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A QUANTITATIVE APPROACH TO USABILITY EVALUATION OF WEB SITES

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Abstract: Web usability arose as research field at the very beginning of the Internet era. The term "Internet" was formally defined in October 1995; nevertheless Nielsen wrote his first article on web usability in May 1995, and looking in the newsgroup archives at groups.google.com we can find a promotional message (<http://groups.google.co.uk/groups?hl=en&lr=&ie=UTF-8&oe=UTF-8&group=alt.comp.shareware>) of a company, dated December 1995, offering consulting services on usability. The pace of evolution of the web is creating new challenges and 15 years after the first studies on web usability, the subject is still attracting heavy interest from researchers. In the recent years numerous authors (Shneiderman and Plaisant, 1998; Nielsen and Molich, 1990; Nielsen, 1994) have been working on developing heuristics to support human evaluation of web sites. This paper builds upon the existing theory to develop a quantitative approach to usability evaluation of web sites.

1. Introduction:

For a number of years researchers have been proposing new and refined methodologies for usability evaluation. This paper builds on the existing research to present a quantitative approach to usability evaluation of web sites, focusing on automated XHTML code analysis.

The study of usability applied to the web, arose as research field at the very beginning of the Internet era. The Internet as we intend it today, where users connected to the network can access data on remote servers, has been developed at CERN, Switzerland, starting from 1989, when Tim Berners Lee wrote a draft called "HyperText and the CERN". The availability of CERN's files using the Internet was announced in the

Usenet newsgroup, alt.hypertext, in August 1991.

Usability is a major factor in the quality and success of a web site (Beirekdar et al, 2003). However, a large amount of data is not reachable to all users, due to usability and accessibility problems in web sites (Jasselette et al, 2007). This led to the development of usability standards and guidelines (Jasselette et al, 2007; W3C, 2010d).

Most academic research focuses on usability, high traffic and high profile web sites – but it seems very likely web users still spend plenty of time in minor web sites. Our approach aims to provide understanding of the usability of web sites, both in terms of numbers (analysing a higher number of web sites) and in terms of evolution (comparing web sites in time).

This paper reports on a prototype PHP (PHP, 2010) software that we have used to conduct automated evaluation of XHTML source code of all DMOZ (DMOZ, 2010) homepages. The rationale is that homepages are often a web site's first – and possibly last chance to attract a user (Nielsen and Tahir, 2002) and that an unusable web page highly affects the chances of a user using a web site.

A number of tools have already been developed to provide some degree of automation in usability analysis (Vanderdonckt and Beirekdar, 2005). This paper will report on the initial stages of this research, by describing our approach and discussing the architecture of the system that we have developed to test through automated analysis of XHTML source code of the web pages then study the evolution of the web pages against usability problems and obtain meaningful quantitative results.

2. Usability guidelines for the web:

To satisfy users by presenting a usable web design, a wide variety of usability guidelines have been designed by different authors (Ivory, 2001; Nielsen and Tahir, 2002; Rohn et al, 2002; Graham, 2003; W3C, 2010b). Each one of them focuses on how to satisfy users by presenting a usable web site design and also these guidelines address a wide range of web page design issues starting from the browser's title to the detail of web page features (Abdulkhair, 2004). According to (Scapin et al, 2000) guidelines are numerous and distributed among different sources: recommendation papers, design standards, style guides that are specific to a particular environment, design guides and algorithms for ergonomic design. Additionally, contradictions exist between guidelines, which might be because of their different ages, the changes in the technology

or because they might be appropriate only for specific group of users.

The Web Content Accessibility Guidelines (WCAG 2.0) (W3C, 2010b) plays an important role in web site usability guideline because it yields to apply broadly to more advanced technologies; is easier to use and understand; and is more precisely testable with automated testing and human evaluation (W3C, 2010c). Furthermore while usability implies accessibility (at least when an unconstrained user population is considered), the contrary is not necessarily true. For example, a missing link to the home page may be a fault affecting usability, while it does not affect accessibility (Brajnik, 2000a). According to the (Brajnik, 2000a) point of view it is possible to categorise guidelines within the following,

1. Consistency of presentation and controls.
2. Adequate feedback.
3. Natural organization of the information.
4. Contextual navigation.
5. Efficient navigation.
6. Clear and meaningful labels.
7. Robustness.
8. Flexibility.
9. Functionality.
10. Others.

Although any of the usability guidelines apply in general, we can filter it according to the scope of home page usability and also have usability guidelines as a check-list when designing home pages (Nielsen and Tahir, 2002).

2.1 Title guidelines:

The web page title is an important element in the web design as pointed out in (Ivory, 2001). The title is the first item that appears in the web browser window, it is considered

as the main references to the web pages, and it can be used in the bookmark list and the history list (Nielsen, 2000; Nielsen and Tahir, 2002). Web site users are always expected to scan rather than read (Nielsen and Tahir, 2002), consequently web titles should have limited length and be descriptive of the page's content (Abdulhair, 2004). In order to successfully select the web page title experts offer some guidelines developers should follow.

- Web page titles should not be more than 64 characters (Nielsen and Tahir, 2002).
- Window titles should contain no more than eight words (Nielsen and Tahir, 2002).
- Web page titles should not contain words such as “.com, online, homepage and etc.” (Nielsen and Tahir, 2002).
- Window titles should not start with words like “The” or “Welcome to” (Nielsen and Tahir, 2002).

The above guidelines are intended to apply to the window or browser title, which can be extracted from the title tag in the XHTML source code.

2.2. Text effects (Bold, Italic, Underlined) Guidelines:

Users can traverse web pages in several ways depending on their reading habits (Sklar, 2000). The user's eye movement can be classified either into a normal reading style starting from left to right and back again or as clockwise pattern.

In both cases the users scan the web page from top to bottom searching for the desired data by concentrating on the emphasized text, which can be indicated by bold, italic, underlining, changed font size, face, colour or alignment. Each of these aspects has its

own guidelines to improve its usage (Abdulhair, 2004).

For what regards bold text:

- It can be easily noticed and read from the screens (Lynch and Horton, 2001).
- Too much bold text lacks contrast and loses efficiency (Lynch and Horton, 2001).
- The experts' recommendations for italic face usage can be summarized as follows:
 - Avoid setting large blocks of text in italic (Lynch and Horton, 2001).
 - Avoid using italic text altogether (Ivory, 2001).
 - Italic text is hard to read in paragraph format (Sklar, 2000).

Underlined text has special meaning in web documents because it represents hypertext links in most web browsers, there is wide agreement on the fact that it should be avoided (Ivory, 2001; Lynch and Horton, 2001).

2.3. Font face guidelines:

Some font faces are more legible than others on normal computer screens, and font legibility is not constant across media. Times New Roman is one of the most legible font faces on paper but that is not true on screen (Lynch and Horton, 2001) and some typefaces are more legible than others (Lynch and Horton, 2001). Font face guidelines can be summarised in the following points:

- Use sans-serif font face for the small text size (Ivory, 2001; Nielsen, 2000; Lynch and Horton, 2001).
- Use serif typeface for the bigger text such as heading (Nielsen, 2000; Ivory, 2001; Lynch and Horton, 2001). Verdana or Arial are especially indicated.

- Use serif font for faster reading (Ivory, 2001). Georgia and Verdana offer excellent legibility (Ivory, 2001; Lynch and Horton, 2001).
- Use Time New Roman for the printer version of webpages (Lynch and Horton, 2001).
- The typeface choice should be based on the amount of web page content (Lynch and Horton, 2001).

2.4. Font size guidelines:

The size of the font is important to fast scanning (Abdulhair, 2004). In order to achieve an appropriate layout with a specific font size for users with average vision, research suggests that websites should:

- Use font size 14 point (or higher) for headings and displaying text (Ivory, 2001; Lynch and Horton, 2001).
- Use font size between 10 and 12 point for body text (Ivory, 2001; Ivory and Hearst, 2001; Lynch and Horton, 2001; Lengel, 2002).

2.5. Link specification:

In the literature reviewed a number of restrictions on links appear:

- Number of words in text link: Use two to four words in text link (Nielsen, 2000); one to three words in each link (Ivory, 2001).
- Links in a good page do not contain stop words (Ivory, 2001).
- Use of internal links should be minimised (Nielsen, 2000; Nielsen and Tahir, 2002)
- Avoid using (link, click, click here, more and etc.) (Ivory, 2001; Nielsen, 2000; Nielsen and Tahir, 2002; Lynch and Horton, 2001).

- Use default browser colour combinations for links (Ivory, 2001; Nielsen, 2000).
- Mark the visited links with a different colour to the unvisited (Nielsen and Tahir, 2002).

2.6. Web contents:

A large number of web sites update their web sites on a regular basis by removing and adding web pages. If done by different people, it could begin to produce inconsistency and in itself cause a usability problem.

2.7. Advertisements:

As web pages may be browsed by large number of users, many companies want to have a chance to attract advertising revenue. They divide their web pages into different sections and one of the sections is used for advertisements throughout. Users seem to be annoyed by advertisements and have learned to ignore them (Nielsen and Tahir, 2002). But if the developers insist on including the advertisements within their web pages, they should reserve special places for them, such as a banner area, and never place them next to important web page content (Nielsen and Tahir, 2002). Furthermore popup windows advertisements are considered to be one of the worst choices because they keep the users out of the page and distract their attention from the main content (Nielsen and Tahir, 2002).

2.8. Images:

Web browsers do not immediately support new publishing technologies, and obviously, old browsers that are still used by many users do not support them (Beirekdar et al, 2002). Different solutions can be applied to

solve the image download time and browser supporting problems. Some of these solutions are:

- Produce small versions of images (Nielsen, 2000).
- Divide a document containing many images into several documents containing fewer images (Nielsen, 2000).

2.9. Frames:

Frames allow web developers to divide the web page into several sections with each section holding a individual web page. Using frames is in general problematic for users that are not familiar with the technology. It is recommended to substitute layers for frames or to organise the information differently by separating it into several web pages (Abdulhair, 2004).

3. Automated usability evaluation:

Automated usability evaluation focuses on developing tools and techniques to rapid evaluation, tools that reach a wider audience for usability testing, and tools that have built-in analyses features of automated. Different automatic web usability evaluation tools have been established to solve the diversity web interface problems (Abdulhair, 2004).

3.1. Existing tools:

Several approaches can be found that try to automate usability evaluation and most of these approaches fall into one or more of the following three categories,

1. Usability data capture: it consists of collecting usability data, such as errors, subjective ratings, task completion time, and guideline violations (Ivory and Hearst, 2001 ;

Tiedtke, 2002; Vanderdonckt and Beirekdar, 2005).

2. Analysis: it is the phase where usability data are interpreted to identify usability and accessibility problems in the web site (Ivory and Hearst, 2001 ; Tiedtke, 2002; Vanderdonckt and Beirekdar, 2005).
3. Critique: it consists of suggesting solutions or improvements to mitigate the previously identified problems (Ivory and Hearst, 2001 ; Tiedtke, 2002; Vanderdonckt and Beirekdar, 2005).

Some of the tools check the conformance of HTML code and repair syntactical problems, which can lead to usability problems; HTML Tidy (Sourceforge.net, 2010) is the most common example. One step further, some tools performed an analysis to verify some predefined rules or metrics. The reviewed tools focus on design rules, downloading times, HTML conformance. Although these aspects certainly affect usability, they are not related straightforwardly. Finally, other tools still conduct an analysis of the HTML source code to check usability guidelines for the Web. The efficiency of automated tools varies according to their scope such as one element, one page, and entire site all have the same functioning principle: to detect usability problems by analyzing the HTML source code of the target page to verify some predefined evaluation conditions (Brajnik, 2000b ; Beirekdar et al, 2002).

4. AWebHUT architecture:

AWebHUT – Automated Web Home-Page Usability Tester works by:

- Filtering and storing web sites.
- Page parsing and data generation.
- Detecting web usability issues.

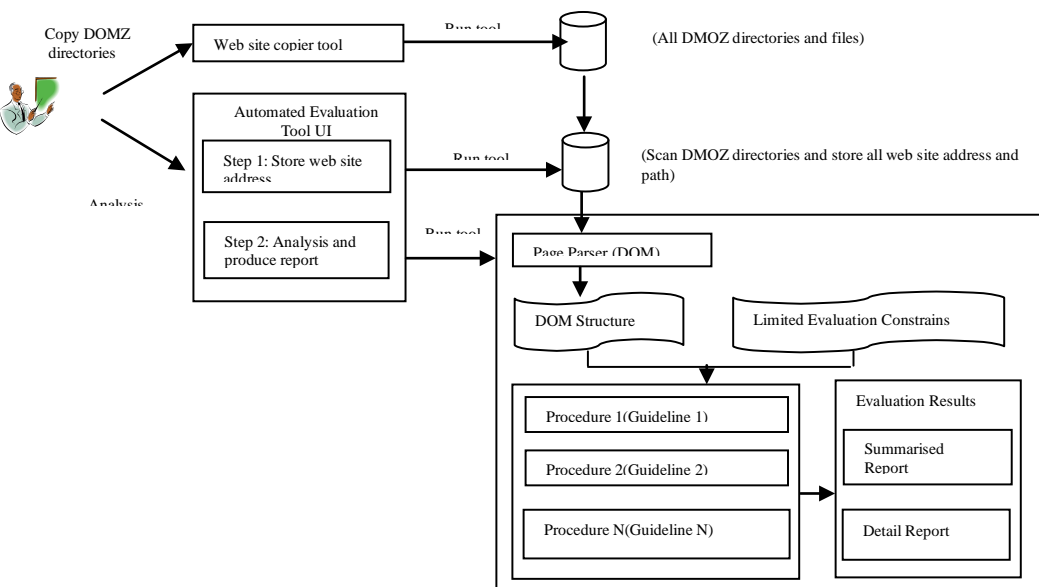
- Visualising the results.

The tool is working with the support of a web site copier tool. A database is used to store all web site address for evaluation. Then the tool catches the web site address from the database and passes it to get whole HTML source code structure of the home page of the web site.

Then, it performs web usability guideline evaluation one by one by calling procedures in sequential manner for which the tool has the separate algorithm. The sequential manner of evaluation is very suitable for the architecture because each web usability guideline is represented and implemented with its own straightforward procedure which yields to gain efficient and fast evaluation process. For each web usability guideline evaluation for a home page several metrics are generated. Finally it provides a summarized and detailed report about the respecting or violation of web usability guidelines.

4.1. Passing home page data:

To provide data for the web usability



ty guideline evaluation process, the HTML source code of home pages were passed. The tool's page parsing strategy is based on scanning the whole web page and extracting the tags, attributes, values, and labels that we used when evaluating our guidelines in term of procedures. For this purpose the Document Object Model (DOM) (W3C, 2010a) is used.

4.2. Organising web usability guidelines and targeting HTML elements:

Vast numbers of web design principles and recommendations exist, which provide web developers with useful web usability guidelines (Nielsen, 2000; Ivory, 2001; Nielsen and Tahir, 2002). One of the main activities of this research was to organise web usability guidelines for automation. Several HTML elements such as tags, attributes, values and labels were used to evaluate a home page against the targeted web usability guidelines.

Figure 1: Tool architecture

4.3. Home page evaluation

The tool produces two kinds of reports: a summarised report and a detailed report. In the summarised report, four levels are used to measure the usability level of home pages as follows,

- N – Neutral: The page is being neutral for the web usability guideline.
- V – Violate: The home page is violating the web usability guideline.
- R – Respect: The home page is respecting the web usability guideline.
- E – Error: The web site address is redirected to another site.

Furthermore the tool produces a detailed report which indicates all instances involving the web usability guideline and point out where the guideline is violating.

5. Evaluation:

The web usability evaluation conducted by AWebHUT will attempt to answer the following questions,

- Are there any categories of web sites which have more usability problems and if so, which ones?
- Are there any categories in which the usability is typically higher, and if so, why?

From the summarised report, it is easy to identify that the addresses of the web sites and the respective categories which have more usability problems. The “Fig 2” shows the screen shot of the summarised web usability report of the first 20 web sites.

6. Conclusion and further research:

As our research covers vast amount of web sites we have created a tool by utilizing different software models, which support web usability evaluation, our research tries to integrate those to provide a reasonable solution for automatically evaluate of web sites against web usability guidelines.

S.No	Web site address	Web site category	1.1	2.1	3.1	3.2	3.3	4.1	4.2	5.1	5.2	5.3	6.1	6.2	7.1	7.2	8.1	9.1	9.2	% of V	
1	http://www.eleonorbenet.com/	/Arts_and_Entertainment/Actors_and_Actresses/B/	R	V	N	V	N	V	V	R	R	V	N	V	N	V	N	V	R	R	47
2	http://www.danielbooth.co.uk/	/Arts_and_Entertainment/Actors_and_Actresses/B/	R	V	N	V	N	R	R	R	R	V	N	V	N	V	N	V	R	R	55
3	http://www.paulspage.co.uk/	/Arts_and_Entertainment/Actors_and_Actresses/F/	R	V	N	R	N	R	R	N	R	V	N	V	N	V	N	V	R	R	18
4	http://homepage.nfworld.com/nichaelmcmahon/	/Arts_and_Entertainment/Actors_and_Actresses/M/	R	V	N	V	N	R	V	R	R	V	N	V	N	V	N	V	R	R	41
5	http://www.melhall.co.uk/	/Arts_and_Entertainment/Actors_and_Actresses/M/	N	V	V	V	N	N	N	R	N	R	N	V	N	V	N	V	R	R	35
6	http://www.theminam.co.uk/	/Arts_and_Entertainment/Actors_and_Actresses/M/	V	N	V	N	N	R	R	R	R	N	V	N	V	N	V	N	R	R	29
7	http://www.hayleynewton.biz/	/Arts_and_Entertainment/Actors_and_Actresses/N/	N	V	N	V	N	R	R	N	R	N	V	N	V	N	V	N	R	R	29
8	http://www.mattparkinson.co.uk/	/Arts_and_Entertainment/Actors_and_Actresses/P/	R	V	V	V	N	N	N	R	N	R	N	V	N	V	N	V	R	R	29
9	http://www.moragiller.com/	/Arts_and_Entertainment/Actors_and_Actresses/S/	R	V	N	V	N	N	V	R	R	N	V	N	V	N	V	N	R	R	24
10	http://theevenings.tv/forever/guest-bio.htm	/Arts_and_Entertainment/Actors_and_Actresses/	R	V	N	V	N	R	R	R	R	V	N	V	N	V	N	V	R	R	35
11	http://www.bbc.co.uk/dramas/faces/	/Arts_and_Entertainment/Actors_and_Actresses/	V	V	N	N	N	V	R	R	R	V	N	V	N	V	N	V	R	R	41
12	http://film.guardian.co.uk/The_Players/Front/	/Arts_and_Entertainment/Actors_and_Actresses/	V	V	N	V	N	N	V	R	R	V	N	V	N	V	N	V	R	R	53
13	http://modelsconnect.net/	/Arts_and_Entertainment/Actors_and_Actresses/	V	V	N	V	N	N	V	R	R	V	N	V	N	V	N	V	R	R	53
14	http://www.tnaw.co.uk/	/Arts_and_Entertainment/Actors_and_Actresses/	R	V	N	V	N	R	R	N	R	V	N	V	N	V	N	V	R	R	29
15	http://www.fiscal.co.uk/entertainment/film/biography/	/Arts_and_Entertainment/Actors_and_Actresses/	V	V	N	V	N	N	R	R	R	N	V	N	V	N	V	N	R	R	33
16	http://www.yata.org.uk/	/Arts_and_Entertainment/Animation/Anime/Clubs/	R	V	N	V	N	R	R	R	R	V	N	V	N	V	N	V	R	R	35
17	http://www.anime.org.uk/	/Arts_and_Entertainment/Animation/Anime/	N	V	N	V	N	V	V	R	R	V	N	V	N	V	N	V	R	R	47
18	http://www.crysko.demon.co.uk/britain.htm	/Arts_and_Entertainment/Animation/Anime/	V	V	N	N	V	V	R	R	N	V	N	V	N	V	N	V	R	R	53
19	http://www.up1.co.uk/	/Arts_and_Entertainment/Animation/Anime/	V	V	N	N	V	V	R	R	N	V	N	V	N	V	N	V	R	R	53
20	http://www.mvanko.pwp.bhevrolet.co.uk/chank/	/Arts_and_Entertainment/Animation/Companies/Cosgrove_Hall/	V	V	N	N	V	V	R	R	V	N	V	N	V	N	V	N	R	R	53

Where, E, Error on page, N, Neutral, R, Respection, and V, Violation

Figure 2: Evaluation result: summary

As the tool depend on another tool of web site copier, it wants to have its own functionality to evaluate any part of the DMOZ (DMOZ, 2010) directory without depending on other tools in future. In addition we will use information from applying the tool to different web sites to identify new functionality as well as identify limitations of the tool. Future plans include the ability to look at an entire site at one time, as opposed to the only home page at a time view currently then it yields to analyse for guidelines that cover inter pages relations or link-structure issues can be possible after validating our results in home page evaluation.

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