# ViCRAM: Visual Complexity Rankings and Accessibility Metrics

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## Abstract

The World Wide Web (Web) has become the means of distribution and use of information by individuals around the world. However, access to this information by visually impaired people is limited due to the Web's visual complexity. ViCRAM is a project that will relate user's implicit understanding of Web page visual complexity with its layout. Eye tracking methods and knowledge acquisition techniques will be used to elicit sighted people's visual perception. During this project we will also determine whether pages that sighted users identify as visually complex are complex for visually impaired users as well, from a Web accessibility perspective. We aim to develop a heuristic framework that will be used for describing Web page's visual complexity and as guidelines for transcoding a Web page into a less visually complex and more accessible one.

## Introduction

Most Web pages focus on visual presentation to implicitly help users understand and interact with the content. When sighted users reach a Web page, they can scan the page and get a comprehension of it in an average of 5 seconds. This view helps them to decide if the page is relevant to their task and move towards the part of the page that interests them. On the other hand, if visually impaired users want to get an idea of how the page looks they spend much more time because they have to listen to the entire page being read from the top left corner of the screen to the bottom right. This is because assistive technologies, such as screen readers, render the source code of the page. In addition, they might spend even more time because the source code is not always accessible. This happens when designers do not always follow the correct guidelines for accessibility and use different coding conventions to represent page elements such as headings and links [1].

ViCRAM is a project that will mainly contribute to the improvement of accessible Web design. We will study sighted users' behaviour and eye movement while interacting with a Web page to elicit their implicit knowledge of visual perception. In addition, we will investigate the coping strategies visually impaired users develop to interact with complex Web pages. A relationship will then be distinguished between Web page visual complexity, sighted users' cognition and visually impaired users' coping strategies. The project's objective is to create a framework that will be used to identify Web page visual complexity for two purposes: to give feedback to the user regarding the presentation of

the page; and to help reduce the visual clutter of the page by using it as a guide for the Web page transcoding process.

## Related work

Within the literature, visual complexity of an HTML document is described through Web site accessibility and usability research. Studies try to identify Web page design metrics that determine whether a site is complex. These studies relate Website design guidelines with complexity explaining that the way a Website is presented depends on the way its page is designed and what elements are used. For example, Ivory et al. [4] performed a quantitative analysis on Web page attributes (e.g. number of images) using a large collection of Web sites. In this case, page composition metrics, such as word count, could distinguish between good and bad pages with respect to design and usability.

Moreover, eye movement behaviour while interacting with a Web page can give further information regarding Web page design issues. Eye tracking studies are mostly performed for Website usability evaluations. Poynter [5] is one such study with large collections of Web pages in their evaluation set. The authors extensively tested eye movements across several news homepage designs and noticed a common pattern between a user's fixation order on the page (scanpath) and the page layout. In [6], the authors show that Website viewing behaviour is driven by gender, the order of Web pages being viewed and the interaction between Website types. Their study also revealed a possible relationship between scanpath variability among individuals and the structural/visual complexity of the Web page.

Throughout the literature, studies show that user's cognition, Website content and the way information is grouped and presented affects Website usability and accessibility. We want to determine how these factors correlate and how we can define Web page visual complexity.

## Research goals

ViCRAM aims to relate user's implicit understanding of a visually complex Web page with its layout. In this way, Web page designs can be associated with a common Web behaviour and visual complexity that will give further insight into accessible Web page design and facilitate visually impaired users. In order to achieve this we will answer three important questions: "What is a visually complex Web page?", "How does a sighted user interact on a Web page?" and "What is the relationship between a sighted user's Web page interaction and its visual complexity?".

A variety of usability and accessibility studies show that complicated Web page structure depends on the page composition and layout [2, 3, 4]. During our research we will identify how Web page elements, such as links, text, and images, interact with each other to produce a visually complex page. Sighted users' Web behaviour using eye movement tracking methods can give better perception of page presentation. This is because users' glancing habits can give important information on where they look first when they reach a Web page, where they pay more attention and for how long they concentrate on specific parts of the page. A related literature survey, a study using knowledge elicitation methodologies, such as card sorting, and users' eye movement behaviour on Web pages will be our research methods for learning more about human visual perception.

Our objective is to develop a framework to distinguish the visual complexity of a Web page. This framework will provide information about the level of visual complexity to visually impaired users so less time will be needed to get an overview of the page. In addition, the framework will be used as a guide for transcoding a page into a less visually complex one.

## Current research status

To date, we were able to perform an empirical study to extract more information on how sighted users describe a visually simple or complex Web page. By using card sorting and triadic elicitation techniques we were able to encourage participants to articulate their opinion and extract their implicit knowledge with respect to page presentation. During this study we concluded that the main factors that affect the visual complexity of a Web page are the diversity (how many different elements are used), density (how many of each element are used) and position of the page elements (e.g. links, words, images). That is, a visually simple page has a significantly lower number and variety of page elements than a visually complex page. The most important difference between visually simple and complex pages is the number of different subjects that each present. For example, visually complex Web pages like MSN (http://www.msn.co.uk) provide a variety of information to a reader (news, entertainment etc.) where visually simple pages like the Mint Group (http://mint.cs.man.ac.uk) focus on one subject. Hence, fewer page composition elements are needed to organize a visually simple page than a complex one.

In addition, we were able to perform a pilot study-using eye tracking methods. We wanted to investigate how sighted users perceive the visual presentation of Web pages, where they look first and for how long. A descriptive analysis of this study's results revealed some interesting patterns. For example, Web page salient elements, such as big logos, pictures and animations, attracted the subjects' attention first but the main content of the page attracted them for the longest. Also, menus were not completely read and no specific reading order between right and left menus or columns was determined. In addition, this pilot study gave implicit information on user's common interaction scanpaths. After gazing at dominant graphics the participants scanned through the main content of the page. They did not fully read the text, in the main content area, and they paid more attention to the links and the first sentence of each block or paragraph. Then, the participants tended to look and read the first three links on the menu, either on the left or right hand side of the screen. A quantitative analysis could not reveal solid conclusions due to experiment design problems, such as participants' page familiarity and imprecise task assignment. However, we did notice a possible relationship between visually complex designs identified by our empirical study and participants' Web behaviour. For example, participants spent more time interacting with a visually complex page than a simple page. In addition, the more visually complex the page was, the more scattered and disordered the participants' scanpath was.

## Future research plan

The next stage of our research is to perform an empirical investigative study. Sighted users will compare and rank Web pages from a visual perspective. We will investigate how font size, image location and menu size affects sighted users' perception. Then, we

will define heuristics that describe the visual complexity of a Web page. These heuristics will be based on the users' feedback of gazing behaviour and visual perception taken throughout our research.

We plan on evaluating our framework to determine whether it gives sufficient results using both sighted and visually impaired users. Sighted participants will be used for an eye tracking study. We will determine the significance between the eye tracking data and our framework feedback. Visually impaired participants will evaluate the visual complexity feedback and the transcoded pages with respect to the time needed to understand the layout of the page with and without the feedback.

## Conclusions

ViCRAM's main contribution is to define a framework that describes visual complexity of Web pages. The framework will be defined by the relationship between a Web page's visual presentation and structure, along with a sighted user's interaction and browsing behaviour. It will be used for both giving feedback directly to designers regarding visual clutter in a page and as guidance for transcoding a page to result in a simpler and more accessible one. Visually impaired users will then be able to access Web pages faster and easier than they used to.

## References

1. C. Asakawa. What's the web like if you can't see it? In W4A '05: Proceedings of the 2005 International Cross¬ Disciplinary Workshop on Web Accessibility (W4A), pages 1–8, New York, NY, USA, 2005. ACM Press.

2. M. Germonprez and I. Zigurs. Causal factors for web site complexity. Work¬ing Papers on Information Environments, Systems and Organizations, (3), 2003.

3. M. Y. Ivory, R. R. Sinha, and M. A. Hearst. Preliminary findings on quan¬titative measures for distinguishing highly rated information¬ centric web pages. In Proceedings of 6th Conference on Human Factors and the Web, 2000.

4. M. Y. Ivory, R. R. Sinha, and M. A. Hearst. Empirically validated web page design metrics. In CHI '01: Proceedings of the SIGCHI conference on Human factors in computing systems, pages 53–60, New York, NY, USA, 2001. ACM Press.

5. S. Outing and L. Ruel. Eyetrack III: What We Saw Through Their Eyes, 2006. A Project of the Poynter Institute, http://www.poynterextra.org/eyetrack2004/index.htm (Accessed: January 2006).

6. B. Pan, H. A. Hembrooke, G. K. Gay, L. A. Granka, M. K. Feusner, and J. K. Newman. The determinants of web page viewing behavior: an eye¬tracking study. In ETRA'2004: Proceedings of the Eye tracking research & applications symposium on Eye tracking research & applications, pages 147–154, New York, NY, USA, 2004. ACM Press.