Using Interaction Patterns in Heuristic Evaluation

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Abstract. Heuristics give some general principles or reflections that should be taken into account when an interface is being developed. Heuristic evaluation should end with a set of recommendations or advices directed to the responsible of the application or web site. Interaction patterns have reached a certain level of maturity. Designers and developers are offered different pattern catalogues that help them to design usable interfaces and better interactions. In this paper, a method to use interaction patterns in heuristic evaluation is proposed. The idea is to establish a correspondence between each heuristic and one or more interaction patterns. After presenting this correspondence, the paper illustrates the concepts by showing a real case.

Keywords: Usability, interaction patterns, heuristic evaluation.

1 Introduction

Nowadays, usability has becoming an important requirement in software projects. The traditional view of usability by which is something interesting or important, only when all the application has been developed and there is no more to be done, is obsolete. One of the most useful methods for evaluating the usability of applications and web sites, both for users and developers, is by making use of heuristics.

Heuristics give you some general principles or reflections that should be taken into account when the application interface is being developed. There are some well-known set of principles, as those defined by Nielsen [11], Shneiderman [17] and Norman [14]. Additionally, designers and developers can make use of other guidelines o good practices in order to assure to their applications the highest level of usability as possible.

These principles are offered as general sentences that have to be determined in each case. For example, one of these principles established that "the state should be always visible" that can be accomplished in different ways. This diversity can also introduce complexity in the process of usability evaluation.

Another problem is that the use of heuristics supposes the evaluator exhibits a rich experience in what usability means and how to check each principle in a particular case (form or web page). Sometimes is not possible to count on an expert for performing the evaluation. In these cases, the method proposed in this paper can help to do this kind of evaluation.

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Heuristic evaluation should end with a set of recommendations or advices directed to the responsible of the application or web site. This important task requires expertise as the usability evaluation includes, not only negative aspects but also positive actions to improve the user interface. The idea described in this paper can also help in the task of proposing improvements.

On the other hand, interaction patterns have reached a certain level of maturity. Designers and developers are offered different pattern catalogues that help them to design usable interfaces and better interactions. Some of them are specific for web applications and other for all kind of applications.

In this paper, a method to use interaction patterns in heuristic evaluation is proposed. The idea is to establish a correspondence between each heuristic and one or more interaction patterns. After presenting this correspondence, the paper illustrates the concepts by showing a real case. This example of application also contributes to improve the method itself.

The paper is organized in the following sections. Section 1 covers the introduction and motivation of this research. Section 2 describes related work about heuristic evaluation techniques and methods. Section 3 offers a brief introduction about interaction patterns. Section 4 contains the proposal of heuristic evaluation using interaction patterns. A case study illustrates the proposal in section 5. Finally conclusions and future work is presented in section 6.

2 Heuristic Evaluation Techniques

A heuristic evaluation is a method to discover usability problems in user interfaces. In concrete, several evaluators examine the interface and judge if the interface accomplishes several usability principles, so called the "heuristics". Usability inspection can be defined as a set of methods based on having evaluators inspect or examine usability-related aspects of a user interface [10]. In this paper, Nielsen and Molich described heuristic evaluation as "an informal method of usability analysis where a number of evaluators are presented with an interface design and asked to comment on it". They presented here nine usability heuristics, and later Nielsen refined it to his famous "Ten Usability Heuristics" [19], based on a factor analysis of 249 usability problems [12] (see Table 1).

Nielsen's heuristics are the most used list by many professionals for product evaluation. But other authors also defined their own lists of heuristics, like Shneiderman's eight golden rules of interface design [17], Gerhardt-Powals research-based guidelines [8] or Norman's seven principles [14].

Evaluators can define their own list of heuristics for a specific environment when they have to evaluate a concrete task, instead of restrict to use one of multiple list of heuristics published [24].

Heuristic evaluation can be performed by a small number of evaluators but several studies have demonstrated that the evaluation is more effective when multiple evaluators are involved. In fact, Nielsen defined that five-six evaluators will be sufficient to discover around 80% of the main usability problems of an interface [11].

Table 1. Evolution of Usability Heuristics from its conception

Nine usability Heuristics (Nielsen and Molich, 1990)	**Ten Usability Heuristics (Nielsen, 1994)**
1. Simple and natural dialog 2. Speak the user's language 3. Minimize user memory load 4. Be consistent 5. Provide feedback 6. Provide clearly marked exits 7. Provide shortcuts 8. Good error messages 9. Prevent errors	1. Visibility of system status 2. Match between system and the real world 3. User control and freedom 4. Consistency and standards 5. Error prevention 6. Recognition rather than recall 7. Flexibility and efficiency of use 8. Aesthetic and minimalist design 9. Help users recognize, diagnose, and recover from errors 10. Help and documentation

In heuristics evaluation sessions, when only one evaluator inspects the interface he uses to find a small number of usability problems. If we want to find other major usability problems we have to ask evaluators to fulfill a questionnaire after each evaluation session, where they can catalogue each one of usability problems discovered and moreover they can weigh each problem. Nielsen [13] proposed a severity scale for usability problems based on three factors: frequency of occurrence, user impact and persistence of the problem (see Table 2). One can see from the textual descriptions that priority is incorporated into the scale, and Nielsen has also noted that market impact should be assessed.

Table 2. Severity Ratings for Usability Problems

Numeric Value	**Textual Description**
0	I don't agree that this is a problem at all
1	Cosmetic problem only: need not be fixed unless extra time is available on project
2	Minor usability problem: fixing this should be given low priority
3	Major usability problem: important to fix, so should be given high priority
4	Usability catastrophe: imperative to fix this before product can be released

Furthermore, the discount usability engineering method [11] uses four techniques: user and task observation, scenarios, simplified thinking aloud and heuristic evaluation. Nielsen [13] suggests that there are two major reasons for alternating between heuristic evaluation and user testing. First, heuristic evaluation does not require users, who can be hard to get, to find usability problems. And second, many researches have demonstrated that both methods can find different problems.

3 A Brief Review about Interaction Design Patterns

Patterns, in general sense, have been defined to transmit understandings of design problems, by means of catching the core of recurrent problems and their solutions in a packed form. Patterns describe the problem fully, give the motivation of the solution and provide a form to apply the solution. A pattern language can be defined as a structured method for describing good design practices within a field of expertise.

Patterns are different from other forms of catching design knowledge, as guidelines or heuristics, in three ways. First, patterns offer a solution to concrete problem rather than providing abstract suggestions. Second, patterns are creative, helping designers, architects and engineers to generate a new solution by presenting several examples of the same problem. And third, patterns are connected between them by a hierarchical structure, so designers can resolve both complex and simple problems. Patterns are not going to replace guidelines or heuristics; patterns are a good complement for them.

Design patterns were developed by Christopher Alexander, in collaboration with Sarah Ishikawa and Murray Silverstein, as a method to allow anyone to design and build at any scale [1]. They based on the idea that users know more about the buildings they need than any architect could, idea that has been exported to the design of websites [22].

Alexander assumed that patterns could entitle both architects and their clients by providing a common and comprehensible language for design. He and his colleagues developed 253 patterns for building and planning towns, communities, houses, gardens and rooms. They wanted to outline an entire language for design, since the effectiveness of patterns was to provide a good solution to common problem, and at the same time to see how this solution was agreeable between client and architect [18].

The design patterns of Alexander are composed of a unique name, a numerical ID, an overview of the context and what the solution is about, regularly in the form of a brief summary and one picture. This overview is followed by a detailed description of the problem, how to implement the solution, a justification why the solution is good and the context where the design pattern should be applied [1].

UI designers [3,6] and also web designers [2,22,23] have adopted too the concept of design patterns. Some authors have described a collection of software design patterns which are now widely used [7]. We can found a main difference between software design patterns and design patterns of Alexander: the former were developed by and for professionals of the software industry while the second were particularly designed for creating good designs by non-professionals.

Design patterns ha0076e reached their greatest success in the area of software design by the success of the Gang of Four book Design Patterns [7], and also by the extensive practice of their pattern names in software development community. Moreover, design patterns have also reached to the area of human-computer interaction (HCI). The first HCI patterns can be considered at the Pattern Languages of Programming (PLoP) Conference [15] whereas pattern workshops began emerging at the Computer-Human Interaction (CHI) Conference [4]. Since then many pattern

libraries have been published [22,23,20,25,6]. In figure 1 we can see an example of a typical interaction design pattern extracted from the web site of Van Welie [16]. The implementation of the interaction design patterns made by van Welie is very similar to the internal structure of a pattern form developed by Alexander; only the names of the attributes are slight different.

There are other fields of application of interaction design patterns, like e-learning, related to Computer Human Interaction. Van Diggelen and Overdijk developed design patterns for networked learning in the classroom and evaluated different solutions to several problems as design patterns [21]. Kohls and Uttecht presented a case study on the mining, writing and application of patterns for interactive educational graphics; it focuses on pattern mining and describes how to derive patterns from experience and analysis [9].

Dearden and Finlay [5] presented a critical review of patterns and pattern languages in human-computer interaction and introduced the concept of interaction design pattern to define design patterns in the HCI area. Thus, interaction design patterns are noticeably different from software design patterns which are focused on the source code and software structures rather than interface design.

Interaction design patterns have been developed for professionals and non-profesionals, as the original design patterns of Alexander. To create successful interactive systems, user interface designers need to cooperate with developers and application domain experts in an interdisciplinary team. These groups, however, usually miss a common terminology to exchange ideas, opinions, and values. Borchers presented an approach that uses pattern languages to capture this knowledge in software development, HCI, and the application domain. A formal, domain-independent definition of design patterns allows for computer support without sacrificing readability, and pattern use is integrated into the usability engineering life cycle [3].

Finally, we can consider that design patterns are basically a method for structuring knowledge and not a method for finding new solutions to problems. Solutions described in design patterns are not necessarily be new or original but should be demonstrated to work in practice. Therefore, design patterns are not developed from theory but identified as invariant aspects of solutions that emerge as best practices [5].

4 Using Interaction Patterns in Heuristic Evaluation

In this paper we propose a methodology to introduce the concept of interaction design patterns in the process of evaluation of a website by heuristics. To conduct a heuristic evaluation, first we have to define the set of evaluators who are going to examine the interface and their level of expertise; next we have to define a concrete task to evaluate and finally we have to provide a set of indicators (heuristics) to compound the questionnaire for evaluating the website. At this stage, we wanted to establish a correspondence between each one of the selected heuristics and one or more interaction design patterns in order to facilitate same directives to designers that helped them to overcome each usability problem.

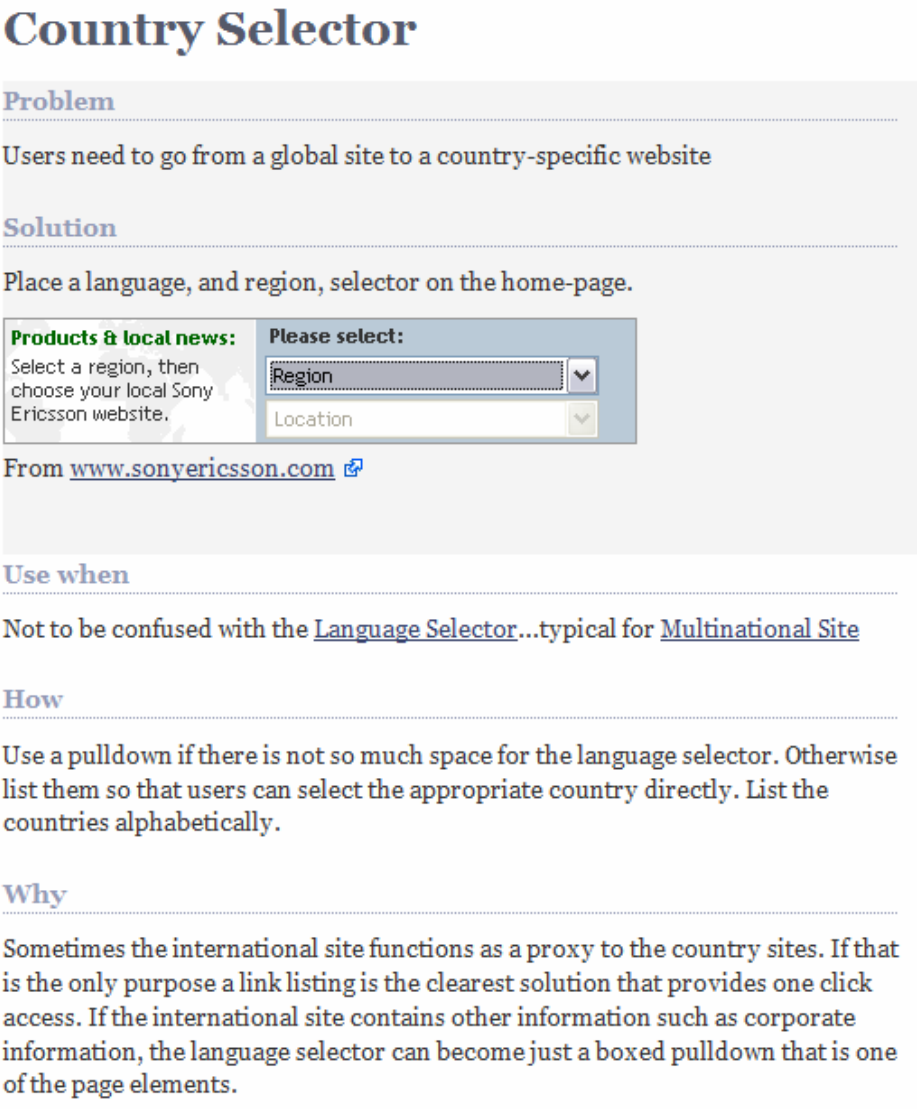

Fig. 1. Capture of a pattern of the web site of Van Welie (welie.com)

The set of indicators was selected as a set of heuristics grouped under the Ten Usability Heuristics of Nielsen [19]. On the other hand, we selected as a set of interaction design patterns a subset of the patterns defined by van Welie [16]. This set of patterns is a well-accepted pattern library like other patterns libraries as Yahoo Design Patterns Library [25] or Designing Patterns Library of Tidwell [20]. We selected Welie's Library by his simplicity, easy of use and similitude with the previous patterns designed by Alexander.

The interaction desing patterns defined by van Welie are grouped in three main sets: user needs, application needs and context and design. The first set, user needs, is composed of nine subsets: navigate around, searching, shoping, basic interactions, dealing with data, making choices, giving input, personalizing and miscellaneous. The second set, application needs, is divided into three subsets: drawing attention, feedback and simplifying interaction. And the third set, context of design, is divided into three subsets: site types, experiences and page types. Other patterns libraries could be more complete than van Welie, but this library is structured hierarchically what facilitates the process of mapping between the set of heuristics and a subset of interaction patterns.

For each one of the indicators of the set of a group of heuristics, we assigned at least one interaction pattern based on the context of use of the pattern and the target of the heuristic. For instance, the interaction patterns feedback and experiences were assigned to the heuristic "error prevention". In Figure 2 we can see the relationship that we define between each heuristic and each one of the group of interaction design patterns. The relationship was established based on the relevance of each one of the interaction patterns contained in each one of the group of patterns that we consider are more relevant to solve the possible usability problems derived from each one of the heuristics.

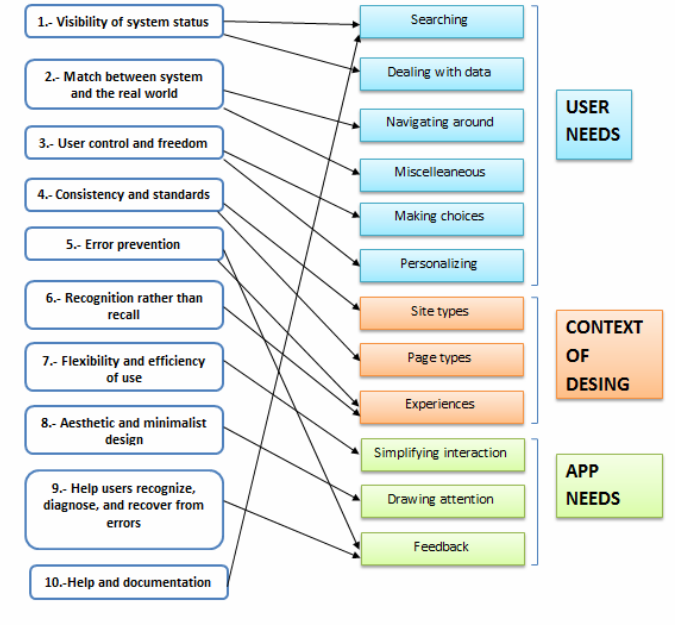

Fig. 2. Correlation between heuristics and interaction design patterns

The objective was to offer designers and developers a starting point to solve each one of usability problems detected in each heuristics when the evaluators diagnose the web site.

Finally we have defined a repository of evaluations with the aim to store all the evaluations performed by evaluators grouped by the type of website they evaluated (e-learning, e-commerce, intranet, etc.), the kind of task they evaluated (navigation, finding information, fulfilling a questionnaire), the usability problems detected and the suitability of the interaction pattern proposed to solve those usability problems. In case that the evaluator considered that other interaction pattern was more suitable to solve the usability problem detected, he can store the alternative pattern proposed. In this manner, after a number of heuristics evaluations we will get a valuable source of information for refining our correlation.

After each heuristic evaluation a report is issued indicating not only the usability problems detected but also a set of interaction patterns proposed to enrich the website evaluated. This will facilitate to designers and developers to solve the usability problems detected as they will receive a directed solution.

5 A Case Study

This section describes how the proposed method has been applied to a real Web site. It was not necessary to go far away to find a motivating and promising case study. This is why we decided to evaluate the web site of our university.

The goal was to improve the user experience of the whole community (students, professors and administrative staff) using the web site. This required performing the evaluation from different perspectives.

Fig. 3. The user has selected an option in the main menu but is difficult to see what

Figure 3 shows the home page of the site under study with a usability issue. As an example, the figure shows a submenu that has been dropped down by the user's

selection in the main menu. It is not possible to determine whether the menu selection was “Investigacion” or was “Internacional” menu.

When heuristic evaluation was applied, we followed the Nielsen’s recommendation and we went through the interface twice. The first pass was intended to get a feel for the flow of the interaction and the general scope of the system. The second pass then allowed us to focus on specific elements testing how they fit the users’ need.

A number of usability issues were found. Some of them are listed following:

1. When the user navigates through the Web, (s)he does not know where (s)he is
2. The title of the different sections appear in no prominent places
3. It is difficult for the user to come back to the home page
4. The different sections do not have the same look and feel
5. The main menu does not give good feedback about the selected option

The usability report can conclude with a complete list of usability issues that must be corrected in the new version of the web site (We would like to remark that this homepage of the web site of our university was designed ten years ago, and precisely now we are involved in the process of opening a new web site, fully redesigned).

It is not necessary to define how to solve these problems; there are a lot of ways to fix each usability problem. The proposed method suggests that the usability expert takes the correlation we showed in the Figure 2 and try to find an interaction pattern that can be used to fix the problem

In the case of the former usability issues, the proposed solutions can be as follows:

1. Lost users in our web page can be fixed using the breadcrumbs pattern
2. The problem of no prominent information about sections can be solved by using the Header pattern
3. The problem of coming back to the home page can be fixed using the Home Link pattern
4. The problem of the different look and feel can be solved by using templates. This a more general problem that is fixed by a general rule
5. There are different possible solutions for the main menu. In the case of this web page we suggested to use the Double Tab Navigation pattern.

This only an example to illustrate how to use the pattern-heuristic correlation to provide a list of solutions that can be applied to different usability issues.

6 Conclusion and Future Work

In this paper we have proposed a new methodology to introduce the concept of interaction patterns into the process of heuristic evaluation.

As all usability evaluation should culminate with a report where all usability problems will be listed, introducing interaction design patterns will help to designers and to developers to better understand the usability problem detected and how to solve it directly as they receive a starting point to overcome the issue.

At the present, we are developing an environment to help evaluators to generate the usability report after a heuristic evaluation. The more evaluations done with the tool, the more interaction patterns will be possible to offer to new reports as the system will be able to select weighted interaction patterns that previous evaluators selected.

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