A Sonification Enhanced Navigation Tool

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ABSTRACT
We describe a navigation tool for a collaborative Web space (CoWeb) containing meta information on aggregated interaction history. We represent the history information by annotating links inside the CoWeb. The navigation tool presents all links on a page together with their meta information in a popup menu. A sonification gives an auditory overview of the distribution of history information. The popup menu itself uses both conventional link markers as well as sound to communicate the meta information to the user.

Keywords
Social Navigation, History Enriched Environments, Sonification

INTRODUCTION

The CoWeb is a collaborative Web space implemented by Mark Guzdial (based on earlier work by Ward Cunningham). CoWebs behave much like ordinary Web sites, except that everybody can modify every page by clicking on a link to "modify this page".

We modified the original CoWeb to aggregate interaction history on its pages and indicate both recent accesses to a page as well as how recently a page was modified. The main mode of representing this information is through link markers next to every internal link in the CoWeb [1].

A goal of the link markers is to increase user's awareness of the traffic in the CoWeb and to support social navigation [2, 3]. The footprint markers we use are an example of *indirect social navigation*, where information is aggregated over a group of users and thus scales well and protects privacy [2]. The markers are also *passive interaction history* according to Wexelblat and Maes's terminology, because they happen as a by-product of navigation [3]. Our navigation tool is not specific to social navigation and could be used to represent any type of meta information, e.g. relevance relative to a user profile, or whether pages have been recommended by colleagues.

MOTIVATION

Conventional Web design wisdom suggests that users don't like to scroll. Because of this rule many Web designers try to keep pages short and the most important links near the top of the page. Links and information scrolled out of view is easier to miss and not as accessible as information at the top of a page. We also observed that people tend to add only to the top of pages once pages reach a certain length.

History markers guide users to recently modified information and to frequently accessed topics, but they can achieve this only when they are visible. Ideally, users would get an overview of the link markers on a page. Such an overview would indicate whether there are links leading to high traffic pages or whether all links on a page lead to "dead" topics. The rationale for using sonifications was that we wanted to provide an "overview" of the meta information without forcing users to focus on a visualization.

A NAVIGATION TOOL FOR THE SOCIAL NAVIGATION COWEB

The navigation tool is a Java applet at the top of the CoWeb page. It consists of a custom popup menu that contains not only the link information, but also the history markers next to all links. An advantage of a popup menu is that it does not occupy much of the valuable space at the top of the page. Its (closed) size is constant, independent of the number of links contained

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in it. However, the user needs to actually open the popup to see the links and their associated meta information. To maintain the advantage of the small, constant size control while giving an overview of the meta information we decided to use a sonification. An "auditory glance" [4] can provide an overview without interruption of other tasks even while looking elsewhere.

Presently our sonification uses only the access history of links. We use five notes of different pitch corresponding to the five levels of traffic we use in the history markers [1]. A footprint symbol in gray, orange or red next to a link indicates how many hits the destination page received in the past 24 hours. A dinosaur marker indicates a page that was not accessed in over 2 weeks. The fifth traffic level (no access in the past 24 hours) has no visual marker. The newness markers use a similar 5 level scheme. Please refer to [1, 5] for more details on the newness markers and on the social navigation aspects of the system.

The CoWeb includes an applet tag for the navigation tool in every content page it serves. Information about the links and their meta information is passed to the applet as parameters. Upon loading the applet plays the sonification for that page. The applet consists of two buttons. One button opens the popup menu, the other re-plays the opening sonification (see figure 1).

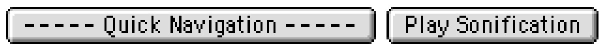

Figure 1: The closed navigation tool

We created three different sonifications. The first design proceeds through the links in a top down fashion and plays a note for every link. The second design plays only one note if multiple links with the same history information occur right after each other. Because some CoWeb pages contain a large number of links these two designs can result in awkward and lenghty sonifications. Our third design avoids this problem by splitting the page into three sections (top, middle, end) and playing pairs of sounds, representing the lowest and highest level of access history in that section, with a slight pause between the pairs.

In all cases it is easy to hear whether links with very different access levels appear more at the top, at the bottom or somewhere in the middle of a page. Users then can decide to either scroll to these links or access them through the navigation popup.

In addition to the sonification we use sound in the popup itself. When the user runs the mouse cursor over a link, she will hear the same notes used in the sonification. Meta information thus is represented visually as well as accoustically. This enhances users' perception of the presented information, and we hope that the parallel presentation trains users to better recognize the notes in the sonification.

Figure 2: The open navigation popup

We encode history information only as pitch at this time. A higher access level plays as a higher pitch, and "dinosaur pages" play at a much lower pitch. Ideally each sound should be recognizable by itself [6] but humans are not very good at judging absolute pitch. As our goal is the sonification of the *distribution* of access levels over the page, users have to judge only relative pitch.

Implementation

The initial implementation of our applet was based on Java 1.0 because we needed to support a user community that partly used older and slower computers. This first implementation used pre-recorded beeps of varying pitch. For the sonification we used sounds with 100msec duration, whereas the sounds in the popup were only 50msec long. We needed to use fixed length sounds because the Java 1.0 AudioClip interface does not allow checking whether a sound finished playing. The sound quality of this first implementation left a lot to be desired. Not all browsers played the sounds consistently, sometimes sounds got dropped, and certain browsers refused to play the sounds at all. All tested browsers played a noticeable "click" between sounds, which makes the audio glance more intrusive than it should be.

Despite these problems we found that the sonification gave a good impression of the distribution of meta information on a page. In a CoWeb community the majority of links tends to show similar traffic levels with only few links greatly deviating from this average. These links were very audible in the sonification, which is what we wanted to convey to the user.

Recently we created a new implementation of the tool using Quicktime for Java. This gave us the ability to utilize Quicktime's synthesizer functionality. The sound quality of this second implementation is superior, however we are struggling with latency problems in the navigation popup. In the first implementation rollover sounds were audible fast enough for users to associate a sound with a link. In the new implementation it is sometimes difficult to associate a sound with a popup item when the user moves the mouse cursor at typical speeds.

Effective use of a multi-modal display requires that the auditory and the visual information are consistent. See [7] for a study on this issue in a tactile feedback device. This study found that "tactile information can effectively aid user's performance only if it is presented in concert with visual information" [7, pg. 388]. It is reasonable to assume this finding holds true also for the auditory channel. Because of the high latency in our present implementation we decided to delay a formal evaluation of the tool until we could significantly reduce latency.

Related work

Albers describes a modified Web browser that uses sonifications to inform users of download activities and to convey meta information about links [8]. His Audible Web used sounds to indicate broken links, the amount of data to be downloaded, and to inform users of download progress. It focused on single links, whereas our navigation tool presents both an overview of all links on a page as well as meta information for single links.

Hudson and Smith used sonification to convey such an overview of people's email boxes [4]. They encoded several items of meta information into one earcon. Their system did not provide as close an integration of visualization and sonification as is achieved in the navigation popup.

Recent versions of the Apples Mac OS use sound in popup menus very much like the sounds in our tool. However the MacOS sounds just indicate cursor movement over popup items and do not convey meta information.

Future work

While our current implementation solves the sound quality issue, the latency problem definitely will require work. CoWebs are implemented in Squeak, a version of Smalltalk with excellent sound capabilities. Originally we considered creating custom sonifications on the fly and serving them as aiff files through the CoWeb. When we chose to use Quicktime for Java we dismissed this approach. However, if we cannot resolve the latency issues using Quicktime for Java we might reconsider and play pre-recorded or custom created aiff sounds through the applet. Once the latency issue is resolved we plan to conduct a formal evaluation of the tool.

Additional work is required in the design of a more sophisticated sonification to provide an auditory glance not only of access history, but also of the other meta information visible in the navigation tool, like the newness of pages and whether links lead to internal or external pages.

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