Eliciting the Users' Unknown Preferences

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ABSTRACT

Personalized recommendation strongly relies on an accurate model to capture user preferences; eliciting this information is, in general, a hard problem. In the field of tourism this initial profiling becomes even more challenging. It has been shown that particularly in the beginning of the travel decision making process, users themselves are often not conscious of their needs and are not able to express them. In this paper, the basics of a picture-based approach are introduced that aims at revealing implicitly given user preferences. Based on a set of travel related pictures selected by a user, an individual travel profile is deduced. This is accomplished by mapping those pictures onto seven basic factors that reflect different travel behavioral aspects. Also tourism products can be represented by this seven factor model. Thus, this model constitutes the basis of our recommendation algorithm. First tests show that this non-verbal way of interaction is experienced as exiting and inspiring.

Categories and Subject Descriptors

G.3 [**Probability and Statistics**]: Multivariate statistics; H.1.2 [**Models and Principles**]: User/Machine Systems—*Human factors*; H.3.3 [**Information Storage and Retrieval**]: Information Search and Retrieval—*Selection process*

General Terms

Human Factors

Keywords

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1. INTRODUCTION

In recent years, recommender systems have clearly moved into the center of attention. Especially in the context of the Web, they often support users in comparing a hardly comprehensible and understandable quantity of options. In this way, recommender systems form the basis of the success of a number of Websites and services.

A user model that is capable of capturing individual preferences and dislikes is of major importance to personalized recommendation. However, before being able to exploit knowledge about users' preferences, this information has to be provided to the system. Although there are some common strategies to accomplish this step such as asking the user either to rate some example items or to answer a number of questions, this initial profiling remains a challenging task [12].

In the context of tourism the elicitation of user preferences is even more difficult than in other domains. The tourism product itself is more complex and less tangible than books, movies or pieces of news [16]. Traveling is usually costly and time-consuming and so the average number of items rated by a user will be smaller than in domains with lower complexity, e.g., books or movies. However, the setting presented in this paper is even more complex. It has been shown that especially in the early phase of their travel decision making process, tourists might neither be aware of their needs nor be able to state them explicitly [19]. In general, traveling is an emotional experience, where preferences are difficult to characterize explicitly; they might rather be implicitly given. Thus, the preferences are not only unknown to the system but also unknown to the users.

In this paper, the basics of a picture-based approach to elicit user preferences are introduced. By addressing a non-verbal level, this approach aims at revealing travel preferences and needs that a user is not explicitly aware of. This is exclusively accomplished by asking the user to select a set of pictures that she or he considers pleasing when thinking of going on vacation. In a next step, those pictures are mapped onto seven basic factors that represent distinct touristic behavioral patterns. The individual travel profile of the user is then obtained as a mixture of those basic factors. Thus, our user model is "simply" constituted by a seven dimensional vector.

Figure 1: Picture selection – offline (left-hand side) and online (right-hand side).

To get a more comprehensive idea of a user's touristic personality, immediate vacation patterns (captured with the help of so-called tourist roles) as well as long-term behavior (captured with the help of personality traits) are taken into account. Based on all this, a computational model is developed that forms the core of a recommendation algorithm for tourism related products. However, unlike other approaches that are typically focusing on the attributes of these products, our model aims at abstracting from those attributes and reaching at a more comprehensive user-centric representation.

The remainder of the paper is organized as follows: Related work is discussed in Section 2. In Section 3 our approach is described in more detail. A short evaluation regarding user response is presented in Section 4; and, finally, in Section 5 conclusions are provided.

2. RELATED WORK

In [12] recommender systems are characterized as "software tools and techniques providing suggestions for items to be of use to a user". Such "items" are typically books or movies, but also more complex products can be within the scope of recommender systems. In the context of tourism content-based approaches (i.e., items are recommended that have similar attributes as items that the user has liked before) and/or knowledge based approaches (i.e., domain knowledge about a user's preferences with respect to the attributes of the items is deployed for recommendation) are regarded as appropriate techniques to predict whether an item is in fact useful to the user [2]. This is due to the fact that tourism can be seen as a domain with high risk (i.e., the price of the items is comparatively high), low churn (i.e., the value or relevance of items does not change so rapidly), low heterogeneity (i.e., needs that the items can satisfy are not so diverse), unstable preferences (i.e., user preferences in the past might not be valid anymore today) and explicit interaction style (i.e., a user needs to formulate an opinion or perform a search to add personal data). Furthermore, scrutability is required, which means that it should be transparent why a certain item is recommended by the system. Despite all these challenges, an increasing number of tourism-related Websites incorporate recommender systems [14].

A similar objective to the one of our work – providing a more sophisticated support in eliciting user needs and preferences – is followed by critique based recommendation methods (e.g., [11]; see [8] for a comprehensive overview). However, there the focus is on the conversational process, iteratively refining first results. Users do not specify their preferences from the early start, but follow several cycles. However, the system needs either some initial user input, e.g., by answering system's question, or an initial example. With the help of initial examples, e.g., shown as pictures of hotels as in [13], the user may iteratively explore the solution space in a graphical manner. This approach is similar to ours; however, their pictures "describe" products, whereas in our case pictures reflect touristic behavioral patterns.

The work of [10] focusing on the design of preference elicitation interfaces supports our approach. Their results show that a) low cognitive effort (e.g., using pictures) leads to a high user liking; b) affective feedback increases the willingness to spend more effort.

Since the 1970s research aims at relating touristic behavioral patterns to psychological needs and expectations. The work of Gibson and Yiannakis [4] has a high impact in this context. They extend a previously developed framework to measure touristic role preferences [18]. In the end, this framework comprises 17 tourist roles (namely *Action Seeker*, *Active Sport Tourist*, *Anthropologist*, *Archaeologist*, *Drifter*, *Educational Tourist*, *Escapist I and II*, *Explorer*, *High Class Tourist*, *Independent Mass Tourist I and II*, *Jetsetter*, *Organized Mass Tourist*, *Seeker*, *Sun Lover*, *Thrill Seeker*) to capture the range of touristic behavioral patterns. The association between these tourist roles and psychological needs is investigated for both genders over lifetime. Statistical evidence is given that touristic behavioral patterns are related to psychological needs and that they change during time.

In [1] a relation is established between these 17 tourist roles and representative, tourism-related photos, which implies that it is reasonable to assign tourist roles to people based on selected pictures. In [5] it is shown that 12 predefined travel personalities are distinguishable regarding travel style (e.g., variety seeking), travel motivations (e.g., social contacts) and travel values (e.g., active vs. passive).

Also in our approach, the tourist roles of Gibson and Yiannakis are chosen as starting point. However, focusing on

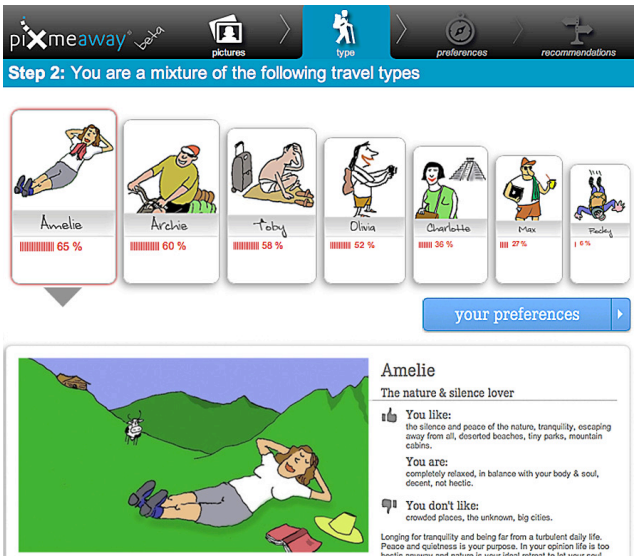

Figure 2: User interface – travel profile feedback.

what people are already doing, their model captures current vacation patterns. Our aim, on the other hand, is more particularly to predict what people might potentially enjoy. For this reason, also personality traits are included into our model. It is widely accepted that they facilitate the prediction of behavioral patterns over time and across situations [17]. Furthermore, statistical methods are deployed to reduce the number of factors of the model. This makes it computational more efficient and thus better applicable on a large scale.

3. FACTORS AND PICTURES

To develop our recommendation algorithm, the following steps were taken:

1. First, a questionnaire was developed taking into account both the 17 tourist types by Gibson and Yiannakis [4] and the "Big Five" personality traits (i.e., *extraversion*, *agreeableness*, *conscientiousness*, *neuroticism* and *openness*) [6]. For both, standard questions were available, which were phrased as statements that had to be rated on a five level scale. Also, it was asked for demographic information such as age and country. The questionnaire was made available online and offline. In total, 997 questionnaires were completed.

2. On this data that comprised 22 variables (i.e., 17 tourist roles plus five personality traits) a factor analysis was conducted that led to a seven factor solution. For those factors, suitable interpretations could be identified. They capture touristic behavioral aspects such as *connected and sun loving*, *educational*, *independent*, *culture loving*, *open minded and sportive*, *risk seeking* and *nature and silence loving*.

3. In a second study, an association between the seven factors and 102 travel related pictures was establish. Those pictures were preselected and evaluated in an interdisciplinary workshop with respect to their relationship to the before mentioned aspects. The pictures were physically arranged on a table in random order (see Figure 1, left-hand side). The participants (in total 105) had to select three to ten pictures that they found most appealing in the context of tourism. Then, they had to rank the selection. This study helped to reduce the number of pictures to 63, and led also to the insight that people tend to select at most seven pictures. Furthermore, the order of the final set was often reconsidered and changed. In the end, also these participants were asked to fill out the questionnaire (see step 1) to validate the association of both factors and pictures.

4. In a next step, 15 experts had to assign up to seven pictures to 10,835 touristic points of interest (POI) all over the world (Experts are frequent travelers who knew the respective POI). They also had to rank them according to their degree of association with the POI. In addition, for each POI and each factor, they had to assign a number from the interval [0, 1] expressing the extent to which in their opinion the POI represented the respective basic factor.

5. Then, the relations between factors and pictures were quantified. A multiple regression model of the form

$$f_j = b_{j0} + \sum_{i=1}^{63} b_{ji} x_i, \tag{1}$$

$j = 1, \ldots, 7$, was fitted for each factor. To calculate the coefficients b_{ji}, the assignments of the experts were used: Each f_j was set to the number assigned in step 4. Then, x_i was calculated as

$$x_i = 7 \cdot \frac{-k + n + 1}{\sum_{i=1}^{n} i} \tag{2}$$

if the i-th picture had been chosen and ranked on the k-th place, and 0 otherwise. The value of x_i does not only depend on rank k but also on the number of selected pictures n. With the x_i the coefficients b_{ji} were estimated using the least squares method.

6. Based on user u's picture choice, Equation 1 is used to calculate f_j^u, $j = 1, \ldots, 7$. Now, to recommend POIs to user u, the Euclidian metric $d : \mathbb{R}^7 \times \mathbb{R}^7 \to \mathbb{R}$

$$d(\mathbf{f^u}, \mathbf{f^p}) = \sqrt{\sum_{j=1}^{7} \left(f_j^u - f_j^p\right)^2}, \tag{3}$$

is applied. Here, $\mathbf{f^u}$ is representing the travel profile of user u and $\mathbf{f^p}$ the POI p. The scores f_j^p, $j = 1, \ldots, 7$ are the results of the assignments of the experts (see step 4).

This approach has been implemented and forms the core of the picture-based search and recommendation engine PixMeAway [9]. In Figure 1, right-hand side the interface for online picture selection is shown. It constitutes the first step of the customer's interaction with the system. The individual travel profile of the user is presented as a feedback with the help of comic characters; it is shown to what extend the preferences of the user align with each of those travel factors (see Figure 2). In a next step (not shown) users can indicate their preferences, such as time or point of departure. Then, the recommendations are displayed.

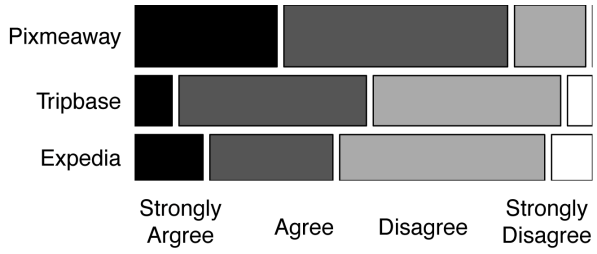

Figure 3: Mosaic plot: "The page is exciting" (based on [7]).

4. USER RESPONSE EVALUATION

In a first user study, aspects of the preference eliciting interface with respect to user liking were investigated [7]. In total, 110 participants were assigned to one of the following Websites in order to explore them: PixMeAway [9], Tripbase, a travel Website providing also recommendations [15], and Expedia, a traveling booking site [3]. After that, their experiences with respect to several emotional categories, such as inspiration, enjoyment, enthusiasm and interest were inquired using an online questionnaire. The main goal of this work was to study the impact of emotional and inspirational aspects of online travel portals on the overall satisfaction of users and their intention to revisit a Website rather than doing a "classical" evaluation measuring precision and recall (since at this stage users have no clear idea what they want).

The findings of this first analysis are promising. For the category excitement, the Kruskal-Wallis test detected significant differences between the distributions of the answers regarding the three Websites ($p < 0.001$). Here, 84 % of the participants agreed or strongly agreed that the experience with PixMeAway was exciting (see Figure 3). There are similar results for the categories inspiration, interest, enjoyment and pride. Furthermore, the study showed a significant correlation between inspiration and the intention to revisit a Website ($p < 0.01$) as well as between inspiration and satisfaction ($p < 0.001$).

5. CONCLUSIONS

In our approach a model space is designed that is based on tourist profiles rather than product properties. Users are mapped to this model by selecting a set of pictures. Also POIs can be integrated into this approach, hence a simple distance metric serves as core of the recommendation procedure. Basic user interactions are conducted in a non-textual manner and are experienced as exciting and inspiring.

Further research will include automated parameter optimization based on user feedback. Another focus will be a flexible administration of the picture set (i.e., exchange of pictures). Also the extension of the approach using other emotional objects such as sound samples is planned. Finally, text mining methods on object descriptions and reviews will be used to position the touristic object automatically in the presented model space.

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