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Extended Abstract

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The Automation of a Heuristic Evaluation Method for Identifying Usability Issues in Websites

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1. Abstract

The availability and usage of web content has increased considerably over the last few decades. With this increase, the need for developing methods for evaluating the website usability has also arisen, and several techniques to evaluate web usability were developed. Most of them are manual processes, which are proven to be tedious and time consuming. Subsequently, many software tools that support these methods have been developed, and efforts are still underway to enhance the simplicity and accuracy of such tools. The main work presented in this paper is a a software solution named as Electronic Validator. This tool was implemented with the aims of developing an effective and efficient usability evaluation method which does not need expertise of usability specialists for website evaluation. The top level design of the E-Validator software system consists of two modules. These are the user interface and the evaluation engine. The software takes web pages saved on disk as input, extracts its related CSS data files and converts these information into a composite data structure. This data structure is then analyzed by the evaluation engine, which then identifies usability problems in the web pages. These usability issues are inserted into a report, which is displayed to the end user. The software solution was evaluated by considering results of heuristic evaluations by industry experts such as QA engineers and UX engineers. The data collected during the evaluation stage was analyzed and overall system accuracy is 72%. However, the E-Validator system has several limitations. The software accepts only off-line web pages for usability assessment; this tool can currently identify only four usability violations listed under two heuristics; and, this software system can only be used to evaluate the web pages in which the appearance and behavior is set by cascading style sheets.

Keywords: evaluation, heuristics, usability

2. Introduction and research problem/issue

Since early eighties, the Internet has shown an exponential growth [1]. Further, they have predicted that this rate of change will not be weakened in the future. The rapid developments in the networking technologies has also contributed to this increase in the size of the Internet. This trend has caused an equal change in the amount of web material which is available online. Due to it's popularity, the amount of online content added to the world wide web, through social media networks, is immense [2]. The use of the web for entertainment purposes has further intensified this issue. This situation has created a growing need to ensure the usability of websites. In fact, usability has been identified as a crucial factor that determines the success of a website and the loyalty of the website visitor [3], [4].

The usability of a website can only be ensured by an effective usability evaluation method. As a result, to ensure the usability of websites, various methods have been developed. However, these manual methods have been characterized as time consuming and expensive since they require professional knowledge. In a survey done by Ivory and Hearst [5], they have identified that automation of manual methods helps to overcome such limitations in usability evaluation. The research presented in this paper has developed an automated usability evaluation system which can identify usability errors in websites. Following an evaluation of this software, an overall system accuracy of 72% was calculated.

3. Research Methodology

In this research, it is hypothesized that a cost effective, efficient usability evaluation method can be developed by implementing a software system that automates the heuristic evaluation method. The software was created using the Java language. The system architecture consists of a graphical user interface and an evaluation engine. The evaluation engine contains fifteen Java classes. The most significant ones are, classes that are related to the system's data structure of CSS data, child classes of the Error class, and the WebPageParser class, which is the core of the evaluation engine. The system design is object oriented.

The majority of websites today use CSS to customize it's appearance. For example the Firefox code inspector has a CSS code analyzer by default, and for most websites you see, it displays CSS encodings. Thus, the system can effectively assess the usability of websites on the selected heuristics. The novelty of this system is that it uses knowledge of usability experts (identified by heuristic evaluation reports) , related to a set of heuristics, for evaluation of usability of websites.

The software tool developed in this research automates the heuristic evaluation method. This software takes web pages of HTML 5 version, which are saved on a disk drive as input. These web pages are selected by the end user

via commands given through a graphical user interface. The system then searches for CSS files which corresponds to these web pages. These CSS files are usually saved in a sub directory when the web pages are saved through a web browser. Identifying usability errors in a web page involves the analysis of these CSS files. When the HTML and CSS data have been

processed, the system produces a report of usability errors that were found in the web pages.

The formula used for the calculation of the the system accuracy is given in Figure 1.

$$Accuracy = \left(\sum_{i=1}^{n} value_i \in A \div Totalnumberoferrorsfoundbyexperts \right) \times 100$$

where A is column 4 in Table 4

Figure 1: The above shows the formula for measuring system accuracy.

4. Results and findings

Implementation of E-Validator software

Usability evaluation by the E-Validator software consists of a number of steps. Initially, the web pages to be evaluated by the software are designated by the user. The program then extracts web page display instructions included in the CSS files related to these web pages. At the implementation level this is done by using the CSS parser library [6]. The fetched CSS instructions are then stored in a data structure. The contents of this data structure is then examined for identifying the usability errors in web pages. The descriptions of these errors are then inserted into a report. This report is then displayed to the user.

Mapping between the WCAG 2.0 usability guidelines and the selected heuristics

This research has automated a modified heuristic evaluation mechanism that was developed in a study done by Chisnell & Redish [7]. The WCAG

(Web Content Accessibility Guidelines) 2.0 guidelines ensure that web pages conforming to them are more accessible by individuals having disabilities. It also ensures that the designs adapting these guidelines are usable for the general website user [8]. These guidelines are recommendations for website design, by the World Wide Web Consortium (W3C). Table I shows a mapping between the usability heuristics considered for implementing the E-Validator software system, and the WCAG 2.0 usability guidelines. The usability issues shown in Table 1 chosen for this research were taken from the heuristic evaluation reports that were produced in the study in [7]. The study related to current research paper has mapped these four usability violations to two heristics from [7] as shown in Table 1.

Table 1: Mapping between the heuristics selected for the study and the WCAG 2.0 usability guidelines

Heuristic	WCAG 2.0 usability guideline	Usability errors identified by the EValidator System	
Use conventional	Guideline 2.4.4 Link Purpose (In Context): The purpose of each link can be determined from the link text	1. Browser links are not in purple and 2. Links are not	

interaction elemen ts.	alone or from the link text together with its programmatically determined link context, except where the purpose of the link would be ambiguous to users in general. (Level A)	underlined or dynamically underlined
Make click- items target content, and	Guideline 2.4 Navigable: Provide ways to help users navigate, find targets to click on easy to determine where they are.	Menus have small able to and hit.

Data Collection

The automated solution developed in this research was evaluat ed in the following manner. Initially 8 sample websites were assessed by industry experts. For this purpose, an online questionnaire was used to collect the results of the heuristic evaluations. These evaluations were performed by these usability experts such as QA Engineers and UX Engineers. The manual heuristic assessments has produced 88 samples of web page evaluations. These results are aggregated and are shown in Table 3. The same websites were evaluated by the automated solution. The results were codified and analyzed and an overall system accuracy was calculated.

Table 2: The different usability errors and their assigned labels.

Usability issue identified by the system	Label
Browsed links does not appear in purple	E1
Links are not underlined	E2

Links are not Dynamically underlined	E3
Menus have small targets to click on	E4

System generated output

Table 2 shows the type of usability errors identified by the software system. Also the labels assigned to each of them is shown as a column in this tab le. The first usability error (E1) included in this table occurs during website interaction when the visited hyperlinks do not appear in purple color. The second usability error (E2) indicates that hyperlinks in a web page are not underlined. The third usability issue (E3) occurs in a web page when hyper-links are not dynamically underlined when a user hovers the mouse pointer over. The final usability error indicated by (E4), occurs in a web page when menus have a small target area to click on. By runn ing the automated solution on the selected websites, the usability issues in the web pages were identified and summarized in Table 2.

Table 3: Aggregated usability errors identified by the system and results of the heuristic evaluations done by industry experts

Website considered	Quantified usability results	Quantified evaluation issues
w1	1	1
w2	1,2,3	1,2,3,4
w3	1,2	1,3
w4	1,2	1,2,3

w5	1	2,3
w6	1	1,3
w7	1,2	1,3
w8 2,4	1,3	

Results of expert evaluations

The selected websites were assessed by industry professionals. As Nielsen & Molich [30] has found, heuristic evaluations provide best results when the usability issues identified are aggregated. For validating the automated system, the assessment results are aggregated before being used for analysis. The aggregated evaluation results for the selected websites is shown in Table 3.

Table 4: Calculation of the system accuracy. In the final column, 1 indicates a match between the system generated result and the expert evaluation related to the specific web site. A 0 indicates a mismatch between the two types of results.

Website	System generated	Expert assessment	Match (1=Yes, 0=No) result
w1 1	1	1	
w2	1	1	1
	2	2	1
	3	3	1
		4	0

w3		1	1	1	
		2	3	0	
			4	0	
w4		1	1	1	
		2	2	1	
			3	0	
w5		1	1	1	
			2	0	
			3	0	
w6		1	1	1	
			2	0	
	3	0			
w7		1	1	1	
		2	2	1	
			3	0	
			4	0	
w8			1	0	
		2	2	1	
			3	0	
		4	4	1	
			Overall Score	72.2222222	

5. Conclusions, implications and significance

The E-Validator software system indicates an overall system accuracy of 72%. This measure shows the level of conformity of the automated method to the manual method. It is possible to validate the hypothesis of the research and conclude that with regard to the selected heuristics in the study, the heuristic evaluation process can be automated by using a software system. Further, it can be justified that by using the automated solution, an efficient usability evaluation can be performed on a web site without seeking professional expertise. The system can identify the programmed usability issues in web pages in less than 20 seconds in a commonly available PC hardware configuration.

6. References (Selected)

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