Usability Tool for Analysis of Web Designs Using Mouse Tracks

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Abstract
This paper presents MouseTrack as a web logging system that tracks mouse movements on websites. The system includes a visualization tool that displays the mouse cursor path followed by website visitors. It helps web site administrators run usability tests and analyze the collected data. Practitioners can track any existing webpage by simply entering its URL. This paper includes a design case that shows the tool's value for teaching interaction design concepts.

Keywords
Mouse tracking, usability, evaluation

ACM Classification Keywords
H.5.4 Hypertext/Hypermedia: Navigation. H5.2. User Interfaces: Evaluation/methodology.

Introduction
Website administrators are constantly looking for new ways to optimize their site in order to attract more visitors. They are also concerned with increasing acceptance and popularity. Whether a website goal is to entertain, or provide information and services, its design should support the intended goals. Website tracking and usability testing can provide valuable insight as to what changes are necessary in order to

reach those goals. A great deal of information about website visitors is readily available on any Web server software. Site logs track how many unique visitors visited a site over a given time, how many times web pages were requested, among other variables. Analyzing server logs can provide quantitative data on the success or failure of a website [9]. Server logs can also provide insight into how users would want information to be organized structurally [10]. However, logs do not provide vital detailed information about what users are doing at a more granular level than the page-view level. Information such as how visitors interact with each webpage, or what information visitors see is currently unavailable. Server logs do not answer usability questions such as how hard is for users to find the link they are looking for within a webpage, where the right location for the menu is, where do users struggle while browsing a website, or which sections cause visitors to leave the site, just to name a few [4].

Traditionally, usability studies and website designs have been done using interviews, subjective evaluations, laboratory observations, etc. More recently, eye-tracking has emerged as a powerful tool to closely monitor users' behaviors while interacting with computer interfaces. Eye-tracking measures visual attention as people navigate through websites. It is useful in quantifying which sections of a webpage are read, glanced at, or skipped/ignored. Although eye-tracking is effective, it is often time-consuming, expensive and not easily accessible. Eye-tracking studies are regularly performed off line on laboratory settings with a relative small user sample. Thus, they are not able to test on typical frequent visitors to a website or replicate their surfing conditions.

Eye-trackers provide usability information used to guide the redesign process. It also ensures that the new design is effective in delivering the desired information to website visitors. If changes are to be made to a site, new analyses are necessary in order to acquire up to date valid usage information, which can make the iterative design process lengthy, costly or, in some cases, nonexistent.

Website visitors often change their surfing habits overtime. As visitors gain familiarity with a site, they approach it differently. Surfing experts navigate in entirely different way from novices (using shortcuts,

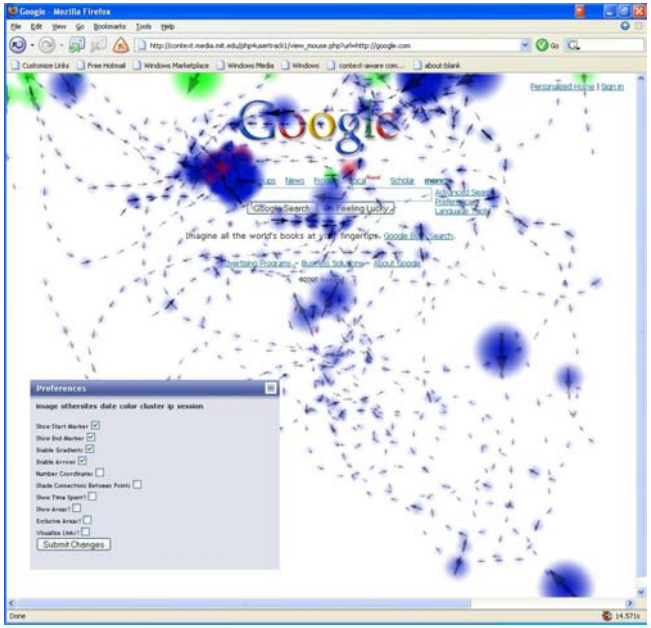

figure 1. A floating configuration window on the analyzed webpage provides multiple visualization options.

skimming through websites, searching for matching words, etc). A tool that monitors web users as they evolve is necessary. Our investigations and previous research show that web surfers move their mouse cursor according to their focus of attention. In fact, some people use their mouse pointer as a reading aid while exploring a webpage. Other people move their cursor to a blank or scrolling area while reading a webpage. This allows us to identify the people who use their cursor in different ways. Studies evaluating Eye-tracking metrics have shown that there is a correlation between users' attention, their eye movements, and their cursor movements while browsing a webpage. These studies suggest that there is a strong correlation between eye and mouse Movements while Web Browsing [1, 8]. Additionally, a study examining, mouse movements on web pages found that 35% of people moved their mouse cursor while reading a webpage [7]. This suggests that the mouse cursor is an indicative to where the user focus of attention is. And can be used to classify user navigation behavior into several categories, such as scrolling, reading, thinking, or interacting with menus. Using mouse tracking on a relatively low traffic site with 1000 visits per day could potentially provide 350 data samples for analyzing how people navigate through the site. Furthermore, the analysis could be complemented by online surveys that can reach a large number of people, adding statistical power to the results.

This paper presents MouseTrack as a tool for monitoring and visualizing mouse movement activity on any website. It allows administrators to easily incorporate mouse tracking into any existing website, run usability studies and is a valuable tool for teaching interaction design concepts.

Related Work

Studies have explored mouse movement as an alternative method for cognitive studies in language comprehension. For instance, mouse movement trajectories could indicate how information is interpreted. Slow and arched trajectories as users move their mouse would indicate an ambiguous state of mind [3,6].

The Enhanced Restricted Focus Viewer (ERFV) is a mouse-based system that collects the path of users' visual attention as they browse a website. However, It works by blurring out most of the screen except for a small focus window at the cursor location [11]. ERFV requires individual images to be generated for each web page. This manual intensive requirement makes it unsuitable for large websites. A major drawback is that users might not browse the web as they would normally do due to the intrusive restricted field of vision.

System Description

MouseTrack is a web-based usability system with an online configuration tool and visualization tool that displays the mouse path followed by website visitors. The path is augmented with arrows indicating directionality and webpage entry points are clearly marked with a different color. Visualization includes a shaded area around the cursor that increases its size to represent time spent over a point. Shade intensity also increases to represent mouse hesitation over continuous zones. The tool allows web pages to be divided in different "to-be-monitored" areas. The degree of activity in each area is reflected by shade intensity, similar to a heat map (see figure 1). The visualization tool aggregates information, but it also

allows evaluation of detailed information, such as time frame, IP address range, and sessions.

MouseTrack offers advantages when compared to traditional usability tools. 1. It can be mass deployed, allowing for large datasets. 2. It is able to reach typical users and first time visitors in their natural environment. 3. It can continuously test live sites, offering insight information as new website sections are deployed. 4. And most importantly, it is transparent to the users, so no experimenter bias or novelty effects are introduced, allowing users to navigate as they would normally do.

Existing web-tracking usability systems, such as WebVIP, WET, and WebQuilt focus primarily on logging mouse click events/interactions [2][5][11]. In contrast, our system focuses on mouse browsing paths within a webpage. The nature of the tool has the disadvantage that not all data offers reliable information, since not all users use the mouse as a reading aid. Mouse trajectories such as long resting positions followed by rapid linear movement help us omit datasets from users whose visual focus is not determined by the cursor. Currently, the tool allows administrators to identify this type of situation by visual inspection. Cases where not enough data points are available are automatically labeled for revision and excluded from the visualization. Another limitation is that the system might interfere with web pages that do not conform to W3C standards. It may also interfere on pages that rely heavily on scripting tools for their appearance or navigation.

Implementation

MouseTrack is a proxy-based application that can be accessed through any web browser. A PHP proxy fetches existing web pages and modifies them by inserting JavaScript code. Returned enhanced versions of these web pages implement an administration interface and add mouse tracking capabilities when browsing a webpage. The end-user can browse enhanced web pages as they normally would, while Mousetrack transparently records mouse activity within the web page.

The mouse movement data collection samples whenever a user moves out of a 50 pixel circle radius and logs the time spent at each position/coordinate. This distance sampling approach filters out very fine movement to reduce data size and remove unnecessary information. When the user clicks on any link, the full coordinate set (2.5k on average) is sent as a request to the proxy server, which in turn stores the data in a database and redirects the user to the desired link. The tool does not require changes to existing websites, and no expert configuration is needed. All that is necessary is a web browser, an internet connection and the URL for the desired page to be tracked.

Design Case

The system was introduced at a workshop to a group of architect practitioners and students that had little or no experience in HCI and interaction design.

The tool made it possible for the students to perform web page explorations on 7 different websites. Their analyses included music reviews, dating, museum, travel, and design competition websites. Websites varied from highly graphical to text only sites. A total of

105 subjects were asked to navigate these websites as they would normally do. They were later instructed to describe what they did on the site. Finally they were presented with their own mouse trajectories and further described what they meant according to the previously described behavior for the site.

The visualization approach of the tool, made the issues and possibilities for improving websites obvious to the workshop participants. The students very quickly went from running subjects through an experiment to being captivated with how web page design changes the way people think. They proposed and prototyped redesigns reorganizing information where it could be easily found, and simpler to navigate.

The system provided mouse activity that was useful in understanding how users viewed a webpage and aided in identifying potential problems with a webpage. For instance, when evaluating a design website, participants found that activity concentrated on three main areas: website logo, website description and selection menu (see figure 2). Even though this is a simple webpage, there was some confusion about the site's interactivity. Most people attempted to interact with the website logo on the webpage, but it did not have an interactivity associated with it. Interestingly, the short website description was effective in getting people to read about it, being one of the most viewed areas. And finally, they discovered that people spent most of their time interacting with menus and selecting art designers to review. This was expected since menus are the only interactive part offered by the site.

figure 2: Three areas in a webpage showing the most activity from first-time visitors to a design museum website.

Participants classified mouse movement data across the sites into several behavior categories: scrolling, reading, pause-think-read-go, interacting with menus (graphical and text only), and random. Scrolling is easily identified by mouse trails up and down the scroll bars. Reading is indicated by smooth mouse trails movements horizontally and vertically across web page paragraphs (see figure 3). As expected, not all users moved their mouse while reading, instead they paused their cursor to either read or think about what to do next. This behavior is characterized by a long pause next to some text or a blank space and fast and direct movement towards a link, usually terminating with a click. Interacting with menus is characterized by hesitation among the different menu options. Finally, random movement refers to people playing around with the mouse cursor in no predictable way and with no underlying motivation.

figure 3: Mouse trajectory indicating reading behavior and hesitation in the menu area. Medium, closely spaced circles indicate smooth movement through the paragraph.

Conclusions

We have described the MouseTrack tool as an approach to web usability that uses mouse tracking as an indicator for visual attention. One major advantage of the tool presented is its ease of use (web-based, hassle-free, no setup). The visualization tool allowed inexperienced observers to concretely learn important user interface principles by observation. Future work includes fully validating the approach by correlating eye gaze with mouse tracks in multiple web environments. Our goal is to introduce this approach to web usability practitioners and obtain universally identifiable mouse patterns that could be automatically labeled to reveal useful information about site design and speed up the iterative design process.

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