OverHear: Bringing website layout to the visually challenged

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User Manual and Installation Guide

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Introduction

One of the main issues with assistive software for visually-impaired users is that it cannot effectively communicate where and how web page components are placed on the screen. A regular sighted person can quickly identify objects and map them to certain functionalities; and what's more, the layout of a website is an important part of sharing in the common experience of being online. For example, sighted users are familiar with the idea that a "closing button" is typically located on one of the top corners of the webpage. This shared convention is useful for website designers, who don't have to build up every interface from scratch. In contrast, a visually impaired person cannot easily map these functionalities to locations.

To solve this problem, our system presents web pages as their own sonic rooms: 3D sonic environments in which each element of the page is "physically" situated. This allows users to explore web pages as if they were a series of connected chambers, navigating from one room to another through the use of aural cues just as many non-sighted users do in their everyday experience.

About the Alpha System(Frontend design is not modified this time, will be modified in Beta System)

The alpha system engine you are about to use is built upon a simple demo website that contains 4 pages. Each page contains a rectangular button emitting a spatialized sound.

By moving the cursor, you will hear the sound change: by dragging the mouse towards the sound source, you will hear the sound "getting closer" and more centered as if you were approaching an object in real life. When the cursor meets and hovers over a button you are able to click, the system switches into a "focus mode": plays a new distinct ticking sound.

When you click a button and a new page has been successfully loaded, the system plays a pleasant, high-pitched bell tone. Each new page will have new aural elements. You are invited to follow the aural cues to find the button that leads you to the next page.

On the demo website, you may repeat this process until reaching the fourth and final page.

Note. The goal of this alpha system is not simply to go from the first to the last page but to see if and how the sound environment helps you to get a sense of the layout of a page without using your eyes. In practice, our engine should help you to situate yourself on any website in a comfortable way that is both familiar and new. The sound elements should guide you while also being pleasing to the ears.

We welcome you to this new user experience, in which navigating feels like going from room to room instead of page to page.

Installation Guide(the same installation process)

Our system requires no installation and runs in the modern browser Google Chrome.

To access our prototype, navigate to the following link:
https://www.cs.mcgill.ca/~lduan5/hci/notebook/comp_proto/welcome.html
Please copy and paste the link to a new browser to make sure the audio works.

For visually-impaired folks, we invite you to continue to use your screen reader to follow through with the onboarding process. You will then be sent through to a demo website with no additional text to allow you to have the full sonic experience of **OverHear**.

Navigating with Sound in Computer Prototype

OverHear brings your familiar, everyday aural navigation strategy to the internet.

Try not to think of the web as a series of flat pages, but as 3D "rooms" full of sound. Imagine walking into a physical place. Each object on the website plays a simple, pleasant looping sound.

Explore the layout of each website with your *cursor*, which acts like your ears.

Left and right. If you hear a sound to your left, move your cursor to your left to approach this object until it is “centered” in front of you. If you hear a sound to your right, turn to your right. It’s as simple as that.

Back and forth. Objects *in front* of your cursor will sound distant and reverberant. Move your cursor up; as you get closer the sound will become more direct, and louder. Objects *below* your cursor will sound slightly muffled as if coming from behind your back. Move your cursor down and the object will become more clear as you approach it.

Focus mode. When you land on an interactable object, the engine will shift into *focus mode*. You will hear a gentle clock ticking, and the surrounding objects become “focused sounding” around you. When you are in focus mode, you can click your cursor and expect an interaction!

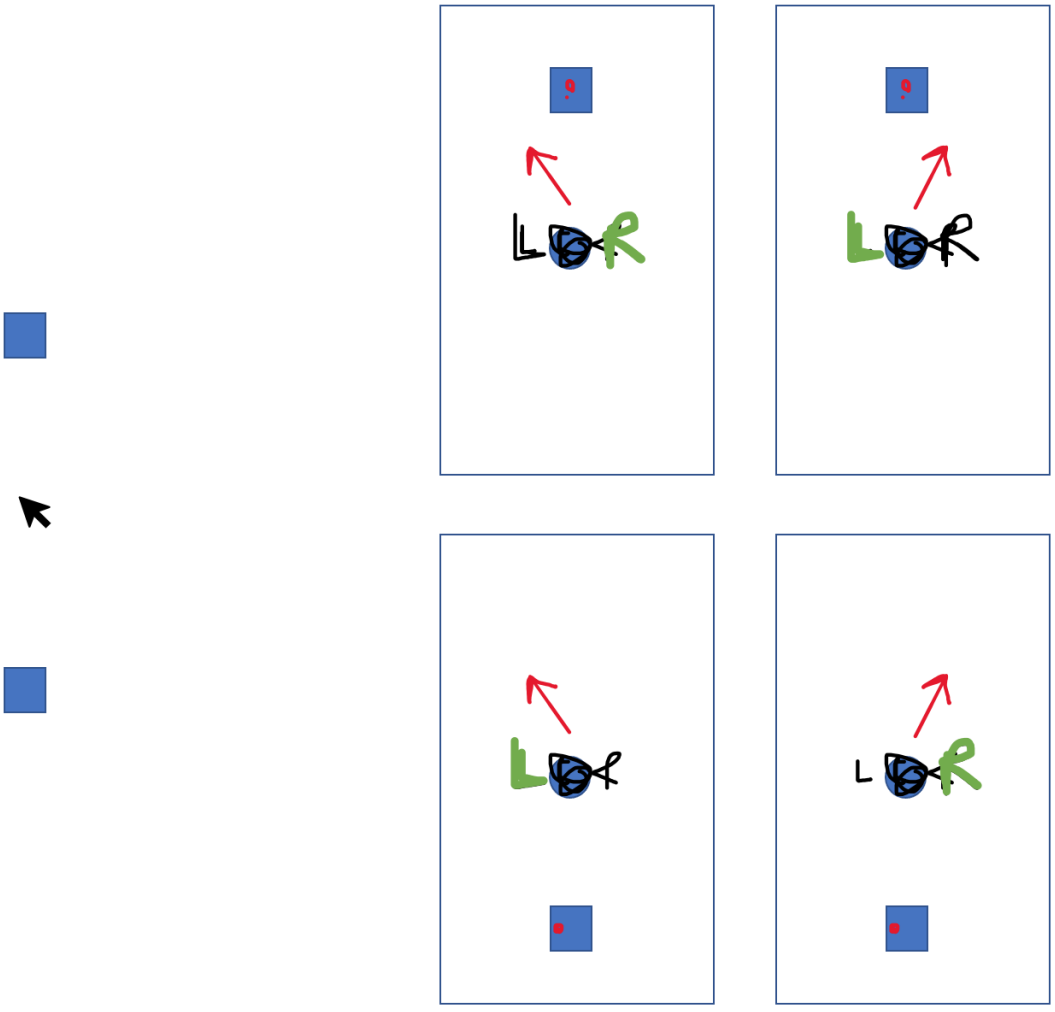
Optional visual feedback. Sighted users or assistants will note a gently pulsing notification bar that indicates if the OverHear engine is on or paused. You may click on this notification at any time to pause or restart the system.

Problems with sound navigation in Computer Prototype
Peers pointed out that they could hear the left and right sounds clearly but front and back sounds could not be identified easily.

Solution of the sound navigation problem (Alpha System Improvements)

Swivel motion. One of the consistent challenges participants face is the meaningful differentiation between front and back sounds. Our engine previously attempted to simulate a head-related transfer function (HRTF) by applying a drastic high-shelf filter to reduce high frequencies for sounds coming from "behind" the cursor (below, on the screen). This filtering simulates the passive attenuation of the pinnae that doesn't apply to sounds in front of the auditor. However, this cue was not enough to purvey a robust feeling of spatiality.

Based on a recent observation, we added a tilting or "swivel" motion to the direction of the cursor. At current, the model assumes that the user is always "facing forward," corresponding to the Y-axis of the website. Our swivel feature allows for this rotation to be temporarily shifted, based on the following observation:



If a sound is coming from in front of the user, rotating their head to the left will result in more sound going into the **right** ear. However, if the same sound is coming from behind the user, tilting their head to the left will result in more sound coming to the **left** ear.

By implementing a slight lagging "tilt" we hope to provide this subtle but potentially important cue. The system stores a lagged version of the cursor position, which is itself smoothed with a one-pole lowpass filter. The coefficient of smoothness is internally adjustable to affect the tilt rate. Likewise, the delta-y of the cursor position is a fixed coefficient value, internally tuneable, that affects the severity of the tilt effect.

We have set these parameters to be subtle to our ears, but further tuning is necessary before the beta deliverable.

Setup

Setting up **OverHear** is simple. To prepare to use the system:

- Please put on **headphones**.
- Put your browser in **full-screen mode**.

(Two screens or multiple browsers will not affect the test, our alpha system will stop all sounds automatically when the cursor is off the browser.)

Users who are not visually impaired are invited to close their eyes, or even wear blindfolds to simulate visual impairment.

Demo Website - Tasks & Instructions to follow
(Note: Sentences in red color means they are the improvements in Alpha System)

Step 1: Click the link to bring you to the welcoming page of the prototype demo. Click the start button to begin the tutorial.

Step 2: Put on headphones, and put your browser in full-screen mode. Follow the tutorial.

Step 3: After the tutorial, you may proceed to the demo website. If you are not visually impaired, we invite you to close your eyes when proceeding.

Step 4: *Listen carefully to the sound around you*. You will hear two sounds representing two buttons. The higher, bright strum is the “next” button, to go forward. The lower, murky sound is the “previous” button, to go to the previous page.

Step 5: Your first concrete task is to **find the button on the bottom right of the page to go to the next page**. This is relatively easy for sighted users, but our system is designed for the visually impaired. Find the button to enter *focus mode* (you will hear continuing “tic-toc” sound telling you that your cursor is in the right place).

Step 6: Click on this button. You will hear a “ding” sound which tells you that the next page has successfully loaded.

Step 7: Repeat all previous steps and navigate through the next few pages. The next button and the previous button will always have the same unique sounds.

Step 8: Continue clicking and navigating until you hear one last “ding,” and no more sound objects. Then you’ll know you’ve made it to the last page of the demo site. *Sighted users are now welcome to open their eyes again*.

To the Reviewer: As a reviewer, we are mostly concerned with how you find navigating the system. The demo website and visual layouts are simple, but the audio engine is complex. Many small considerations went into how to map the left/right, and up/down of the spatialization so that the system feels as natural as possible and is as simple and straightforward as possible to navigate. Our latest improvements in the Alpha system allow you to identify the front-and-back sounds easier. Besides, the “tick-toc” sounds problems are fixed. Also, if you are using multiple screens while testing, our system will not disturb your other work, it automatically stops when your cursor is off the browser page.

Your feedback on the feel of the auditory system is the most important to us. We realize this is a little different than your standard evaluation task! Thank you for your feedback.

As usual, fixing the existing bugs opens up the possibility of new ones; we have yet to see any substantial hit to performance, but we will keep an eye out and adjust as necessary for the next version of the system.