Using recommendations to help novices to reuse design knowledge

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Abstract. The use of pattern languages is not so straightforward since its users have to identify the patterns they need, browsing the language and understanding both the benefits and trade-offs of each pattern as well as the relations and interactions it has with other patterns. Novice designers might benefit from tools that assist them in this learning task. In this paper we describe a recommendation tool embedded in a visual environment for pattern-based design which aims at suggesting patterns to help novice designers to produce better designs and understand the language.

Keywords: Collaborative filtering, Design Patterns, end-user development.

1 Introduction

Design patterns are supposed to help novices, including casual designers and end-users, to produce better designs, since each design pattern encapsulates a piece of design knowledge based on real experience. Patterns are usually organized as a cohesive language [5] so when novice designers approach complex design problems that involve the application of several patterns, they can navigate through the language to identify successful design options. However, the use of pattern languages is not as straightforward. The chance to identify the right patterns strongly depends on the designers experience and on the communicability of both the patterns and the relationships used in the language. Taking into account that pattern languages should support novices we have to look for ways to assist them in finding the solutions they need. In this context there are two ways to try to enhance the pattern searching process. On the one hand, we can try to reduce the cognitive gap between the designer perspective of the problem and the pattern description by using notations more meaningful for the user. On the other, we can help novices to understand how patterns relate by

making explicit framework, that in the sense of [2] are collections of patterns that experienced designers usually apply together. In this paper we propose a recommendation system that has been built upon a visual tool that follows the first approach (reducing the cognitive gap) to deal with the second one (knowing how experts do combine patterns). We will describe the tool and a limited experiment with novice designers.

2 Related Works

In an empirical study [3] it was found out that novices apply different strategies to browse pattern languages and most of them are driven by the need to understand whether a design pattern contributes or not to solve a specific design goal. VEISIG is a tool aimed at fulfilling this browsing strategy [4]. It represents a pattern language using a visually enhanced and interactive graph that puts the stress on design goals, since they seem to be closer to the designers' perspective of the problem. The tool also highlights the relations amongst patterns so that designers can realize how they interact. This way of interacting with the language was considered useful in an experiment with non-expert designers [4] but participants didn't identify all the patterns required to solve the problem they were proposed. To deal with this flaw, the concept of framework [2] can be implemented as a recommendation system. Recommendation systems rate collections of items taking into account several sources of knowledge. To the best of our knowledge there is only one work about recommendation and design patterns and [18] but it is oriented towards identifying the patterns required for a given problem description. Our goal is to help casual designers to reuse the design knowledge underlying patterns languages that can be inferred from the way more experience designers use them; but still we aim at letting them the initiative to explore the language and take the decisions about the patterns they need to use.

3 The Recommendation module

In this paper we propose the creation of a recommendation module for VEISIG in order to help novice designers to improve their designs by reusing design patterns and the knowledge of more experienced

designers. The recommendation module is based on collaborative filtering to obtain a rating for each pattern of the pattern space. According to literature there are four kinds of recommendation systems [1]: content-based; collaborative filtering; hybrid systems and preference-based filtering systems. Among them only collaborative filtering do not rely on the previous experience of the same user; which is our case would be useless. Instead of that it rates the items to recommend using the ratings that other users gave them. In our case, the knowledge base is made up of the pattern language (whose items and structure gather explicit expert design knowledge) and the solutions made by expert users, that is, implicit expert design knowledge.

VEISIG provides users with a visual representation of the pattern language using design goals. Goals are related through structural relations (AND and OR), positive contributions or negative relations (Hurt and Break). Patterns, which are the boxes, are tied to the goals they satisfy. Goals are organized in six design views to facilitate users' exploration: structure, navigation, presentation, personalization and security. Once the user has selected the goals (those with a tick in fig. 1), she can ask for recommendations. The recommendation algorithm is described below.

First, it rates all the patterns that are not in the initial user selection (MZ1, MZ2 and MZ3 in the example). The rating of a pattern indicates its affinity with the initial set and it is obtained using three factors:

a) The number of occurrences where the pattern appears in combination with any of the patterns in the initial set.

b) The types of relation with the patterns in the initial set. In the example, AZ1 is connected with all the patterns in the initial set with a contribution relation, so it rating is increased.

c) If a pattern is categorized in the same design view than patterns in the initial set, its rating is increased.

Once all the ratings are obtained, the recommendation algorithm chooses the pattern with higher rating. From that pattern, the results are filtered to produce a number of manageable recommendations, that shouldn't be higher than the number of patterns in the initial set.

Recommendations never include patterns that have a conflict relationship with those in the initial set or with patterns with a higher rating in the recommendation set. Recommended goals (patterns) are highlighted in the visual representation and shown in a popup window.
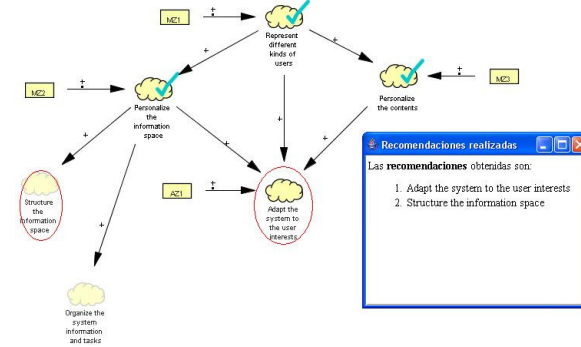

Fig. 1. Example of recommendation

4 Evaluation

We made a preliminary evaluation study of the recommendation module trying to achieve two goals: (1) check if the recommendation system helps to select patterns to improve a design, and (2) if it is useful for novice designers. The participants (evaluators so forth) are undergraduate students from computer engineering who didn't know anything about the patterns language. They can be considered novice designers as their knowledge on web design is more concerned with technical issues than with usability ones, which are those gathered in the pattern language. 39 students took part in this study.

First of all we gave them a brief introduction on the tool functionalities. Then, the evaluation was divided in three phases. In the first one, they were prompted with a group of tasks that could be solved using VEISIG and the recommendation module. All tasks had the same structure: a problem with an incomplete solution. We asked them to improve the solutions with new patterns. The second phase was a questionnaire used to collect users' perceptions and opinions about the system as well as suggestions to improve it. Table 1 summarizes the questions included in the form. Q_3, Q_4, Q_6, Q_7 were open, whilst Q_1, Q_2 and Q_5 used a 5-values likert scale. The first three questions were about using the language (i.e. browsing the design space). Q4 and Q5 collect

information about the usefulness of the system for designing solutions, and Q6 gather their impression on whether the system was useful for novice users or not. The last question, Q7, was focused on getting feedback about whether the module could help to understand the patterns language. Finally they had to measure their expertise in design patterns, web design and other design issues. As expected, most of the users were knowledgeable in web design and design patterns in general, though they did not know anything about VEISIG and its pattern language. So our participants could be considered as novice users for this language: they didn't know the patterns in advance or the way they were organized in the language but they were able to design solutions.

Q_1	Does the recommendation module help in the navigation of web pattern space?
Q_2	Were your strategies improved by the recommendation system?
Q_3	What should be added to improve the navigation quality?
Q_4	Are you satisfied with the proposed solutions?
Q_5	How would you improve the quality of the solutions?
Q_6	In your opinion is this component useful for expert users or for novice users (or both)? Explain your decision.
Q_7	How useful was the system to understand the patterns and their relationships?

Table 1. Questions about VEISG and its recommendation module

The main findings we got from the answers to these questions are the following:

- *The recommendation algorithm is considered useful.* Most participants said that they felt the design time had been reduced and helped to obtain better solutions. Indeed all of them improved the initial solutions they were proposed when they used VEISIG to look for more patterns.

- *Novice users might find the recommendation tool useful not only to improve their designs but to learn about patterns and their relation.* Most participants thought that VEISIG was useful to understand the patterns language and its relationships, so that it can help to understand better the language and its patterns.

- *Users do not blindly trust the recommendations.* Even if the system might help in designing a solution, most of the users said they would've preferred to know the reasons that support such recommendations.

Users prefer to know how a solution was designed instead of applying a solution whose source is unknown.

4 Conclusions and Future Work

The use of design patterns may reduce development effort if designers are able to reuse the design knowledge. In this paper we have introduced a recommendation module that according to a preliminary study might help to understand a design patterns language and to produce better solutions. However, the validity of the experiment is limited and it should be repeated with real end-users to get sound conclusions and to detect how the recommendations could evolve to make up a really useful knowledge reuse environment for end-users.

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