Combining User Contexts and User Opinions for Restaurant Recommendation in Mobile Environment

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ABSTRACT

In a mobile setting, user preferences vary in different contexts. Advances in mobile technologies have made the collection of user context information feasible, and as a result, the context-aware mobile recommender system field has been formed. Although there exist several different approaches to incorporating context into the recommendation process, context-aware recommendations are still difficult to compute. It is unclear which contextual factors are important and to which degree they influence user-item selection decisions. In this paper, the authors design a novel mobile restaurant recommender system combining user contexts and user opinions to provide restaurants to mobile users. This system extracts restaurant features from online user reviews and calculates the polarity of them based on sentiment analysis. It takes a new approach for assessing and modeling the relationship between contextual factors and restaurant features. On this basis, a hybrid recommender method is constructed, which integrates the contextual matching algorithm based on analytic hierarchy process and the collaborative filtering algorithm based on context similarity. From the user study, this system suggests restaurants that make the user more satisfied than another comparative system.

KEYWORDS

Context-Aware, Mobile Applications, Opinion Mining, Recommendation Systems, Restaurant Recommendation

INTRODUCTION

Mobile devices are undergoing great advances in recent years allowing users to access an increasing number of services or personalized applications that can help them select the ideal restaurant. But, users are often confused about where to eat when reaching new and unfamiliar places because there could be a large number of selections for consideration in the mobile internet. Moreover, user interaction is harder because of small screens and restricted user input capabilities on mobile devices (Bader et al, 2011). Mobile recommender systems thus have been recognized as valuable tools for supporting information searching and decision making in this context (Yang & Hwang, 2013).

Much research has been conducted to recommend specific content based on user preferences (Kim et al, 2004; Choi et al, 2007). However, in a mobile setting, user preferences vary in different contexts (Liu, 2013; Liu, 2014; Liu, 2015). For example, the tourism destinations a user prefers in summer and winter could be completely different; the restaurants a user chooses to eat with colleagues and the lover might also be different. So, it is important to incorporate the contextual information into the recommendation process in order to recommend items to mobile users in certain circumstances.
Advances in mobile technologies have made the collection of customers’ context information feasible, and as a result, the context-aware mobile recommender system field has been formed. Although there exist several different approaches to incorporating context into the recommendation process, context-aware recommendations are still difficult to compute. It is unclear which contextual factors are important and to which degree they influence user-item selection decisions (Baltrunas et al, 2012). In this paper, we design a novel mobile restaurant recommender system combining user contexts and user opinions to solve this problem. This system extracts restaurant features from online user reviews and calculates the polarity of them based on sentiment analysis. It takes a new approach for assessing and modeling the relationship between contextual factors and restaurant features. On this basis, a hybrid recommender method is constructed, which integrates the context matching algorithm based on analytic hierarchy process and the collaborative filtering algorithm based on context similarity. From the user study, participants revealed that, by using the system, they can receive useful information catering to their contexts, which help them make rational decision. Moreover, this system suggests restaurants that make the user more satisfied than another comparative system.

The rest of the paper is organized as follows. Section 2 reviews research works related to recommender systems. The proposed mobile restaurant recommender system architecture is presented in Section 3. Section 4 presents the evaluation method aimed at assessing the performance of the recommender system. We conclude in Section 5.

LITERATURE REVIEW

Context-aware recommender systems have been recently explored in some fields, such as music (Reddy & Mascia, 2006; Hariri et al, 2012), tourism (Cena et al, 2006; Baltrunas et al, 2011; Levi et al, 2012; Yang et al, 2013; Tseng et al, 2013), mobile guides (Carmagnola et al, 2008), movies (Said et al, 2011), micro-blogging services and location-based social networks (Ma et al, 2011; Yuan et al, 2015), and advertising (Dao et al, 2012). In the study of context-aware recommender systems, obtaining context information and paradigms for incorporating context into recommender systems are the two key points (Adomavicius & Tuzhilin, 2011).

The contextual information can be obtained in a number of ways, including: explicitly, implicitly and inferring (Adomavicius & Tuzhilin, 2011). Explicitly obtaining assumes that contextual information is obtained by directly approaching relevant people and other sources of contextual information and this information is gathered either by asking direct questions or eliciting this information through other means. Explicitly obtaining assumes contextual information is obtained implicitly from the data or the environment, such as a change in location of the user detected by a mobile telephone company. Inferring assumes contextual information is obtained by using statistical or data mining methods to infer. Context may include almost everything, so it is very difficult to obtain all context information. In different applications, different types of contextual information have different degree of influence on user preferences and recommendation tasks. Therefore, it is necessary to identify and obtain the effective contexts which do have influence on the recommendation tasks before the recommendation generated.

With rapid development of the mobile Internet, more and more information recommender services are needed in the complicated and changeable situation, so it is necessary to incorporate context information into the recommendation process to improve the accuracy of recommendation and user satisfaction. Choi et al (2007), according to the characteristic of short message service under the mobile Internet environment, exploited mobile users log file and users’ feedback information to obtain users’ interest preference under specific contexts, and built context-aware mobile recommender system MCORE. Kim et al (2008), on the basis of building user context model, put forward the collaborative filtering method based on hidden markov model in ubiquitous environment. Kuo et al (2009) combined LBS (Location Based Services) with recommendation technology, and put forward the location-based recommender model LBSRM. Hong et al (2009) proposed a system framework