Eye Tracking and EEG Features for Salient Web Object Identification

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Abstract. We propose a biological-based feature comparison for identifying salient Web objects. We compare several features extracted from eye tracking and EEG data with a baseline given by mean fixation impact introduced by Buscher. For this, we performed an experiment with 20 healthy subjects in which gaze position, pupil size and brain activity were recorded while browsing in a Web site adaptation. Our results show that there are EEG features that could be related to Web user attention in objects. In particular the Gamma Band RMS and the EEG Variance indicate that the longer subjects view a web object (more attention), the less brain signal disturbance appears. We also discarded pupil size features due to low correlation with baseline. These results suggest that EEG features could be used to identify salient objects without using the time users spent on them as done in previous methodologies.

1 Introduction

The penetration of the Web has changed people’s behaviour over time. For example, when any sort of information or product is required, people usually, and almost naturally, check the Web. Thus, companies and organizations have wanted to get presence in this network and increase their sales and market position. To achieve effectiveness in their goals it is necessary to design web sites that can attract more customers than competitors’ web sites.

However, designing and implementing attractive websites require knowledge about customer behavior and preferences. For that purpose there are several techniques for discovering customer experience while browsing a website, including polls, surveys, weblog analysis, etc. In addition to those techniques several modern methodologies such as mouse tracking have been developed in order to extract more objective patterns from web user behavior.

In this study we compare different types of data analysis from web user behavior, including eye tracking, pupil size and electroencephalography. The aim is to find out what the most relevant objects on a web site are depending on the different data analyses. In addition, we discuss the salient web object identification differences between each analysis.

This comparison is interesting due to the fact that each biological response can explain different human behaviors. For instance, eye fixations have been...
related with attention in the focus area [1], pupil size has been related with
cognitive load or mental activity [4] and EEG signals have been related with
many phenomena, in particular, emotional or cognitive states [7].

To achieve our objective, we performed an experiment where the gaze move-
ments, pupil size and EEG signals were recorded for 20 subjects. The task con-
sisted of browsing 32 web pages of the MBA program of the University of Chile’s
web site.

The paper is organized as follows, first we present some related research,
and then describe our approach for identifying salient objects and features from
biological signals used as comparison measures. After specifying the experimental
setup, we will attempt to answer the data processing and research questions.
Next, the results are shown along with their pertinent discussion, and finally we
conclude our study and propose future work.

2 Related Work

One remarkable line of salient web object identification was developed by Buscher
et al. The main motivation comes from the need to understand how people allo-
cate visual attention on Web pages, taking into account its relevance for both web
developers and advertisers. In 2009, authors implemented an eye-tracking-based
analysis in which 20 users were shown 361 pages while performing information
foraging and inspection tasks [1]. The main assumption was that gaze data could
represent a proxy of attention. From that, an analysis framework was developed
by first generating a tool that allows DOM elements to be characterized and a
mapping performed between gaze data and the DOM elements. The second part
involves the use of the extracted web features in a machine-learning setting to
predict salient elements on a web page.

Another relevant contribution by Buscher et al. is the introduction of the
concept of fixation impact. It allows the identification of the set of elements that
are under the gaze of the user at a certain time. It follows empirical studies that
show that human vision is characterized by a narrow window of high acuity along
with the standard gaze area. Thus, when visualizing an element, it means that
other elements in the surroundings are also being considered. Therefore, given a
fixation point, a DOM area is selected in order to identify every element under
it. A distance score is given to each element based on its coverage, assuming a
Gaussian distribution. The fixation impact is computed using this distance and
also incorporating a time dimension, which means the fixation duration.

A methodology to extract salient web objects was developed by Velásquez
et al. This methodology started with the analysis of plain text for identifying
the Website Keywords, defined as “word or possibly set of words that is used
by visitors in their search process and characterizes the content of a given web
page or web site” [10]. Afterwards, the methodology was extended, defining a
web object as “any structured group of words or multimedia resource within a
web page that has metadata to describe its content” and a Website KeyObject as
“the web object or group of web objects that attracts web users’ attention and