CZWeb: Fish-eye Views for Visualizing the World-Wide Web

Brian Fisher, Makrina Agelidis, John Dill, Paul Tan[a], Gerald Collaud[b], Chris Jones[c]

[a]Graphics and Multimedia Research Laboratory, Center for System Science, Simon Fraser University, Burnaby, BC Canada, V5A 1S6

[b]University of Fribourg, Fribourg, Switzerland, gerald.collaud@unifr.ch

[c]School of Business Administration, University of Washington, Seattle, Washington 98195; cvj@u.washington.edu

The proliferation of interconnected information on the Web suggests the need for tools to organize the interconnections. We discuss an implemented system, CZWeb, which traces a user's path through Web space using a fish-eye view technique. An experiment using 12 university students accessing a web site to answer specific questions showed that CZWeb helped them create a useful representation of the links on a web site. Moreover, the results suggest that although users need tools to organize their view of webspace, those tools may not need to possess all of the characteristics of a spatial map.

1. INTRODUCTION

With the exponential growth of the Web, navigating through the immense amount of published information presents users with a daunting challenge. As users navigate through the web, they may not be able to find the information that they know to exist or they may forget how to return to a previously visited site. In short, they may become "lost in hyperspace."

Tools widely used to address this problem include lists of bookmarks or favorites, keyword search engines, and taxonomies of web pages (e.g.,Yahoo). None can be claimed to completely solve the problem.

Navigating on land on the real world, one frequently relies on a high-quality map. Several researchers ([1],[5],[7]) including ourselves [2] have proposed map-like visualization tools to represent the intricate interconnections among pages published on the Web. It is unclear, however, if such tools actually do a better job than existing tools at helping users create a mental model of webspace.

For example, a survey of web users [8] found that being "unable to *visualize* [emphasis added] where they have been and can go" was much less of a problem (14.3%) than being able to "find a specific page" (34.5%), "organize pages" (25.8%), or "return to a page" (23.7%). Paper-based maps allow navigators to identify key features (individuation), to identify how different features relate to one another (non-metric relationships), and finally, to measure distances (metric relationships), since the location of features generally corresponds to their actual position in space. Which of these are useful?

In short, do all the characteristics of traditional maps help users navigate through the Web? The tool we investigated, CZWeb [2], uses a Continuous Zoom approach [3] to create a dynamic fish-eye [4] or distorted map [6] of the pages visited as the user navigates through the web (Figures 1-2).

A fish-eye or distorted view approach allows the user to see portions of the map in more detail while still seeing surrounding context. Previous experimentation has shown that fish-

eye view techniques can help users diagnose and repair faults in electrical power distribution networks more effectively than simple geometric zooming techniques [3].
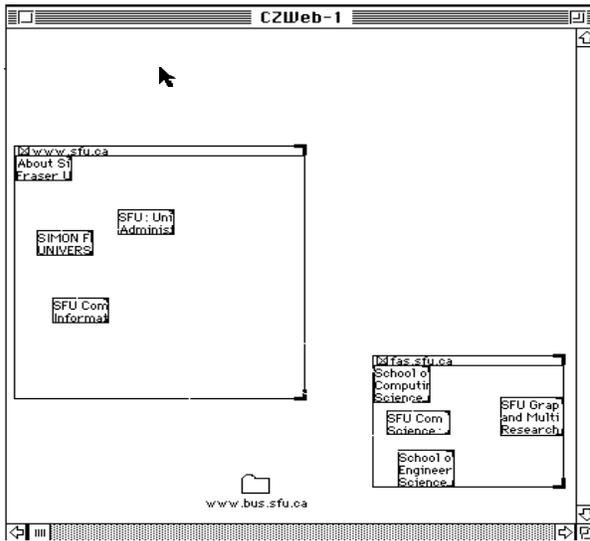

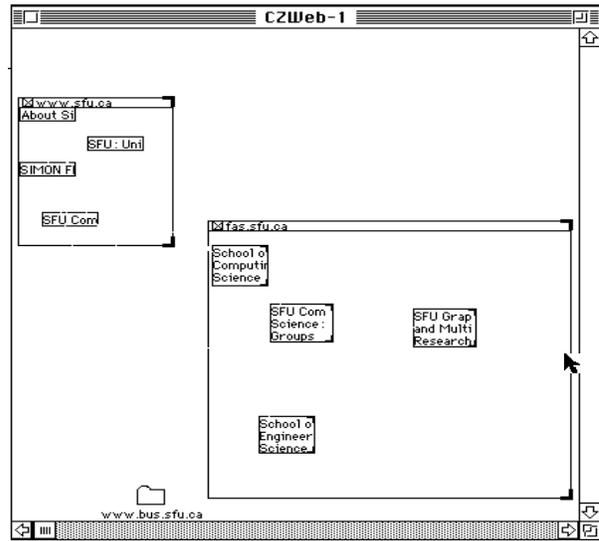| Figure 1. A typical view of the Web as seen in CZWeb. | Figure 2. After zooming in on the cluster node in the upper right of Figure 1. |

CZWeb supports both individuation and non-metric relationships but not metric relationships among web pages. We were interested in the basic question of whether or not CZWeb still be helpful to web navigators given its limited use of characteristics of traditional maps. This paper describes a preliminary experiment using CZWeb, a Continuous Zoom-based Web navigation aid, to explore this question.

2. CZWEB

CZWeb's map consists of a hierarchically organized network (or graph). Users can show sections of the map in greater detail, and the rest of the map shrinks in response. Each node in the network is represented as a rectangle. Two types of nodes are supported, *page* nodes representing a particular web page and *cluster* nodes representing a group of web pages or other cluster nodes. Cluster nodes can be *opened* to show their contents, or *closed*, where they are represented by a simple folder icon.

As the user navigates using a web browser, each new web site (identified by its server name from its URL) is added as a cluster node. Each page visited at the site is added to the map as a page node inside the cluster node. Directed edges (arrows) indicate a link from one web page to another. When nodes are added to the network, a spring embedding algorithm is used to determine a new layout for the nodes in the network.

Changes to the network are smoothly animated (either from expanding sections of the network or when new nodes are added). This provides the user with a sense of continuity from one view to another.

Users may also reorganize the map by creating new cluster nodes and moving page and cluster nodes inside other cluster nodes. This is allowed, since the physical organization of web pages as created may not reflect the users' ways of organizing the information.

CZWeb provides strong support for individuating particular loci through continuous animation as the map changes. It supports non-metric relationships through the hierarchical

network representation of web pages. Since nodes representing web pages are continuously repositioned, CZWeb does not impose any fixed metric relationships on web space.

3. EXPERIMENT

The experiment used 12 university students. Students were asked a series of questions before the experiment to assess their experience. Questions considered their experience with different computer operating systems, internet tools including web browsers, electronic mail, their perceptions on how the web is used, how often and how easily they use the web.

The next phase of the experiment examined how well CZWeb helped them find information in a website (http://www.cs.ubc.ca/spider/inkpen/czweb/CZWebtest.html) created for the experiment. The web site described information about 1996 Olympic sailing events, including results of a race and a glossary of terms (Figures 3-4).
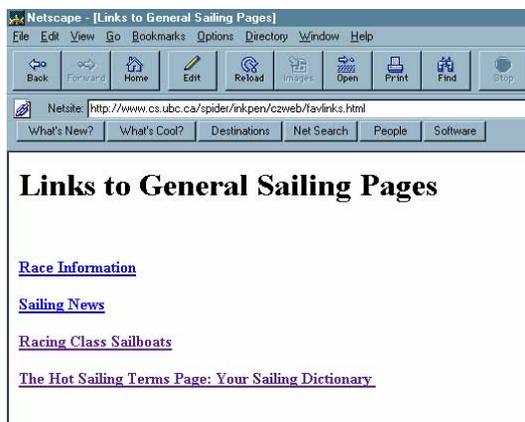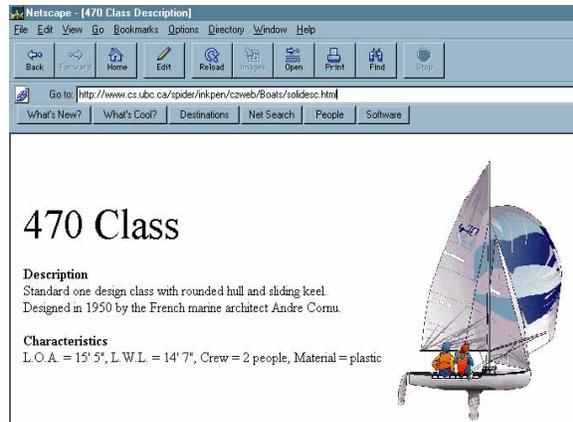
Figure 3. The Sailing Web Site Home Page

Figure 4. A typical page within the site.

They answered a series of 12 questions, such as "Why would you do two 360 degree turns during a race?" The questions were designed so that the answers sometimes required combining information found on two or more web pages. The first two questions asked were used as demonstrations of the site and CZWeb. After seeing the demonstration, the subjects navigated through the site to answer the remaining ten questions. As they browsed, CZWeb created a map of the pages visited. To move from page to page, they could use the links embedded in the web page, use the **back** and **forward** buttons in the web browser, create and use bookmarks in the web browser, use the browser's history list or they could use CZWeb. Subjects were asked to think aloud and were videotaped during their task.

When the task was completed, subjects completed a post-test questionnaire. The questionnaire asked users to rate various aspects of CZWeb (available from the authors).

4. RESULTS

On the question "How would you rate CZWeb's overall ease of use", results were positive ($t=2.244$, 11 df, $p>0.05$). It was also useful for moving to site ("Having CZWeb's picture of the Web sites you have visited helps you move around the Web" ($t=3.079$, 11 df, $p>0.05$).

Compared to navigation tools common to Web browsers (**Back/Forward**; **History**), subjects rated CZWeb more useful for:

- "helping you to understand the Web organization better" (p < 0.0001).
- Moving to less recently visited sites "going back more than 5 sites" (p < 0.0001).
- Localizing the user's position "knowing where I am in the Web and avoiding going to the wrong site" (p < 0.0001).

5. CONCLUSIONS

CZWeb adds value when users navigate through the Web. The experiment did not, however, show that CZWeb contributed significantly to users' global visualization of the web. No significant effects were found for questions such as how CZWeb:

- Reflects how you think about the Web.
- Makes you feel like you are travelling throughout the Web.
- Makes Web organization more clear.

It appears that users have a greater need to individuate web pages and isolate relationships among than to prevent dislocation in webspace. This corresponds to the survey results of [8]. As the questions become more explicitly spatial, agreement falls off. Perhaps users want to generate organizations that reflect how they think about the relationships between sites, a personal Web space, which may lack the static metrics of real spaces and maps. Protocol analysis of the videotaped sessions should yield further insights on what features of CZWeb were helpful.

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Appendix A: Sample Questions for Subjects to Answer
1. What are the 8 classes of boats? (*demo*)
2. Describe the Tornado class sailboat. (*demo*)
3. What is unique about the Soling Class sailboat?
4. Who were the two teams involved in the Star Class Protest?
5. Who were the two individuals that were disqualified in one of the early races in the Laser Class?
6. What is the name of the boat used in the Paralympics?
7. Why would you do two 360 degree turns during a race?
8. What shape is the Olympic race course?
9. In the 1996 Paralympics team, who is the jib trimmer and what is his role?
10. Which Olympic sailboat is only sailed by women?
11. What is the "lazy guy"?
12. Which of the Olympic class boats require two sailors?

Appendix B: Post-Test Questionnaire
1. How do you rate CZWeb's overall ease of use? (1=very easy; 5=very difficult)
2. Having CZWeb's picture of the web sites you visited (1: strongly agree; 5=strongly disagree; 6=no opinion)
   a. reflects how you think about the web.
   b. gives you more confidence in exploring the web.
   c. slows down the computer too much.
   d. helps you feel more adventurous.
   e. lets you know where you are in the web.
   f. takes too much time to use.
   g. helps you move around in the web.
   h. makes me feel like I'm travelling throughout the web.
   i. takes up too much space on the screen.
   j. makes web organization more clear.
3. Please rate how you think CZWeb would be for the following functions (very useful, useful, not useful, don't know):
   a. Pure Entertainment (games, chat, humor)
   b. Personal uses (hobbies, health, recipes, travel)
   c. Business (buy and sell, product info, banking)
   d. Academic (exchange data and results, communicate with colleagues, grad info).
4. Please rank (first second third) how you would use each of the navigation tools (CZWeb, Back/forward, history) for the given application
   a. Getting to the site you wanted dependably
   b. Helping you to understand the web organization better
   c. Going to the previous site
   d. Going back 5 sites
   e. Going back more than 5 sites
   f. Know where I am in the web and avoid going to the wrong site
5. I feel that looking for information on the World Wide Web using CZWeb is: (Strongly Agree, Agree, Neutral, Disagree, Strongly disagree, Don't Know):
   easy; entertaining; confusing; complicated; intimidating; hard; boring; straightforward; simple; frustrating.