

Eye Tracking Method to Compare the Usability of University Web Sites: A Case Study

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Abstract. Web sites are one of the main source which enables human computer interaction, also widely used for receiving and transmitting information. University web sites are frequently visit by their students to get some information. In today's fast life cycle these web sites has great usage, many people prefer to use them. University web sites are extremely important for the students of that institution. In the last years, usability has become a highly important research subject. Designing usable web sites is considerably important factor for the user satisfaction in our case for university students.

In this study, a new design is proposed for the engineering faculty web page and eye tracking method is used to compare the usability of it with the original design. Participants were observed while trying to finish specified tasks. In evaluation period, fixation count, fixation length and heatmaps of each website are taken into the consideration. At the end of the study showed that proposed design is more effective and efficient. Participants required fewer fixations and less time to complete the given tasks.

Keywords: Eye tracking, HCI, usability, computer interface design, design evaluation.

1 Introduction

In recent years, human-computer interaction became a really important issue because of the rapid development of computer technologies and the increase number of the web users.

With the fast developing computer technology and the foundation of the internet in the last two decades, from now on, people started to make their operations on the internet. At first, internet was started with the purpose of use of searching and gaining information. Web sites are one of the main source which enables human computer interaction, also widely used for receiving and transmitting information. University web sites are frequently visit by their students to get some information as well. In today's fast life cycle these web sites has great usage for many people.

Research in the web sites and reach correct information about their universities and becomes highly important for the people who are working or studying at the universities in this competitive and continuously growing academic world. With the help of the developments of the online technology and the world of the internet, people can

reach the resources all over the world. As a result research methods are naturally evolved from paper based catalogs to the searchable online web sites. Those university web sites become served as the main repositories of general information over the last years [1]. For this reason university web sites and their usability performance becomes very important in nowadays.

Usability is an emergent quality of an optimum design, which is reflected effective and satisfying use of information technologies. As an emergent quality, usability is implicit in the design and manifests itself through interaction with the product. Although this definition implies that usability evaluation necessarily involves a user interaction, evaluation may also be conducted on the basis of the product's features and characteristics [2]. In other words, usability, a holistic view to ergonomic and collaborative product design (in our case web page), is seen as a critical dimension of which importance is increasingly swiftly in designing stages. [3][4]. Usability is defined as effectiveness, efficiency, and satisfaction of a product for achieving specified goals for specified users in a particular environment.

Designing usable web sites is seen a company philosophy for firms in today's competitive business environment [5]. It is an important stage to observe and analyze multi dimensional web usability attributes in product design. In general, usability refers to how well users can learn and use a web sites to achieve their goals and how satisfied they are with that process. Usability, defined as that people who use the product can do so quickly and easily to accomplish their tasks. Web usability may also consider such factors as cost-effectiveness and usefulness. Usability measures the quality of a user's experience when interacting with a product or system - whether a Web site, a software application, mobile technology, or any user-operated device [3].

A key methodology for carrying out usability is called User-Centered Design. In the early 1990s Jakob Nielsen and Jeffrey Rubin pioneered the testing of web sites to determine whether they met users' needs [5][6]. They adapted usability engineering techniques developed for computer software design and applied them to Web design. Tests revealed that the way material is arranged, labeled, and presented on the Web (the site's "information architecture") has a major impact on users and their ability to operate a site effectively. Usability testing has since become the focus of considerable attention both for commercial and academic sites [7].

Eye tracking is vey successful research method that used in perception and visual research as well as the other human factors for years. Combined with conventional techniques those gather data based on users' explicitly and bluntly behavior such as speaking or mouse clicks. Eyetracking provides another layer of insight into how users process the visual information to which they respond when interacting with systems. In the literature there are many studies with related to eye tracking. [8][9][10].

In this study we evaluated existing web page design of an engineering faculty in terms of its usability, ease of search, fixation count, fixation length, and the required mouse clicks to complete the task. New web design which is proposed for the faculty was evaluated for same items. The next section of this study briefly explained the methodology which used in evaluation of the usability of the web sites. Section 3 gives the results of the experimental study and with the discussion and conclusion section ended this study.

2 Methodology

In this study, eye tracking method is used and this method is briefly and simply explained as follows. Eye tracking software follows the participants' eye movements on the web page or any other object. It's claimed that because of this it's possible to work out what someone is attending to and even what they're thinking about. Eye tracking uses infra red technology that shows where a pupil is by reflecting light off the retina of the eye. It's embedded in the monitor so totally non-obtrusive.

Moreover, there are two main methods for evaluating the usability of this kind of web sites which are;

- User-based evaluation and
- Heuristic evaluation

In this study user based evaluation method is preferred. If the evaluation includes users, group tests moderated by experts have proved especially helpful. As we know the quality of a website can have different aspects such as contents, language, structure, design, navigation and accessibility [11].

Participants have selected from engineering faculty students. Ten volunteers who are using their faculty web site on average three times a week. Participants' age interval is 20-23 and five of them were male, others were female. Internet usage of the participants was changed 2-3 hours per day.

Tobii 1750 eye tracker was used in this study at METU HCI Laboratory. Device has 50 Hz. Sampling rate, 1024 x 768 pixels screen resolution. Participants were asked to use a mouse to complete their responses and given tasks.

In this experiment, the participants were asked to perform different tasks using each design to examine the websites, the original design and the proposed design. Each participant completed two blocks of tasks one block per design (5 tasks for each, total 10 tasks). These blocks of tasks presented to the participant in a random order, also websites which were evaluated in a random order to prevent the biasing and learning effects. In addition to them, there was 15 minutes unrelated mind exercise between the evaluating existing and new design websites.

Duration of this study was taken 30 minutes but all participants spent approximately 20 minutes and tried to finish given tasks. During this time period, their eye-movements and mouse movements, number of mouse clicking, consumed time on each task were tracked and recorded. All of these items allow us key points for assessment of original and proposed web sites.

Following procedure in this study is explained in below steps:

- i. Web site which is examined randomly open
- ii. Random task is open, user push the 'enter' button
- iii. User tried to complete given task
- iv. At the end of the task F10 button is pushed
- v. When all the tasks were finished, 15 minutes unrelated exercise is started
- vi. Steps 2-4 are repeated for the other web page.

3 The Results of the Experimental Study

In this part of the study, results of the evaluations are presented. Producer of this study was conducted six steps as explained at the end of the previous section. Five tasks for each web site were performed by the participants. These tasks can be explained simply like the following. In the first task participants were asked to find

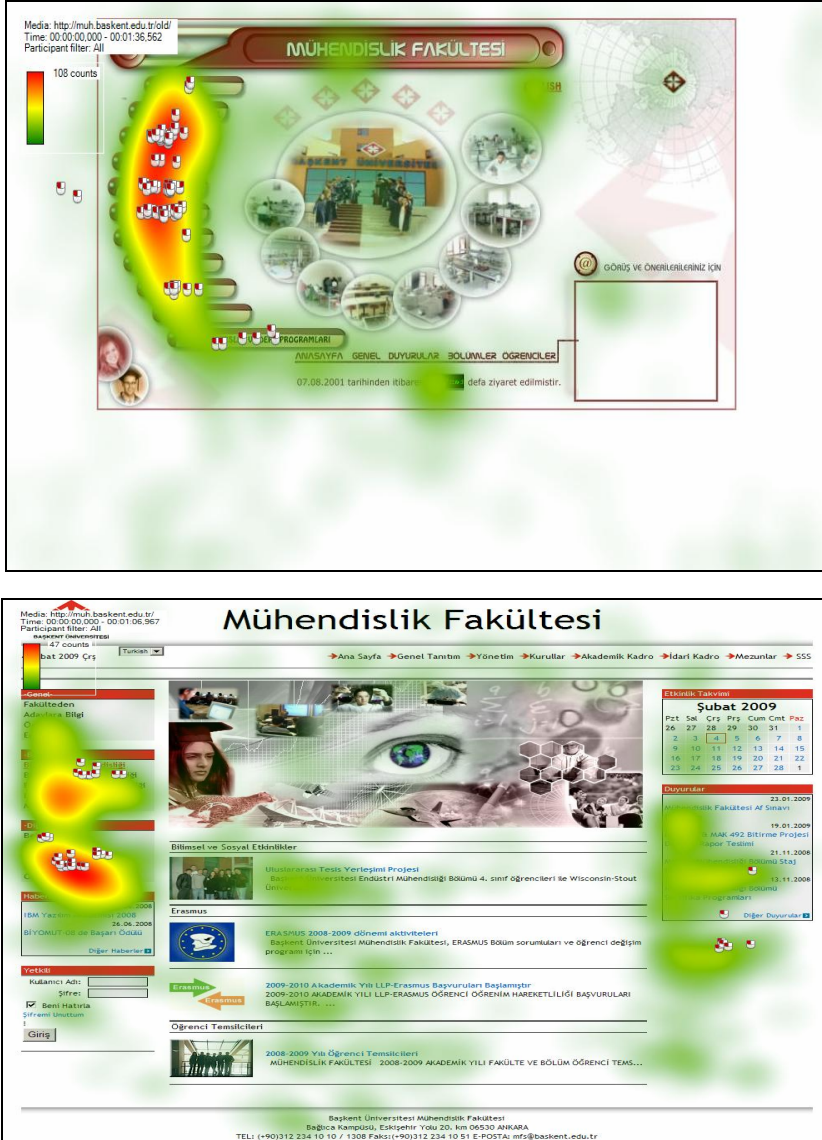


Fig. 1. Heatmaps for all tasks and all participants (original and proposed design respectively)

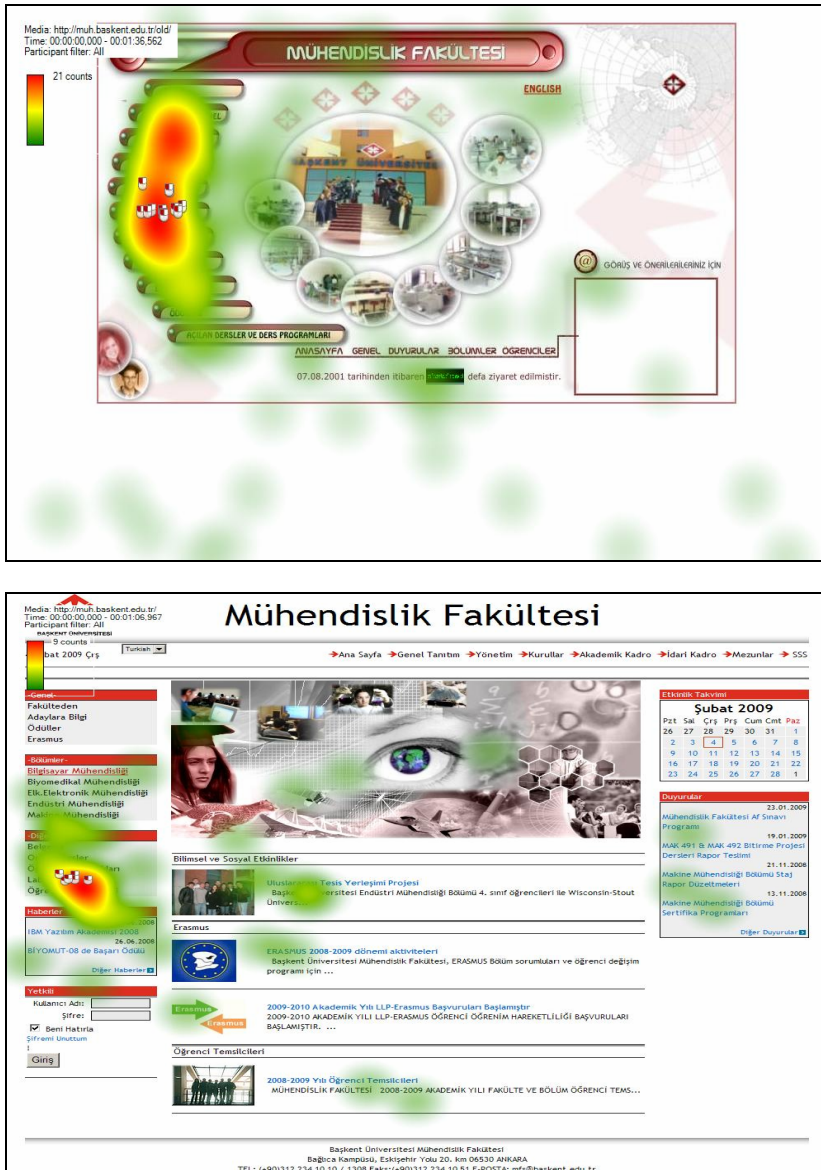


Fig. 2. Heatmaps for Task V for all participants (original and proposed design respectively)

course contents of the specifically indicated department. Then, they tried to find evaluation form about the laboratory instructor. Third task was about the computer engineering weekly schedule. In the fourth task all participants were asked to find the specific student organization in the industrial engineering department. And finally participants tried to get some information about the laboratories at the engineering faculty.

At the end of the experimental part of this study some different heatmaps can be obtained from the software. Heatmaps showed that how much users looked at different parts of a web page. Users most looked areas are colored red; the yellow areas indicate fewer fixations, and the least viewed areas colored as green. Gray areas didn't attract any fixations. There are two examples of them in below.

In Figure 1, heatmap of all task which performed by all ten participants are shown for proposed and original web site designs. In original design fixations were cluttered and scattered all over the page, even blank areas had many fixations. Listing part of the original website which has key links such as departments, laboratories, announcements has many fixations during the experiment. Original web site has 108 mouse clicks but proposed website has 47 mouse clicks. These clicking counts showed that proposed design has more concentrate clicking and ease to perform given tasks.

In Figure 2 heatmap of the task five was shown and much like Figure 1 more concentrated result was shown. Specifically for task five, proposed design has 9 mouse clicks while original design has 21 clicks. Eliminating of the distracting factors such as many and blank areas from the original design have helped to reach this result. This was also increase the efficiency of the proposed design according to the original design. Also from the heatmap of Task five in the proposed design in Figure 2, it can be shown that little participants' tendency to read in an "F" pattern, and their focus strongly on information that is placed in 'List' part.

In this study fixation count and fixation length are also evaluated for the proposed and the original design. Fixation count and fixation length were observed for three different area of interests (AOI) which were heading, menu and list. These results are given in below Table 1 and 2. Fixation counts of all tasks were less in proposed design comparatively the original design. Participants were completed the given tasks with less mouse clicks. Difficulty level of Task 2 is higher than the other tasks, so in Task 2 fixation count numbers are conspicuously increase.

Table 1. Average values of the tasks for fixation count

<i>Proposed Design</i>					<i>Original Design</i>				
	Heading	Menu	List	Avg.		Heading	Menu	List	Avg.
Task 1	2.500	0.333	11.167	4.667	Task 1	2.2	1.3	18.9	7.467
Task 2	4.333	1.167	32.833	12.778	Task 2	3.2	0.4	17.8	7.133
Task 3	2.222	0.222	8.889	3.778	Task 3	1.7	0.4	14.2	5.433
Task 4	1.000	0.500	11.167	4.222	Task 4	2.8	0.5	17	6.767
Task 5	0.667	0.000	5.333	2.000	Task 5	0.9	0.2	12.8	4.633
Avg.	2.144	0.444	13.878		Avg.	2.160	0.560	16.140	

In Table 2 which is shown below fixation length are placed. In general it can be said that participants has consumed less time while proposed design evaluating according to original design. Especially Task 2 has most time difference between the original and the proposed design even Task 2 has the most difficult one.

Table 2. Average values of the tasks for fixation length (sn.)

<i>Proposed Design</i>					<i>Original Design</i>				
	Heading	Menu	List	Avg.		Heading	Menu	List	Avg.
Task 1	0.260	0.226	0.397	0.294	Task 1	0.256	0.248	0.492	0.332
Task 2	0.313	0.259	0.317	0.296	Task 2	0.284	0.308	0.548	0.380
Task 3	0.211	0.259	0.379	0.283	Task 3	0.32	0.18	0.559	0.353
Task 4	0.223	0.181	0.452	0.296	Task 4	0.265	0.279	0.479	0.341
Task 5	0.254	0.000	0.418	0.294	Task 5	0.297	0.199	0.516	0.337
Avg.	0.252	0.185	0.393		Avg.	0.284	0.243	0.519	

4 Discussion and Conclusion

In this study, an eye tracking method is used to evaluate the university web site. Original and proposed designs were evaluated by trying to complete given tasks. Five tasks were given to the all ten participants for two different web sites. All participants achieved to finish all task for each web site. All tasks include some visually search questions and needed to display correct information on the computer screen. At the end of the evaluation period results showed that proposed design was more efficient according to the eye tracking method in evaluation of usability and participants required fewer fixations to finish the task. Specifically fixation counts were differ dramatically in proposed design according to original design. Also participants consumed more time in original design according proposed design. In this study there was an exception for fixation count of Task 2. Original design has better result in that part of the study. Task 2 is most difficult and hard to display its answer on the screen. This reason is cause of this exception. In this study, an example of how eye tracking can be used to compare and improve interfaces was presented.

In future research, participant number and number of tasks in different areas can be extended, by this way more efficient, effective and accurate results can be obtained. Tasks which are used for evaluating web design can be use in cognitive mapping techniques and petri-nets methods to compare and measure cognitive complexity of web sites.

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