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Design Criteria for Transparent Mobile Event Recommendations

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ABSTRACT

Recommender systems assist the user to overcome the information overflow of today's information society. When a recommendation failed, user's trust in a system decreases due to the fact that most recommender systems act as black boxes. They don't offer any insight into the systems logic and cannot be questioned as it is normal for recommendations between humans. Users don't know how and which personal information is processed. Transparency, which is about explaining to the user why a recommendation is made, allows understanding the nature of a recommendation. Within a mobile environment, it is possible to address the user more individualized but transparency needs a completely different way of visualization and interaction. The paper in hand aims at an analysis of a survey which asked about the kind of style element as well as how much information should be visualized on a mobile device in order to offer transparency.

Keywords

Recommender Systems, Mobile Recommendations, Trust, Individualization, Transparency, HCI.

INTRODUCTION

With the onset of the information society and the emergence of the information flow, the user is confronted with the conflict between getting the information he is looking for and spending the time he is able to, while searching for what he is interested in [1, 2]. "To give customers exactly what they want, you first have to learn what that is. It sounds simple, but it's not" [3]. At this time, recommender systems gain significant importance by helping the user to find what he is actually looking for, as e.g. service providers which are "suggesting ... those products which best suit his needs and preferences in a particular situation and context" [4].

Recommender systems are well known in the academia as well as in practice. GroupLense [5], MovieLense [6], Video Recommender [7], Ringo [8] and Fab [9] are only a few systems that are developed by researchers. Some websites like Amazon.com, CDNow.com, Barnes & Nobel, MovieFinder.com, Pandora.com, TiVo.com, Netflix.com or Launch.com have also made successful use of recommender systems [10,11]. But when it comes to an explanation of a recommendation, most of the recommender systems act as black boxes [12]. They cannot be questioned as it is normal for recommendations between humans [11]. The user doesn't understand the systems logic behind the recommendation. Trust in a system decreases if the recommendation failed without any reasons. Transparency is about explaining to the user why a practically recommendation is made, how the system works [13] and enables the user to make a more accurate judgment of the true quality of a recommended item. Transparency also can increase the trust in a system [11,12,14], offers a higher acceptance of recommendations [12] and allows refining recommender processes.

When it comes to a mobile environment, transparency is even more important due to the processing of personal information e.g. location data, time of usage, interests, and other situational dependent information that can be used to offer a more individualized recommendation [15,16]. Processing this information, especially location data, needs mostly users' approval [17, 18]. Transparency, for instance, can be used for building trust and enabling a way for checking if personal privacy policies are respected. Furthermore, transparency on mobile devices needs a completely different way of visualization and interaction with reference to its limitations [19].

The paper in hand addresses a survey analysis of design criteria for transparent mobile event recommendations. Events are typically every kind of activity users can participate in, e.g. movies, concerts, lectures, meetings, dinners and others. An event is minimally described by its name, a location where it takes place and a time when it starts and ends. Why an event is recommended to a user can have several reasons. An event can be recommended based on user's interests, on the distance

between the event's location and the user's current position, due to the fact that a couple of friends already accepted the recommendation or the user's calendar is just empty. The conducted survey asked about the usefulness of recommender systems in the user's daily life, a way of how recommendations can be presented and questioned concerning their understandability on the fixed as well as on the mobile internet. Therefore, questions about design criteria as e.g. the style element (text, icons, video, audio) and the level of detail (e.g. 1,3 or 5 explanations of each recommendation) are part of the questionnaire in order to provide an acceptable visualization from a users' point of view. The results and their interpretations are given later.

The paper in hand is structured as follows: The section "Theoretical Framework" gives an overview about transparency in the area of (mobile) recommender systems and demonstrates its importance as well as its novelty. The section "Research Methodology" discusses the underlying research approach, related to design research, research questions as well as hypotheses and artifacts. The section "Survey Design" gives an overview of the survey design including information about the participants. The sections "Data Analysis and Results" and "Research Findings and Limitations" present the survey's results, discuss them in relation to the stated hypotheses and indicate their limitations, while the last section sums up the contribution of what is learned and how further questions can be addressed.

THEORETICAL FRAMEWORK

Research in the area of recommender systems is performed over the last 20 years in a few different areas. The algorithm refinement, the analysis of user behavior and the consideration of user feedback are typically distinguished. Algorithm refinement is conducted on the one hand by optimizing recommender techniques like rule-based filtering, content-based filtering, collaborative filtering and hybrid approaches [9,20,21,22,23,24] and on the other hand by addressing new application areas with specific domain related input vector e.g. music [25] or video [6,7]. The analysis of user behavior is accomplished by classical research separated into the active way which asks the user explicitly about his behavior [26] and the passive way [27,28] where the behavior is derived by indirectly information collection and interpretation. The third path of research in recommender systems addresses the consideration of user feedback, often given by the buzzword "recommendation by critique" [4,29,30].

All these topics are of importance but for a while researchers have recognized that a new aspect called transparency also plays an important role of the acceptance and usage of recommender systems which literature base is very limited. When using recommender systems users typically disclose some personal opinions e.g. in the form of ratings. Based on these ratings, a recommendation e.g. for movies, books other products is made. The user has the possibility to accept or reject the recommendation. Over the years literature indicated that recommender systems are not always be trusted by users [11,12,14], but when a user doesn't trust a recommender system, he will not disclose personal information. Most of the recommender systems act as black boxes, not offering any insight into the systems logic or justifications for recommendations and cannot be questioned [11,12,14]. Recommendations are often correct, but also occasionally very wrong [11]. There are no indicators given when trusting a recommendation and when to doubt one from a user's point of view [11]. In addition a user is very sensible when it comes to recommendations in an area he is not familiar with [12].

By offering transparency which is about explaining to the user why a recommendation is made, the user will trust a service provider more than before [10,11,12,14,31]. In case something went wrong, the level of trust normally decreases, but when transparency is offered to understand what happened, trust does not have to decrease. Transparency explains to the user how a system works [31], enables more accurate judgment of the quality of a recommended item [32]. It offers a higher acceptance of recommendations and can increase sales [12]. The user can question the recommendation that also helps the system to refine the recommendation process [11]. Transparency is even more important in a mobile environment because personal information e.g. location data, time of usage, interests, and other situational dependent information can be used to offer a more individualized recommendation [14,15]. Its processing needs mostly users' approval [17, 18]. Transparency provides a method to check if personal privacy policies are respected. Furthermore, in a mobile environment transparency also needs a completely different way of visualization and interaction [19] which this paper focuses on.

For discussing transparency of mobile recommendations along this paper, the following working definition is defined: "Enabling transparency comprises explaining to the user why a specific recommendation is made and offers the option of questioning".

The aim of this contribution is to make a statement about design criteria for visualizing transparent mobile event recommendations in order to support its design process.

A more general view, derived by a literature review, sums up the following criteria, transparency can address:

- (1) Visibility and interactivity [31,32]
- (2) Explanation and justification [17]
- (3) Transparency in the meaning of “diaphanous” and “to see right through something” [34,35,36]
- (4) Understandable, self-explanatory [37,38,39]
- (5) Traceability [39] and controllability [40]

RESEARCH METHODOLOGY

The current section addresses the research methodology of this paper in form of a research procedure. Furthermore, the research questions, artifacts and hypotheses are defined.

Procedure

The underlying methodology of this research paper is based on design research [41,42,43]. A design research based process model [44] is chosen (figure 1) to address the research questions. The procedure is separated into six stages. Every single stage is related (in brackets) to the design research approach by Hevner [41] and Takeda [42].

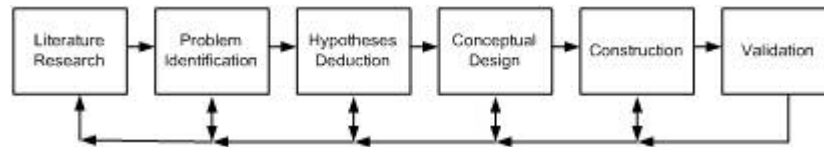


Figure 1. Research progress related to design research [45]

It starts with the literature research, followed by the problem identification (awareness of a problem). The hypotheses deduction and a first conceptual design (suggestions) are part of the third and fourth stages. Stage five is about the construction (development) of a specific artifact and the procedure concludes with the evaluation (evaluation) in stage six.

The literature research (stage 1) and the problem identification (stage 2) are already given by the introduction as well as by the theoretical framework and will not be extended by this article. One of four research questions is given later. The hypotheses (stage 3) are given below, which represent the main aspect of the analyzed survey and support the research question as well as the conceptual design. The construction (stage 5) and the validation (stage 6) are not part of this article.

The analyzed survey is focusing a pre-evaluation that is part the conceptual design in stage 4. The pre-evaluation is supporting the conceptual design in a way that it offers first insights on how to visualize transparent mobile event recommendations by taking into account the limitations of mobile devices. An assumption is that transparency can be given by explanations [10]. Questions e.g. are: What kind of style element is appropriate and how many details should be presented? Within this step it is not discussed what information is displayed.

The construction of the survey which e.g. includes how to set up a questionnaire, how to identify the target group, what are the questions that should be asked as well as in which form should these questions be asked are supported by available literature. One that includes a 9-phases procedure model in order to do so is given by [41] and is followed while setting up, carrying out and analyzing this survey.

Research Questions, Artifacts and Hypotheses

In order to design a transparent communication process between user and service provider for mobile recommendations, a couple of questions have to be asked. For instance it is important to know how transparency is defined, how it can be realized or implemented in a mobile environment, which information should be communicated to the user and how to integrate transparency into recommender processes in order to refine them.

Based on literature it is indicated that transparency is a new and relevant topic in recommender system’s research, especially in the area of mobile recommendations [10,11,12], however basics of handling transparency are missing which leads to the following research question (RQ):

(RQ1) How can transparency be defined (e.g. characteristics) and realized (e.g. design elements) in a mobile environment by considering its advantages and limitations?

RQ1 addresses the definition itself and visualization aspects related to the assumption that transparency can be given through explanations.

According to design research, the following artifact has to be designed:

- (1) By addressing RQ1 the concept of transparency for a mobile environment is defined that includes the consideration of questions from a data processing point of view.

The conducted survey supports RQ1 by indicating what kind of design component might be appropriate from a users' point of view. Based on, the construction of a second artifact - the systematic and engineering course of action to develop and integrate a software component that enables transparency within mobile recommendations - can be initiated. Derived hypotheses to support RQ1 are the following:

(H1) Recommender systems are used and helpful in the users' daily life.

H1 is based on the assumption that people who realized the usefulness of recommender systems, used them a lot and maybe different once. Therefore they will recognize differences in the visualization.

(H2) The relevance of transparency is more important for those who know that personal information are processed within recommendations.

People who know that a lot of personal information is saved and exchanged are more interesting in the nature of recommendations (the information that is used to generate a recommendation) than people who don't aware of the information collection.

(H3) The combination of text and icons as style element is the best solution to visualize transparent mobile event recommendations on a mobile device.

Based on the history of mobile navigation menus it is assumed that the combination of text and icons might be the best way to visualize an explanation for a recommendation in an area the user is not familiar with.

(H4) Three explanations for one mobile event recommendation are sufficient to offer transparency from users' perspective.

H4 is based on the assumption that a mobile display is limited in size. If an explanation contains text and icons maybe three or four explanations will suite on a display without scrolling.

While H1 and H2 have a more general character to support the motivation, H3 and H4 support the design aspects for transparency.

SURVEY DESIGN

To examine the hypotheses, described above, a survey was conducted. Test subjects were volunteer users (n = 318) who are technical affine. In addition they also have a mobile device, use it often, even if they didn't use mobile recommender systems but they are aware of their limitations. All participants reported by using the internet.



Figure 2. Section D - design example with text and icons

The survey consists of 4 different sections. Section A is about general statistical questions as age, gender, family status and occupational category. Section B of the survey asked about the personal relevance of recommender systems (e.g. usage or usefulness) on the fixed as well as on the mobile internet. Both sections help to confirm if the right target is met as well as to answer H1 and H2. Section C of the survey is about transparency in recommender systems. The test subjects were asked if they know that personal information can be processed in order to generate recommendations. Furthermore, they are asked if they know what kind of personal information is processed. In addition, questions about the understandability of today's recommender systems, its visualization as well as its transparency were asked. Section C concludes with questions about appropriate style elements in order to visualize explanations of recommendation as well as different amounts of explanations for each recommendation in the fixed internet. Section D offered 12 different design examples for transparent mobile event recommendation. The designs differ in the style element (e.g. text, icons, video, audio, text + icons) and the amount of explanations for each recommendation (e.g. 1,3 or 5). At the end of section D, the participants were asked what style element is appropriate for a specific mobile event recommendation system.

All these results should indicate how mobile event recommendation can be visualized in a transparent way. Figure 2 shows one design example that combines text and icons in order to explain an event recommendation.

DATA ANALYSIS AND RESULTS

The following section presents some results of the survey, while their interpretation and limitations are part of the next section.

Survey Participants

318 volunteer users took part at the survey. 66.04% are male and 32.08% are female. Most of the users (37.11%) are between 22 to 25 years, while 21.38 % are between 26 to 29 and 15.41% between 18 to 21 years.

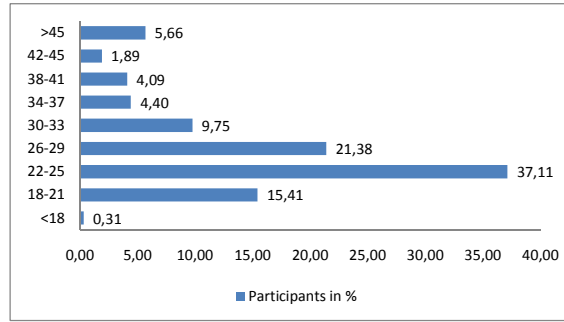


Figure 3. Age of participating users

As given by figure 4, 64.78% of all participants were students, while e.g. 22.01 % were employees.

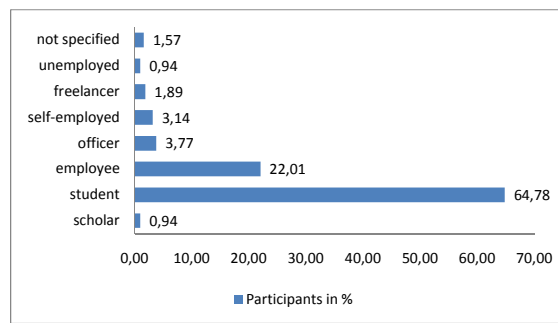


Figure 4. Occupational Category of volunteer users

H1) Recommender systems are used and helpful in the users’ daily life

H1 implies that users understand the usefulness of recommender systems. They know that recommender systems help to get information they are looking for by spending less time than searching by themselves.

The participants were asked, if they have used recommender systems for searching information, they are interesting in. 96.86% (308) did while 3.14% (10) didn’t use recommender systems.

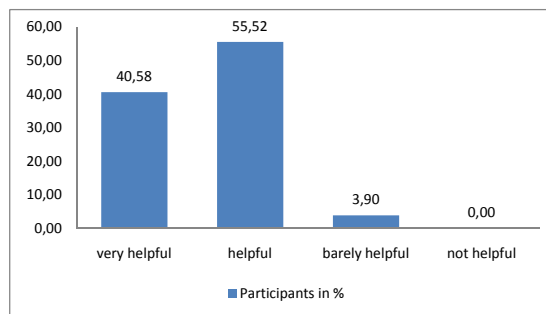


Figure 5. Usefulness of recommender systems

No user, who used recommender systems in the past said that these systems are useless. 96.10% said that recommender systems are very helpful or helpful in their daily life. Only 3.90% said that these systems are barely helpful.

H2) The relevance of transparency is more important for those users who know that personal information are processed within recommendations.

By addressing the H2, the participants were asked about their general knowledge about recommendations.

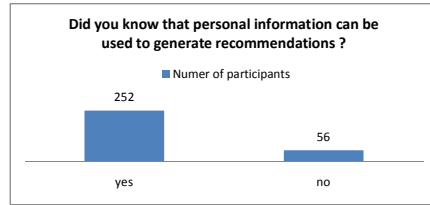


Figure 6. Awareness of processed personal information

252 participants (81.82%) know that getting personal recommendations often means that the system is accessing personal information as user profiles or history data, while 56 participants (18.18%) didn't know. The next question was only answered by the participants who are aware of this information processing.

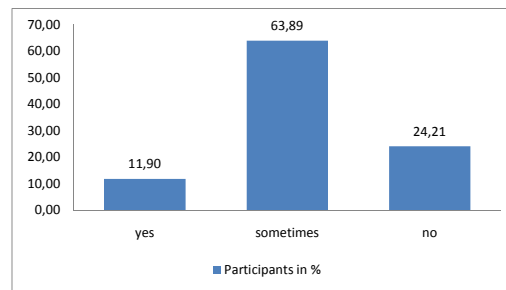


Figure 7. Understandability of recommendation

63.89% of the 252 users who knew that personal information was processed only sometimes were aware of the kind of information that was used (e.g. user profile data) to offer a recommendation, 24.21 % didn't know.

Furthermore 308 participants who already used recommender systems were asked about the recommendations' understandability, visualization and transparency on the fixed internet. 206 participants (66.88%) normally understand what items they get recommended. Only 79 participants (25.65%) said, they don't understand recommendations and don't know what they should do. When it comes to the visualization of recommendations 197 participants (63.97%) said that today's visualization is appropriate, while 111 users (36.04%) said today's visualization isn't sufficient to understand the nature of a recommendation.

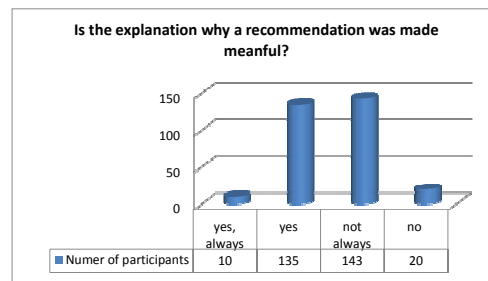


Figure 8. Transparency of recommendations

47.06% (145) of the participants said that the explanation of a recommendation is comprehensible in the way which allows understanding why a recommendation was made. Around 163 participants (52.92%) do not always or never know which personal information is processed to generate a recommendation and are not satisfied by the used visualization.

H3) The combination of text and icons as style element is the best solution to visualize transparent mobile event recommendations on a mobile device

In order to address H3 and the mobile environment, 12 different design examples for a transparent communicated mobile event recommendation are given as e.g. figure 2 demonstrates. These design examples differ in the style elements (e.g. text, icons, video, audio, text + icons) and the amount of explanations for each recommendation (e.g. 1,3 or 5). For each design example, the participants were asked if they understood the recommended item, if they understood why this recommendation was made (with reference to its explanations), if the number of explanations were sufficient to understand the recommendation and finally, if the given explanations were easy to follow.

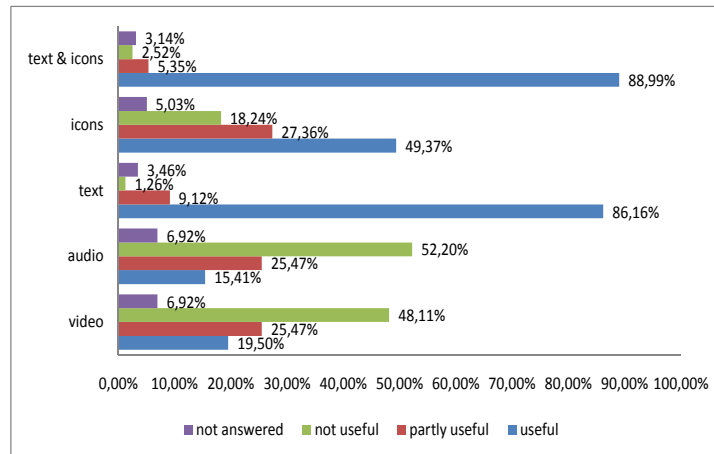


Figure 9. Preferred style element for transparent explanations on mobile devices

Later, the participants were asked which style element was appropriated to visualize a mobile event recommendation in a transparent way. 88.99% of all participants said that the combination of text and icons is the best solution to visualize explanations for recommendations. 86.16% said that text was a great way to describe an explanation. The usage of icons without any textual description was only an acceptable explanation style for 49.37% of the participants. Describing the nature of a recommendation by showing a video (19.50%) or playing an audio file (15.41%) was less accepted.

H4) Three explanations for one event recommendation are sufficient to offer transparency from users' perspective

As mentioned before all design examples also differ in the amount of explanations for each recommendation. The participants were asked how many explanations are sufficient for a mobile event recommendation to offer transparency.

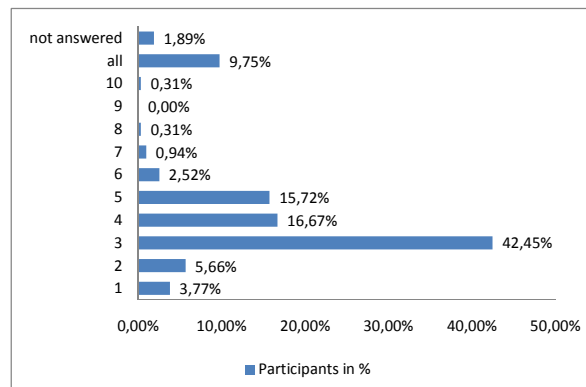


Figure 10. Number of explanations for each recommendation

42.45% of the participating users said that 3 explanations for one mobile event recommendation are sufficient to understand why a recommendation is made. If we use 1-5 explanations, 84.04% of all participants were satisfied.

RESEARCH FINDINGS AND LIMITATIONS

As mentioned by the introduction, the survey results support the conceptual design by offering insights in how to visualize an explanation for transparent recommendations on mobile devices. The relation between the survey results and the hypotheses are given below.

Nearly all participants who came in touch with recommender systems said that these systems are helpful (96.10%) or at least barely helpful (3.90%) in their daily life (H1).

It was also indicated that 81.82% of all participants knew that recommender systems can process personal information in order to generate a recommendation. Furthermore, 81.10 % of the participants only knew in some cases or didn't know what personal information was processed. In addition, 52.92% said that there was no sufficient explanation for a recommendation given that allows understanding what information was processed or why this recommendation was made (H2).

After presenting 12 different design examples for transparent mobile recommendations which differed in style elements as well as in the level of detail, 88.9 % of the participants pointed out that a description using "text and icons" might be the best way to visualize an explanation on mobile devices. The second highly preferred option was only "text" followed by "icons", "video" and "audio" (H3).

The design examples also contained different levels of details. 1, 3 or 5 different explanations for each style element were presented to the participants. Mostly 42.45% decided that 3 explanations for each recommendation are sufficient, followed by 4 (16.67%), 5(15.72%) and all (9.75%) (H4).

The limitations of these results are the following: The results are based on an explorative survey which is not representative. The survey only addresses mobile event recommendations but the results are maybe transferable to mobile recommendations in general which have to be evaluated in future. Furthermore, the display size probably influences the amount of sufficient explanations for each recommendation.

Summing up, the results indicate what kind of style element might be useful to explain mobile recommendations in a transparent way. Based on these results, a prototype will be implemented. After, an evaluation in form of interviews will be conducted: one interview with users of the mobile event recommender system and another interview with experts (e.g. mobile service provider or mobile operator) who offer such a system.

CONCLUSION AND OUTLOOK

The paper in hand discussed the importance of transparency which is about explaining to the user why a recommendation is made. When it comes to a mobile environment transparency is completely new, especially its visualization and integration into mobile recommender systems. A briefly literature review was given that stated out its relevance as well its novelty. The conducted survey confirmed the hypotheses of how to design a mobile event recommendation in a transparent way based on explanations which influences the prototype development. The aim is to increase users' trust in a recommender system, the willingness to disclose personal information and to generate more individualized, high quality recommendations. By transparent recommendations and the possibility to question these in a second step, recommender algorithms can be refined. According to the research procedure, the work this paper presented covered the beginning of stage four. Further research will be conducted in the area of what kind of information should be displayed and how can this information infect the recommendation refinement.

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