference on Uncertainty in artificial intelligence* (pp. 43-52). Morgan Kaufmann Publishers Inc..
- [5] Pazzani, M. J. (1999). A Framework for Collaborative, Content-Based and Demographic Filtering, *Artificial Intelligence Review*, 13(5-6), 393-408.
- [6] Tran, T., & Cohen, R. (2000). *Hybrid Recommender Systems for Electronic Commerce*, AAAI Technical Report WS-00-04.
- [7] Castillo, L., Armengol, E., Onaindía, E., Sebastiá, L., González-Boticario, J., Rodríguez, A., ... & Borrajo, D. (2008). SAMAP: An user-oriented adaptive system for planning tourist visits. *Expert Systems with Applications*, 34(2), 1318-1332.
- [8] Huang, Y., & Bian, L. (2009). A Bayesian network and analytic hierarchy process based personalized recommendations for tourist attractions over the Internet. *Expert Systems with Applications*, 36(1), 933-943.
- [9] Schiaffino, S., & Amandi, A. (2009). Building an expert travel agent as a software agent. *Expert Systems with Applications*, 36(2), 1291-1299.
- [10] García-Crespo, Á., López-Cuadrado, J. L., Colomo-Palacios, R., González-Carrasco, I., & Ruiz-Mezcua, B. (2011). Sem-Fit: A semantic based expert system to provide recommendations in the tourism domain. *Expert systems with applications*, 38(10), 13310-13319.
- [11] Garcia, I., Sebastia, L., & Onaindia, E. (2011). On the design of individual and group recommender systems for tourism. *Expert systems with applications*, 38(6), 7683-7692.
- [12] Hsu, F. M., Lin, Y. T., & Ho, T. K. (2012). Design and implementation of an intelligent recommendation system for tourist attractions: The integration of EBM model, Bayesian network and Google Maps. *Expert Systems with Applications*, 39(3), 3257-3264.
- [13] Lucas, J. P., Luz, N., Moreno, M. N., Anacleto, R., Figueiredo, A. A., & Martins, C. (2013). A hybrid recommendation approach for a tourism system. *Expert Systems with Applications*, 40(9), 3532-3550.
- [14] Yang, W. S., & Hwang, S. Y. (2013). iTravel: A recommender system in mobile peer-to-peer environment. *Journal of Systems and Software*, 86(1), 12-20.
- [15] Chiang, H. S., & Huang, T. C. (2015). User-adapted travel planning system for personalized schedule recommendation. *Information Fusion*, 21, 3-17.