Assessing users' product-specific knowledge for personalization in electronic commerce

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Abstract

While many electronic commerce (EC) companies are adopting one-to-one marketing approaches using various personalization technologies to make their products and services unique for the purpose of attracting and retaining customers and improving their completion edges in the EC ecosystem, which, nevertheless, has low entrance barriers for new players to join and further intensify the competition, none or few of them consider a fundamental issue—the user's product-specific knowledge. Our research proposed to add this new domain of the customer's knowledge on appropriate target products into the personalization process as a part of the overall EC strategy for businesses. In this paper, we present our initial design for assessing the user's product-specific knowledge using the proposed innovative method for detecting it directly in a non-intrusive way without asking users to answer or fill out any types of questionnaires. Our method is based on customer's on-line navigation behaviors by analyzing their navigation patterns through pre-trained artificial neural networks. An empirical study designed for a case of EC store selling digital cameras was conducted in our research to prove the concept, and a good preliminary result was derived from the study.

For the purpose of comparing the performances between the conventional approach of using questionnaire and the proposed innovative approach of navigation pattern mining, a questionnaire based approach for evaluating the user's product-specific knowledge was designed and incorporated into our knowledge level assessment system (KLAS). Our study result shows that although the pure questionnaire-based KLAS is intrusive and may not be accepted by some users, for those users willing to complete the questionnaire, the proposed navigation pattern approach can be combined with the questionnaire-based approach to create a hybrid KLAS which has a significantly improved accuracy rate in detecting the customer's product knowledge level.
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1. Introduction

In recent years, people's life and living styles have been deeply influenced by Internet, which enables electronic commerce (EC) for companies and their business partners to conduct business and perform electronic transactions (Lin & Lu, 2000; Liu & Arnett, 2000). In addition to the purchase of products and services over the Internet, EC also encompasses all electronically conducted business activities, operations, and transaction processing within and cross companies. Through EC, companies can alleviate constraints (upon time, space, and cost) to enhance the way they connect to and interact with their EC counterparties by serving customers and collaborating with business partners electronically and intelligently. To catch the revolutionary opportunity and benefit of EC, an explosive number of companies are competing in the EC ecosystem, which, nevertheless, has low entrance barriers for new players to join and further intensify the competition. Thus, for the purpose of attracting and retaining customers and then improving their completion edges, some EC companies take advantage of differentiation and personalization technologies to make their products and services unique and to tailor their products and services for specific user preferences. For example, through personalization, businesses can research on customer's behaviors for developing appropriate marketing strategies, and then delivering suitable products and services to the targeted customers accordingly. Wind and Rangaswamy (2001) found that the opportunity and capability to offer

consumers a flexible and personalized relationship is probably one of the most important advantages among all possible benefits offered by EC to businesses. It is shown that personalization can ultimately enhance customer's satisfaction level and loyalty, and the increase in each customer's visiting frequency can further create more transaction opportunities and benefit the Internet businesses (Lee, Liu, & Lu, 2002).

From the consumers' point of view, the Internet has become a major channel to the worldwide sources of information. While the Internet traffic has been increasing rapidly since 1997, at the range between 70 and 150% annually (Odlyzko, 2003), it is estimated that the amount of information available from Internet doubled every 18 months, and the number of home pages is even increasing in a faster rate (Yang, Yen, & Chen, 2000). This fact is causing users a serious problem of information overload when they try to retrieve information from the dynamically and continuously growing web resources. Therefore, the need from web users in identifying and using more intelligent systems or tools for conducting information gathering and information filtering from the huge size of web related sources is on the rise (Li & Zhong, 2004). In regard to products and services, different people have different and/or various needs, interests, and preferences; nevertheless, the taste and inclination of a person on products and services may also change or evolve with time. Thus, the 'one-to-one marketing' strategy was proposed to provide personalized service in the EC environment (Allen, Kania, & Yaeckel, 1998; Weng & Liu, 2004). 'If we have two million customers, then we should have two million shops on our website', said by Jeff Bezos, CEO of Amazon, may serve as an example to show the importance and the value of the personalization strategy in EC environment. Personalization technology can give users a better, in terms of efficiency and effectiveness, EC experience since they do not have to browse through all the irrelevant noise.

In general, there are two major approaches to provide personalized information: content-based and collaborative filtering (Aggarwal, Wolf, Wu, & Yu, 1999; Yu, 1999). In the content-based approach, it matches the content of candidate items against the user profile, which is constructed by analyzing the content of items that the user has favored in the past or user's personal information and preferences. Some recommendation systems, which are used by EC companies to suggest products and provide information to customers, operate based on this approach, such as NewsWeeder (Lang, 1995) and Infofinder (Krulwich & Burkey, 1996). In the collaborative filtering approach, it identifies other users that have showed similar preference to the given users and provides what they would like. Several recommendation systems are developed based on this approach, such as Tapestry (Goldberg, Nichols, Oki, & Terry, 1992), GroupLens (Konstan, Miller, Maltz, Herlocker, Gordon, & Riedl, 1997), Ringo (Shardanand & Maes, 1995), PHOAKS (Terveen, Hill, Armento, McDonald, & Creter, 1997), and Siteseer (Rucker & Polenco, 1997). While the content-based personalization suffers limitations in dealing with non-text multimedia resources (such as movies, music, etc.) and in making classified recommendations other than the localized domain specified by a user's profile/preference, the collaborative filtering approach is unable to provide new items to a user and unsuited to a user with changing or evolving preferences. Various renovated or hybrid approaches were proposed to cope with the shortcomings of content-based personalization and collaborative filtering, and to increase the accuracy of recommendation systems, by integrating content-based approach and collaborative filtering approach (Changchien, Lee, & Hsu, 2004; Weng & Liu, 2004), applying data mining techniques (such as association rules mining) to collaborative filtering (Kim, Cho, Kim, Kim, & Suh, 2002; Lee, Kim, & Rhee, 2001; Wang & Shao, 2004; Wang & Thao, 2003), and combining collaborative filtering based on item and collaborative filtering based on user approaches (Li, Lu, & Xuefeng, 2005).

Although all the above-mentioned recommendation systems share the same spirit of assisting in the user's search of items of interest, none of them address a fundamental issue—the user's product-specific knowledge. Our research proposed to add this new domain of customer's knowledge on all potential products into the personalization process as a part of the overall EC strategy for businesses. In this paper we present our initial design for assessing the user's product-specific knowledge. Since a user's product-specific knowledge level on various products varies, we proposed an innovative method for detecting it directly in a non-intrusive way without asking the user to answer or fill out any types of questionnaires. Our method is based on the customer's on-line navigation behaviors by analyzing their navigation patterns through pre-trained artificial neural networks. An empirical study designed for a case of EC store selling digital cameras was conducted in our research to prove the concept, and a good preliminary result was derived from the study. This automatic and non-intrusive approach for evaluating the customer's product-specific knowledge was incorporated into our personalized promotion decision support system (Changchien et al., 2004), which used data mining techniques in accordance with marketing strategies to help the business prepare the highly potential and suitable promotion products for each individual customer.

The subsequent sections of this article are organized as follows. Section 2 describes product knowledge, web usage mining, and back propagation networks. Section 3 proposes a method together with its two variations for evaluating the customer's product-specific knowledge level. Section 4 shows our experiment results, and Section 5 concludes this paper after the discussions.