TOWARDS USABILITY IMPROVEMENT OF SEMANTIC WEB APPLICATIONS

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Abstract: In recent years, a new revision of the Web is being proposed. It goes beyond Web 2.0 so it is called the Web 3.0. We concentrate on just one of them, the one called the Semantic Web. This proposal has been technologically developed and improved but its lack of taking off among end-users seems due to problems in the end-user interactive experience. In this paper, we explore this aspect because it is as important to improve Web 2.0 applications as improving Web 3.0 interfaces and it is as important to develop technology as emphasizing its new user interfaces. Thus, we present a usability evaluation carried out through the heuristic evaluation in eleven semantic web applications to detect common misconducts. In addition, we also assess if we can use the same heuristics for a semantic web applications and for a common Web applications.

1 INTRODUCTION

Semantic Web (SW) and Web 3.0 are emerging terms that appeared to go beyond current Web, being currently accepted that the former is a subset of the latter. Even accepting that these proposals can provide a "better Web", it is not obvious that they will improve the end-user interactive experience when using Web 2.0 based interfaces.

However, Web 3.0 should not be viewed as a replacement of Web 2.0, it extends (or enhances) Web 2.0 through new possibilities. These provide new tasks that present the same basic goal than other tasks include in a common interface, but these tasks increase user experience making actions such as sharing or searching content easier.

We agree with James Kalbach blog's words (Kalbach, 2010): *"The success of next-generation information systems depends much more on human factors than on more sophisticated technologies"*. It means the paradigm used to design a user interface should not be realized by final users; paradigms must be transparent layers to them.

Apart from that and in the same way as other kind of user interfaces, we have to consider user experience factors in interface design to improve it and achieve a new interface that makes it easier to have a positive experience. And, for achieving it we do not see other way than including end users in interface design, following the User Center Design (UCD) principles (Abras et al., 2004).

As UCD practitioners, as a rule, we consider end users when designing an interface such as a Website. But, some questions such as *"what happens with a semantic web application?"* come up to our minds.

According to Peter Morville in (Morville, 2005): *"As interface stands on the shoulders of infrastructure, tomorrow's user experience will rest on the foundation of today's Semantic Web technologies"*. We have to make efforts to improve the visible layer of the interfaces. And we have to achieve that end users can carry out their tasks in a usable way to improve their interactive experience.

Nowadays, SW is mainly used in the backend part of the system (Cyganiak and Jentzch, 2010). We consider that there is much work to do for improving its positive experience of use and bringing it also to the frontend. We completely agree with the creator of SW, Tim Berners-Lee, when he said (Berners-Lee, 2007): *"We do not yet have Semantic Web technology available which is that easily usable by grandparents and children. That is true."*

Many resources exist and we use them to design SW applications but, why do we not add to these resources aspects (such as usability) that we consider necessary for improving user experience? Ora Lassila adds: "*After 10+ years of work into various aspects of the Semantic Web, I am now fully*

convinced that most of the remaining challenges to realize the Semantic Web vision have nothing to do with the underlying technologies. Instead, it all comes down to user interfaces and usability. (Lassila, 2007)"

Thus, we did research on the user interface part of the SW and in this paper we present a list of common misconducts that we found. For this, we carried out an experiment analyzing 11 interfaces that use SW technology.

In the next section we present some works related to our article. Then, a SW evaluation is showed in section 2. Section 3 shows the obtained results. And finally, discussion, conclusions and future works are presented.

1.1 Related Work

The general goal of this paper is to include usability, as one of the most important factors used in user experience, in a SW design such as in (García et al, 2010).

User experience is a relatively new concept which according to our research approach includes different facets (Masip et al, 2011), being usability one of these facets. To now, for a long time, scientific community used only usability features to improve the quality of interactive systems.

Nowadays, this tendency is changing; experts see the interactive experience as a whole and include more facets than usability to achieve a positive user experience. As a first step in SW application, we start to improve the quality of this type of interfaces including usability features in its design. Because we consider if SW designers apply specific usability aspects in their designs, user experience will be better.

There are papers in literature concerning the usability of SW applications but, usually, these are focused on few features of semantic applications such as natural language (Cimiano et al, 2008) (Dittenbach et al, 2003) or search engines (Reichert et al, 2005) (Duke et al, 2007).

Furthermore, we found works concerning usability problems in SW applications. For instance, in (Roy et al, 2010) the authors justify that if we use ontology, user experience will improve. Another work is (Jamenson, 2006), where the author shows usability aspects about some tasks. But, works do not present details. We try to do so in the following sections.

2 SEMANTIC WEB EVALUATION

We consider that the first step to improve user experience of semantic applications is including one of the most used factors in user experience, the usability (Dix et al, 2004) (Nielsen et al, 1994).

So, in this paper we used heuristic evaluation to check a set of chosen Websites and show their common usability problems. We use heuristic evaluation because is fast, cheap and one of the oldest methods to evaluate the usability of the interactive systems. In the following sections, we present the evaluated Websites, the method used and the process followed to evaluate these interfaces.

2.1 Set of Evaluated Websites

Sometimes, it is obvious for a SW expert that one Website is designed with semantic technology, but other times, this semantic technology goes unnoticed and it is very difficult to detect it. However, the technology used to design a Website should be

Table 1: Websites for specialized users.

URL	User profile
http://iserve.kmi.open.ac.uk/browser.html	iServe is the place on the Websites where linked data meets services. So, it is a platform for publishing Semantic Web Services as linked data, no matter their original format. (from: http://iserve.kmi.open.ac.uk/wiki/index.php/Home).
http://lod.openlinksw.com/	Everybody who wants to add this engine in search bar of an OpenSearch - capable browser. But those who use this engine will be an expert finder of information.
http://www.faviki.com/pages/welcome/	Everybody who wants to keep their own tags and connect them in common, universal concepts from the world's largest collection of knowledge.(from: http://www.faviki.com)
http://dblp.rkbexplorer.com	Semantic web expert who is interested in RDF linked data and co-reference information.
http://sig.ma/	Everybody who wants a Web of Data browser Website, an embeddable/linkable widget and a semantic API.

transparent to end users. So, a good Website design has been done if we (as SW experts) cannot detect semantic technology in it.

Therefore, having usability improving of SW application as a goal, we chose eleven sites that we knew that they use semantic technology in their implementation. And, while we were choosing these Websites, we detected that Websites can be (and should be) classified into two different groups: Websites for end-users (general audience) and Websites for specialized users.

Websites for end-users are Websites where everybody can visit and they can understand its content. So, these Websites are for users who should not have any knowledge of semantic technology to be able to use them.

On other hand, Websites for specialized users are Websites where, obviously, everybody can visit, but only expert users who know the content meaning will understand the information provided because they have some knowledge of semantic technology.

In the following two tables, every Website of each group and a brief description about a specific user profile who can use these webs are shown.

Table 2: Websites for end-users.

URL	User profile
http://news.bbc.co.uk/sport2/hi/football/world_cup_2010/default.stm	Everybody who likes football and especially, the World Cup.
http://www.uptake.com	Everybody who wants to learn about new places or something special in a specific city around the world.
http://www.viewchange.org	Everybody who wants to browse, watch or share videos about real people and progress in global development.
http://www.zemanta.com	Everybody who frequently uses web word processors and need content and picture suggestions related to composition.
http://www.freebase.com	Everybody who wants to browse, see or share data in an open way.
http://www.data.gov/	Everybody who wants to know much information about the Government data stored in many locations.

2.2 Usability Evaluation

SW distinguished itself by showing specific tasks or information that in a usual Website we normally do not find it. However, knowing that one of our aims is to assess the evaluation methodology itself, we

will attempt evaluating these interfaces using the same method that we use in a "traditional Website". It will provide us with useful information to consider if the method (or part of it) needs to be adapted. So, we decided to use one of the most used methods to evaluate usability: heuristic evaluation (Dix et al, 2004) (Nielsen et al, 1994). It is an inspection method that allows usability experts to get improvements faster and cheaper than other evaluation methodology such as user test. Therefore, heuristic evaluation also helps us to get the list of misconducts.

In previous works, we got 16 usability categories defined by at least 3 authors (Masip et al, 2010). Now, these categories are used to evaluate interfaces that apply semantic technology to their design, and we explore if our set of heuristics is complete enough to detect all problems for this type of interfaces. Bearing in mind that semantic technology must be transparent for end users.

2.3 Evaluation Process

We followed the generic process that Nielsen presented (Nielsen et al, 1994). The steps to carry out the heuristic evaluations are:

- **First review**: one evaluator navigated through each interface to make first contact with it. She was expert in heuristic evaluation but she was non-expert in SW applications.
- **Heuristics scores**: every heuristic was scored and some specific observations in each heuristic were written. She used the same set of heuristics for all Websites. And she scheduled only 3 usability evaluations per day, avoiding an extreme memory load and the comparisons between systems.
- **Finally**, we could summarize the quantitative and/or qualitative results.

3 RESULTS

Our goals were not to present specific usability problems detected in each Website according to scores used. Our main goals were: First, detecting common mistakes in SW applications. Second, assessing if the heuristics used are complete enough for this type of interfaces.

3.1 Misconducts

As we mentioned, we present every mistake that we found at least in three evaluated interfaces:

- Interfaces do not include a visible navigate resource (next and before), so you can only use menu options presented in the navigator.
- If we usually use cursor, in these interfaces cursor movement is not consistent.
- Websites do not show sitemap, so, we cannot see a general view of the Website.
- Computer experts appreciate shortcuts because they make easier and more quickly some tasks. In the analysed Websites there are not clear shortcuts to the main tasks.
- Many Websites are difficult to use; even so, they do not show any help section or documentation. What can you do in this interface it is not so clear.
- There are jargon words about Web content or ontology vocabulary. This ontology vocabulary is too specific for end-users.
- And in the same way than the point above, it shows not familiar vocabulary. In fact, it causes much confusion to end-users.
- We know that in semantic web area URLs are very important but even so, these URLs are not understandable to users.
- In semantic applications, information is related itself but this relation is not visible in end user layers. Each menu tag is not visibly associated with upper menu tag.
- Due to new task presented in semantic web applications, some of them are difficult to learn and carry out.
- We consider that in Web application is very important to show update dates because Website is changeable by nature. But, actualization date does not appear.
- In reference with the last point, many dates that appear in these Websites do not follow international format, they do not include p.m or a.m abbreviations and they do not show the month in letters to avoid confusion between days and months.
- Websites do not highlight link areas when the cursor is on it. Taking into account that in semantic web applications many links appear, user does not know where cursor is.
- Semantic applications display many pictures. We realized that some of these pictures do not have the label tag.
- Contact information does not appear clearly.
- Website can be visited by many people that live in different countries with different cultures and languages. So, including language options is very important.
- Link labels are not appropriate.

- Designers use some orientation resources such as breadcrumbs for locating users in the Website, but the analyzed Websites lack this type of orientation information.
- Interfaces should be intuitive but in the Websites analyzed the user were forced to remember previous experiences to be able to carry out a task again.
- Reducing user memory load is essential to show information in a clear way, without so much information. The Websites evaluated present too much information. For instance, if we search "Leo Messi" in sig.ma Web page, we see an enormous scroll with a lot of information.
- We consider that in Websites we should show enough information to carry out tasks without problems.
- According to other misconducts such as the vocabulary used, the main goals of each interface are not so clear. But this mistake is a consequence of other cited problems.
- If a search does not have results, system does not warn users.
- We should know the meaning of the tables with only catching a glimpse of it. When tables are shown in interfaces, their columns or rows titles are not representative and understandable.
- Another consequence about understandable links is the opening of new windows without warning users. And sometimes, these links or pages are "Not found" pages.
- It is important that the interface uses the same aesthetic design in the site. However, Websites display different aesthetic design, and sometimes we (as evaluators) thought we were in a different Website.

To sum up, the general impression is that navigation systems are poor.

3.2 Quantitative Results

Quantitative results will be analysed distinguishing between Websites for end-users and Websites for specialized users. There are many repeated problems. Nevertheless some different aspects were identified, the most important being that Websites for specialized users present more usability problems. It is due to Web designers not giving importance to specific features that are essential in a Website for end-users. In next table we show that in all Websites 63 different problems appeared. From these, 48 are common in both types of Websites but the remaining fifteen are separated as follows:

Websites for end-users have 4 problems that Websites for specialized users do not suffer, and Websites for specialized users have 11 problems that do not appear in Websites for end-users.

Table 3: Classification of problems.

Total of problems	Equal problems	Different problems	
		Websites for end-users	Websites for specialized users
63	48	4	11

In usability evaluation section we cited a set of 16 usability categories that we used to carry out all heuristic evaluations (Masip et al, 2010). Now, we present a table with the amount of misconducts that we detected in each category. We detected 63 different problems in all Websites, which can be summarised into 26 misconducts detected at least in three Websites. Note that we do not show all categories because we did not find misconducts in all of them. So, we do not include categories without problems in the next table:

Table 4: Quantity of problems.

Category	Number of problems
Navigation	4
Memory load	4
Dialogs	4
Internationalization	3
Content	3
Consistency	2
Shortcuts	1
Help	1
Search	1
Flexibility	1
Easy use	1
Feedback	1

4 DISCUSSION

According to the evaluation, the weakest usability categories in this type of Websites are navigation, memory load, dialogs, internationalization, content, consistency, shortcuts, help, search, flexibility, easy use and feedback. Problems found in navigation category are related with menus structure. It is worth highlighting that some interfaces analyzed are browsers, so, menu is poor or null. The same happens when analyzing where the information is located. It is clear that if the ontology appears, the Website might present a complex structure so, it is impossible to use the traditional breadcrumbs. But it is also clear that ontology's might have hierarchy of information. So designers should try to create breadcrumbs or something similar to locate users in the interface using the upper classes and show breadcrumbs.

Regarding to dialog, it uses more ontology expressions in Websites for specialized users than in Websites for end-users. And these expressions are closely linked to ontology jargon. It often causes that vocabulary used is not intuitive for common users or/and users expert with knowledge included in the ontology. Heuristics about memory load, apart from their links to the abusive use of specific language, refer to the amount of information that can be found in some pages. There is an overload of information and links whether user is a novel or expert user.

About internationalization, we highlight that it is very important to show dates in each part of content because it is important to know the validity of the content and their last updating. And we cannot forget that if we use date and times, we will show the time zone to locate our area in a more specific way and they have to use international format. When the design suddenly changes, the most important problem in consistency category appears. Finally, Websites search results are presented in an unclear way and often they are impossible to understand. But, in the same way such other problems, this type of problems also appears in other type of Websites. So, it is not a typical problem of SW applications but it is important to highlight its appearance.

According to our Websites classification (Websites for end-users and Websites for specialized users), we detected that in Websites for end-users, interface design is more accurate and designers spent more efforts to achieve a Website aesthetically better than design of Websites for specialized users. So, Websites for specialized users present more usability problems than other type of Websites. Furthermore, in table 4, we note that categories in which interface designers should do more efforts to improve them are navigation, memory load, dialogs, internationalization, content and consistency, respectively. However, the worst categories are navigation, memory load and dialogs. So, these should be the first features that designers should improve immediately.

5 CONCLUSIONS AND FUTURE WORK

In this paper, a usability evaluation of Websites those use SW technology in their design has been

presented. We proved that we can use the same usability evaluation method in semantic application than in another common type of application. In addition, we proved that the set of used heuristics is applicable in SW application and in another type of interactive system that not use this kind of technology. So, extending our set of heuristics to evaluate this type of interfaces is not necessary yet because it covers all usability features for SW applications. Moreover, another and important reason is that technologies used to design some application should try to go unnoticed by end users. But if in few years new functionalities will appear, we should extend usability categories to cover all features in SW applications. However, we will do the same in another type of application. In fact, it is technology evolution. Even so, we realized that it is very important to design for users and include user experience features in all interfaces design. Then, considering that usability is one of the oldest factors that scientific community uses to improve the user experience of product, we included this factor in SW application as the first one to start improving the user experience of this type of interfaces.

We carried out a usability evaluation in eleven semantic Websites and we concluded that the main problems are in navigation, dialogs and memory load categories. So, semantic application designers should make more efforts to achieve a SW application that causes end user a positive experience. We hope that this article will help semantic application designers to realize that when they include some semantic tasks for users, these tasks should be easy and intuitive. Our future work will be based on extending user experience evaluation to other factors apart from usability.

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