Green Advocate in E-Commerce

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Abstract. The continuous growth of e-commerce sees waves of information explosion. Online shoppers have to confront with more information than ever when they are making purchasing decisions. Among the tools that try to reduce this burden of information overload, recommender system is one of the widely employed techniques which can be seen in stores such as Amazon.com and iTunes Store. This paper presents an approach of the interaction design of recommender system in the context of green digital products. By cultivating the field of game design, elements that make game fun and engaging are borrowed and applied to the design of the recommender system to motivate shoppers to opt for greener choices. In addition, the idea of Kansei Engineering will be employed in the system to recommend according to the perceived characteristics of products. A framework of such system will be described, along with future extensions of the framework in the realm of e-commerce.

Keywords: e-commerce, recommender system, green digital product, game design, interaction design, Kansei Engineering.

1 Introduction

Online shopping, like its traditional counterpart, is essentially a process of decision making. In traditional bricks-and-mortar stores, shoppers also go through a similar process to make a purchasing decision, but the scale and magnitude of information involved are very different from those of online stores. Thanks to the advance in Information Technology, online shoppers can browse through a plethora of product or use some shopping tools provided by the online stores to filter out less wanted items. Some common shopping tools are product comparison tools, recommender system, rating and review systems, and so on. These tools are extremely useful for online shopping since the process involves an overwhelming amount of information, or

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information overload. This research focuses on recommender systems among these shopping tools.

Conventional recommender systems usually base their recommendation mechanism upon profit revenue or customer preference. Such systems recommend items so that the potential profit for the store can be higher, or that the customer is more likely to prefer if the customer actually buy items in the recommendation list. However, such profit or preference seeking systems may not be adequate when there is an agenda that the store wants to advocate, or when the preference of a customer is not easy to determine. Consider green consumer electronics. More and more companies are promoting their brand images or products by adopting green practices or green design. They utilize the trend of environmental awareness and set their green marketing strategies, but such trend is not reflected in the design of recommender systems. Moreover, greenness of a product may drive the price higher or lower. Customers need to be informed and encouraged to buy green products. Recommender system can take on the role of an advocator in this respect.

As to the determination of the preference of a customer toward a product, some product fits the bill better than the other. Take movies for example. Each movie has a set of characteristics that can be directly related to customers' preferences, such as casts, directors, and movie genre. It is the same with music or books, but not quite so with consumer electronics. Recommender systems for consumer electronics are usually specification-wise, which means they recommend products that are similar to each other in terms of specifications. Such design is useful for consumers who have a clear utility goal in mind, but it is only a specification-wise match between a product and a consumer's functional needs. Although some products are perceived as fashionable and some others as professional, items are still categorized according to their specifications, not their *perceived characteristics*. In addition, for specification-based recommender systems, it is difficult in the regard of recommending across product categories. For example, a fashionable customer has bought a fashionable mobile phone and now he or she wants to buy a headset that is as stylish as the phone. Since the specification ontology of these two types of product is different, it is not easy to recommend products by specification only. Additional characteristics need to be considered for this purpose.

To extend the field of recommender systems toward the directions mentioned above, this research proposes a framework that integrates an advocate module and a Kansei ("feeling" in Japanese) module in addition to a conventional recommender module, and the framework will be illustrated in the context of green consumer electronics. The task of the advocate module is to recommend greener products by a mechanism based upon a theory borrowed from game design called Flow Theory. This module tries to advocate green consumerism by advancing consumers' green appetite in a progressive way. The task of the Kansei module is to recommend products according to the perceived characteristics of the products whose perceived characteristics are defined as a set of Kansei words. A Kansei scoring system will also be developed to encourage consumers to contribute Kansei words, much like the concept of Web 2.0. A fuzzy inference system is used to synthesize the inputs from these three modules.

2 Literature

2.1 Game Design

Games have a lot to offer when it comes to making systems fun and captivating. Applying game-like interface or game-like mechanism is quite promising in the design of ordinary systems, such as process management tools and educational programs.

A theory which game design bases heavily upon is the Flow Theory by Csíkszentmihályi [1]. Csíkszentmihályi studied extensively to find out what makes enjoyable experience, or flow experience, which is an experience "*so gratifying that people are willing to do it for its own sake, with little concern for what they will get out of it, even when it is difficult or dangerous*". An important condition for the flow experience is the match between the challenge of a task and the skill of a user.

2.2 Kansei Engineering

Kansei Engineering (KE) is a methodology established by Nagamachi in 1970 to identify the relationship between consumers' feeling and design elements [2]. It has been successfully applied to areas such as automotive industry, construction machinery industry, office and home appliance, house construction, fashion industry, and so on. There are three types of procedure to apply KE [3]: Type I is category classification, Type II is computer-assisted system, and Type III is mathematical modeling. The Kansei module used in this research is closely related to that of Type II KE.

3 The Proposed Framework

3.1 General Structure and the Framework

There are four major modules in the proposed framework: Recommender module, Advocate module, Kansei module, and Fuzzy Inference System. Recommender module is responsible for recommending products based upon product information and derived consumers' needs, which works like most conventional recommender systems. Advocate module is responsible for deciding a suitable level of product greenness for a consumer. Kansei module is responsible for the determination of the match of users' Kansei requirements and the perceived characteristics of products. Finally, Fuzzy Inference System is responsible for fusing together the outputs of the three modules and other user-defined criteria. The general structure of these modules is shown in Fig. 1, where the inputs (user model and product model) and outputs (recommended items) are also included.

3.2 Determination of Product Greenness

Different eco-labels have different meaning. Some refers to the raw material while some refers to the energy efficiency. To determine the overall greenness of a product, the framework uses Analytical Hierarchical Process [4], or AHP, to integrate experts'

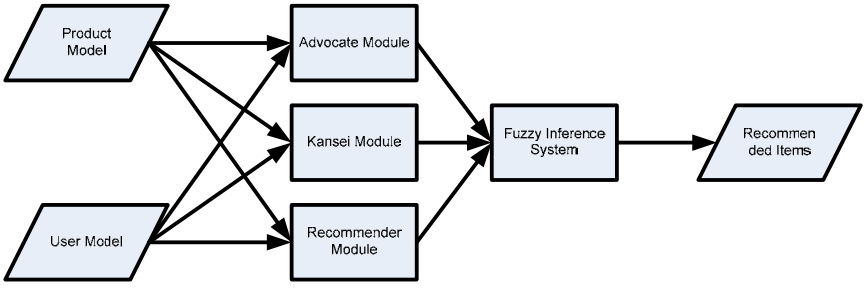

Fig. 1. General structure of the proposed framework

opinions on how important an eco-label is to the greenness of a product. The hierarchy can be one or two levels.

Once the weight of each eco-label is determined, the approximation of product greenness can be calculated. Let PE_i be the row matrix of eco-label status of product *i*. The *j*-th item in the row matrix is either 1 or 0 indicating whether product *i* has eco-label *j* or not. Let *EW* be the column matrix of eco-label weights obtained from the AHP mentioned above. Then, the overall greenness of product *i*, or PG_i, is $PE_i \times EW$.

3.3 Determination of Consumer Green Consciousness

In the proposed framework, the green consciousness of a consumer is defined as the relative weight of product greenness among other subjective criteria. For example, in some products, greenness may drive the price higher or lower. It may also impede or facilitate some product features, such as slow computing speed for energy efficiency. AHP is also used in the elicitation of the weights, and to simplify the process, only one level is used. The weights of these factors are then stored in User Profiles and will be used in the Fuzzy Inference System.

3.4 Product Kansei Tagging

To encourage users' involvement in the product Kansei tagging effort, a user reputation system is developed which works like a product rating system. In a product rating system, a user can rate and comment on the product, while other users can rate his or her ratings and comments. If the ratings or comments are well-received by other users, the user who gives ratings or comments can build up his or her reputation in the website. The process of Kansei-tagging is very similar to that of rating a product. Once a user becomes involved in a Kansei tagging session, he or she can tag a product with a set of Kansei words that describe the perceived characteristics of the product in question. Then, another set of Kansei words of the product is randomly retrieved from the Product Kansei Tags database. If there is no previous data for this product, an initial set of Kansei words is used instead. This initial set can be supplied by the retailer or by the brand owner of the product. The matching score between these retrieved and current sets are calculated and stored in User Profiles along with the set of Kansei word. This step updates the part of the User Model that indicating what

Kansei words are more likely to be associated with a user. To update the set of Kansei words of the Product Model, words which are frequently used as tags and highly matched are appended to the set of Kansei words of the product in question. Less frequent and lowly matched tags can be removed.

The process of calculating the matching score of the retrieved and current sessions can be described as a "gaming with a purpose" (GWAP) scenario. GWAP is a class of games "*in which people, as a side effect of playing, perform tasks computers are unable to perform*" [5] . In our case, tagging a product with Kansei words that describe the perceived characteristics of a product is not easy for a computer to perform. To engage users in the tagging, the framework pairs the current user with a previous to create the sense of competition or social interaction, which is an output-agreement game according to Ahn & Dabbish [5].

3.5 Advocatory Recommender

The core part of the framework is the advocatory recommender, which consists of a green advocate module, a Kansei ranking module, a recommender module, and a fuzzy inference system. The advocatory recommender is activated explicitly or implicitly. By explicit activation of the advocatory recommender, a user actively seeks for advices on what he or she can buy. The user can choose to enter some Kansei words as the criteria of the perceived characteristics of product. Adjustments of the weights of the criteria can made at this moment, as well as the addition of extra criteria, such as brand or year of make. Those are user inputs. Then, the green advocate module is invoked to determine an appropriate range of greenness of products according to the user's green consciousness. Finally, the fuzzy inference system is used to synthesize the outputs of the modules mentioned above according to the weights of user criteria.

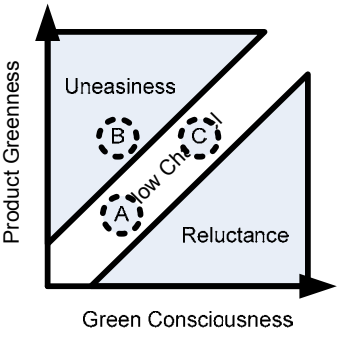

Fig. 2. The flow channel of the green advocate module

The green advocate module adopts the concept of Flow Theory and provides a progressive challenge that encourages users to opt for greener choices over time. Consider the three dotted circles in Fig. 2. In the normal mode, this module recommends products whose greenness matches the green consciousness of a user, such as circle A in the figure. After some sessions of purchase, the module tries to recommend products whose greenness is a bit over the users' green consciousness, as the

circle B in the figure indicates. If the user finds it acceptable and chooses it, then the module will give the user a "level up", or moving up a notch, in the axis of green consciousness, as the circle C indicates. If the user doesn't choose it, then the module should fall back to circle A.

The advocatory recommender uses a fuzzy inference system to integrate multiple decision variables. The proposed rules for this inference system are summarized in Table 1. In our proposed form, only two decision variables are considered in each rule, and only two levels are considered in each variable. However, it is possible to extend to consider more variables and more levels.

Table 1. The proposed rules of the fuzzy inference system

Decision Variables				
Price	Feature	Greenness	Customers with higher rule weight	Output
High	Rich	N/A	Feature-demanding	Neutral
High	Poor	N/A		Undesirable
Low	Rich	N/A	Price-sensitive and feature-demanding	Favorable
Low	Poor	N/A	Price-sensitive	Neutral
High	N/A	High	Green-conscious	Neutral
High	N/A	Low		Undesirable
Low	N/A	High	Price-sensitive and green-conscious	Favorable
Low	N/A	Low	Price-sensitive	Neutral

4 Conclusions and Future Research

The process of decision making of online shopping is inherently complex in this information age. On the one hand, information can be gathered easier and quicker than ever, promising to solve the problem of information imbalance. On the other, the volume of information is to vast for us to take advantage of, creating another problem of information overload. Several solutions to this dilemma are put forth, and recommender system is among the widely used. A recommender system mimics the interaction of people asking for advices from friends, gurus, or sales person. Some notable examples of recommender systems can be found on Amazon.com, Netflix, or iTunes Store. However, most recommender systems base their recommendation on profit or user preference. What if there is an agenda, such as green marketing, which a store wants to advocate? Given the rising concern of the environmental issues, this paper proposes a framework of recommender system that has a green advocate module that encourage users to opt for greener products in a progressive way. The green advocate

module is based upon a theory called Flow Theory borrowed from the field of game design.

Products such as movies and music albums have a lot of characteristics that can be related to customers' preference. Yet for products like consumer electronics, specifications and functions are usually used in recommender systems. To enrich the recommendation, the concept of Kansei Engineering from the field of Industrial Design is used in the proposed framework. Users are encouraged to tag products with Kansei words that describe the perceived characteristics of products. The tagging process is based upon the concept of gaming with a purpose, and the score of the tagging game can help the user build his or her reputation on the e-commerce website. Recommender system can take advantage of the Kansei tags of products and Kansei requirements of users to generate recommendations by determining the similarity of a product and user's Kansei requirements. The integration of the conventional recommender module, the Kansei module, and the green advocate module is achieved via a fuzzy inference system.

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