AuVi (Audio to Visual)

Our Team

Drew McCoy - *UX Designer*

Jacob Longhurst - *Design Research Analyst*

Josh Spires - *Hardware/Software Architect*

Toby Dunkelberg - *Hardware/Software Architect*

Contribution Statement

Drew	25%	Wrote report; proofread assignment
Josh	25%	Wrote report: proofread assignment
Toby	25%	Presentation: proofread assignment
Jacob	25%	Presentation; proofread assignment

Problem & Solution Overview

Deaf people live in a world that is unique, one without sound. This has been a source of identity, culture, and often pride for them as people. It also can be a source of frustration, as elements of our society often assume hearing when designs are made. Deaf people face unique challenges, particularly in the context of transportation. When biking, driving, and walking, there are many auditory signals that deaf people are not aware of. They cannot hear bike bells and shouts, sirens, and honking horns. They also cannot hear cars and other vehicles approaching behind them.

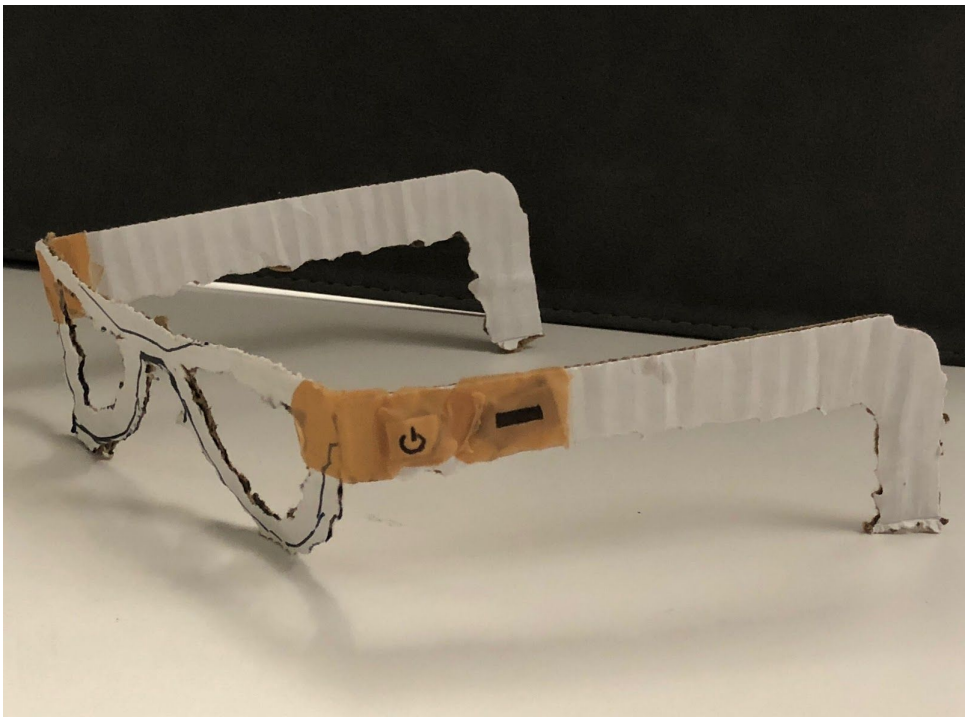
Our design solution gives deaf people the ability to sense auditory signals visually, allowing them to better adapt to changing circumstances while they are commuting. The design is made up of two parts: a sensory system and a notification system. The sensory system is made up of two sensors that sense audible signals and the direction they are produced from. The design then relays this information to the notification system - a special pair of glasses. Depending on the direction of the sound, LED lights embedded in the rims of the glasses turn on, alerting the user of important audible information. This design gives the deaf piece of mind knowing that they are able to detect things that could alert them of unsafe situations.

Initial Paper Prototype

The initial prototype was a wearable notifier. AuVi consists of two items: the sensors from the attachable design with an optical display on glasses. The sensors detect audio and visual information, while the glasses present the information in a stereoscopic, user-friendly form.

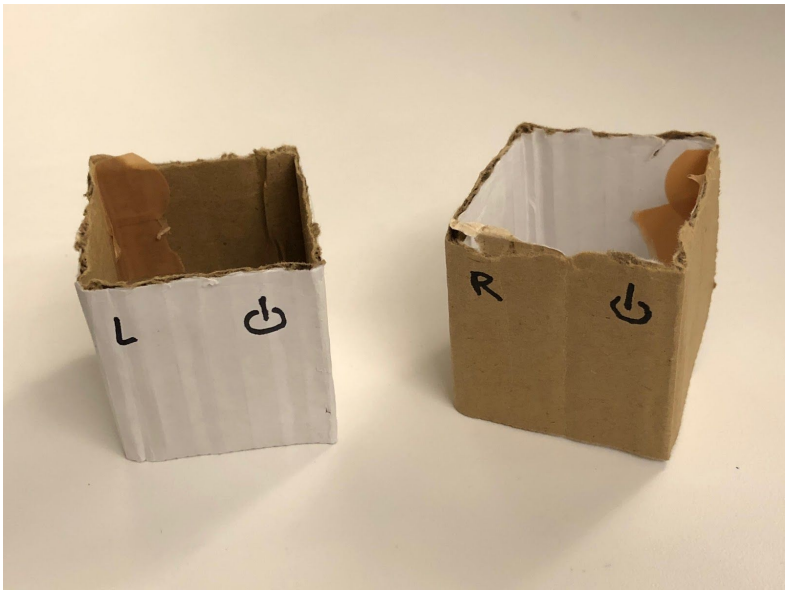
The Glasses

The glasses feature a display surrounding the peripheral of the lens. They light up directionally depending on where the sensors locate the sound. Lighting on the left and right of the lense correspond to noises on the left and right respectively. Lighting on the bottom correspond to noises directly behind.



The Sensors

The sensors come in pairs. They are attachable to many different types of items, such as backpacks, bicycles, and car bumpers. The sensor will collect and relay information for display to the user. The sensors will automatically pair with the glasses to relay the audible information seamlessly.



Our Design's Key Tasks

- Notify bikers and drivers when someone is trying to pass them. y?
- Informing a driver that an emergency vehicle is approaching.

Why are these tasks more compelling than the others?

These tasks were explicitly identified by our participants as being their biggest concerns. Additionally, we believe notifying commuters of other their surroundings will benefit our target group and the general population by keeping them safer and more informed of their surroundings. While the design is primarily intended for the deaf and hard of hearing, a notification system can also be useful for commuters who have an artificial hearing impairment (e.g. headphones, noise pollution). This will improve users safety during their daily navigation.

Why this design?

We chose this design because it allowed us to address the two key tasks that address the major complaints expressed by our research participants. By picking these tasks as our focus, we can better address the needs expressed in interviews, while using the same product in multiple, unique, and important transportation situations. This is important because environmental sounds are crucial for safety in every mode of transport.

Why is this design suited to our target group?

Our proposed design is better suited for our target group because the design bridges the information gap that deaf people experience; it maps imperceptible audible signals to perceptible visual signals. Our design will make users feel more comfortable in their commuting environment by alerting them to environmental sounds they otherwise would have missed.

User Testing

Process

The user testing process was largely informal. Users were presented with a rough version of a user manual to familiarize themselves with the product functionality. This let users get accustomed to using the power cycle, brightness adjustment, sensor pairing, and their notifications on the glass. Once users were familiar with the functionality, we performed task analysis with the tasks outlined in the initial prototype.

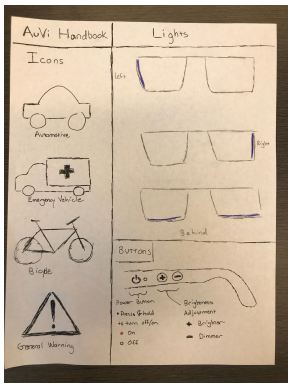
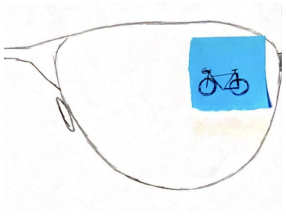
We had three users test our design. The first was Dhruv, our section TA. Dhruv was a great participant, as he is a part of our target group and is knowledgeable about our design problem and solution. The other two participants included a CSE undergrad who is passionate about user interface and interaction design and a friend who is an avid biker.

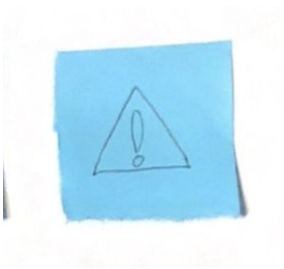
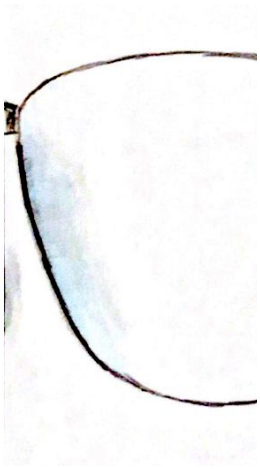
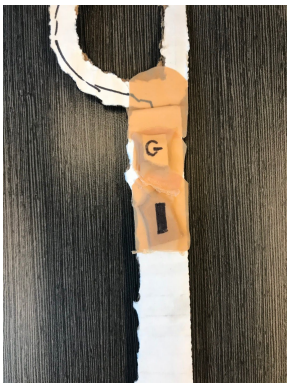
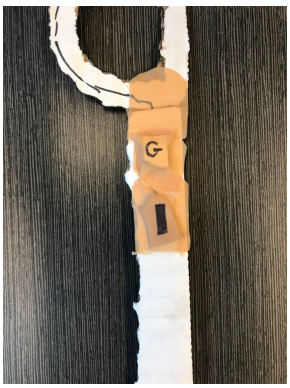
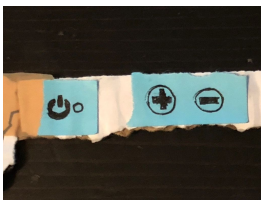
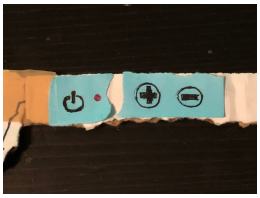
The major revision to the testing process was the inclusion of a user manual. This piece of information was absent from initial user testing that helped immensely in future testing as it let users get accustomed to the product's functionality and also presents an opportunity to refine the user manual.

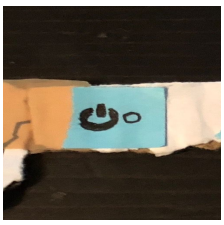
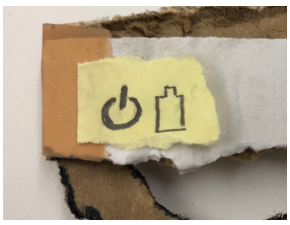
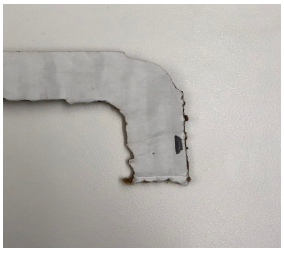
Results

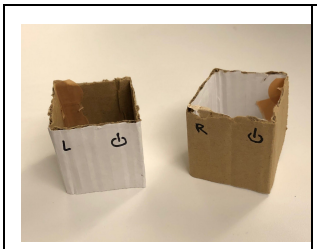
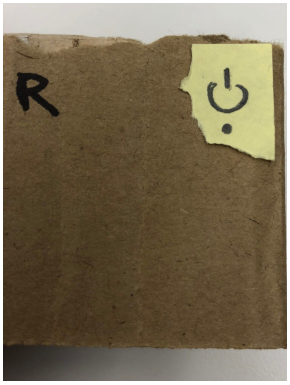
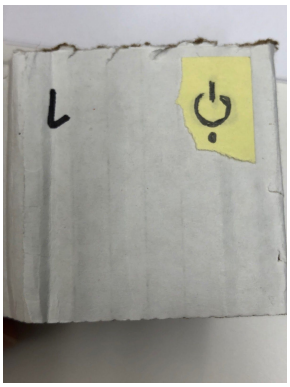
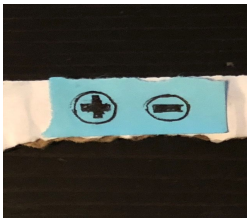
During initial usability testing, participants noted a need for power lights on the sensors. Regarding sensor pairing, participants were unsure if the sensors were connected. They noted a complete lack of feedback regarding a successful or unsuccessful pairing. This was particularly alarming. Participants also thought the brightness buttons on the side of the glasses need revision. While examining the hardware, participants wondered how the glasses were charged. This led to the participant asking if there was a visual indicator on the hardware for determining battery life. While wearing the glasses, participant thought the (!) alert strategy was weird. They mentioned (?), (+), and (*) as alternatives.

Prototype Revisions

Initial Prototype	Feedback	Response	Final Prototype
N/A	Devices has a learning curve, and the signals were not adequately explained to me. (Severity 3)	Added a paper documenting usage and signal meaning to our prototype.	
   	Add additional icons, it seems like the ones that you have are not as useful as they could be. (Severity 2)	Not implemented on the prototype for testing, but we will be considering it for our final design	N/A
	The icons are too large, they block a lot of the vision through the glasses (Severity 3)	We decreased the size of the icon post its in later tests. Changed so icon only appears when looked at.	(Icon has to be looked at to be visible) 

	Change the icon for the general warning, it is not very descriptive (Severity 4)		
	The interface for notifying a user of the location of sound could be changed. Perhaps by animating the icon to have sounds come out of it in the direction the sound is coming from. (Severity 2)	Using gradient lighting that will better highlight the changing directionality of the sounds.	
	Put the glasses controls on the right side of the glasses. (Severity 2)	Controls moved to the right side, as most users are likely to be right handed	
	Add a light that lights up when the device is on Trivial to add (Visibility 3)	We added a red light to the power button to indicate that is it on.	 

 	Where do you charge the glasses? How do you tell how much battery they have?	Added a battery life indicator and charging port	   

	Feedback for sensor connecting, what if they are not connected, dangerous! (Severity 2)	Added a light on the sensors indicating a connection to the glasses	 
	Different icons for brightness, thought they were volume buttons. Use icons like keyboard brightness on mac. (Severity 4)	Added brightness icons, to make it more descriptive for the user	
Not originally supported	Deaf and hard of hearing people would benefit from real time captioning (Severity 1)	This would be a really cool feature to add but once again we want to focus on transportation first.	No current plans to support

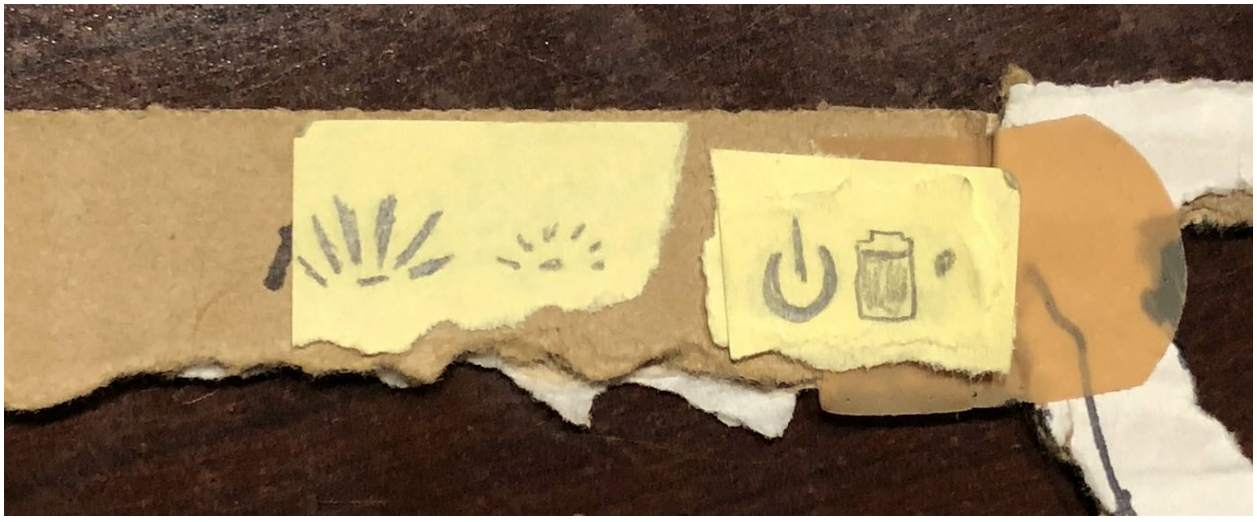
Final Paper Prototype

We've revised our prototype in several ways. The first is by changing the power button and dimmer controls of the glasses themselves. After additional feedback in our usability test, we added bright and dim icons to make it easy for the user to distinguish button purpose. The second major change is that instead of holding up the individual indicators we put them on a piece of paper and hold that up instead. We used this update in the next two tests, and it made testing easier for the participants and a much smoother process. We also added a battery life indicator and a charging port on one of the ear hooks of the glasses. We added connection indicators to the audio sensors, and update the display to a blue gradient, to better allow for directional location. The last major change is the introduction of a quick user manual so participants and future users can have a brief overview into how our interface works, and what all of the buttons and indicators do.

As we evolve our design, we will update this outline to make it easier for users to understand how AuVi works. There are several things that we still plan on addressing in our final design, such as the fastening of the sensors, and potentially adding many more icons to improve usability.

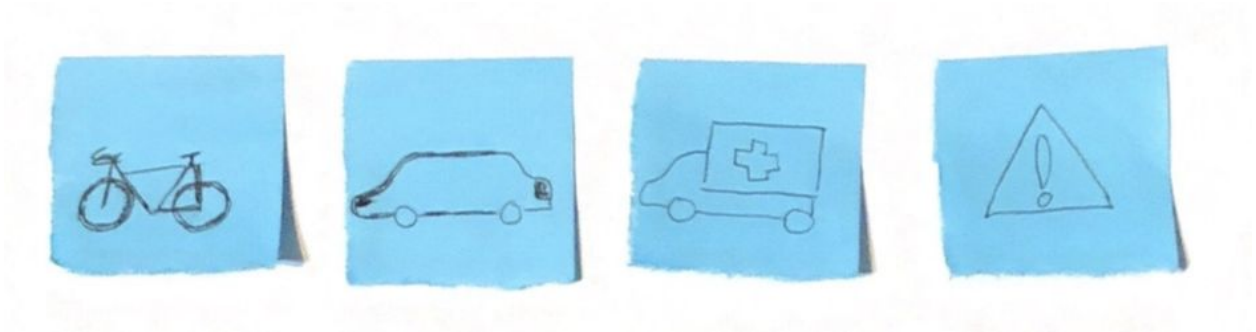
Glasses

Revised Power & Dimmer Buttons



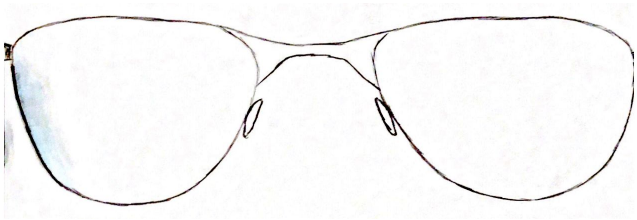
Sensors

Icons

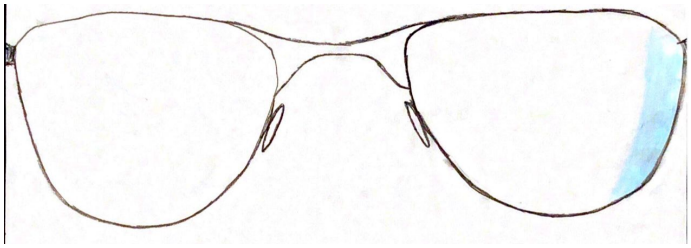


Location Notifications

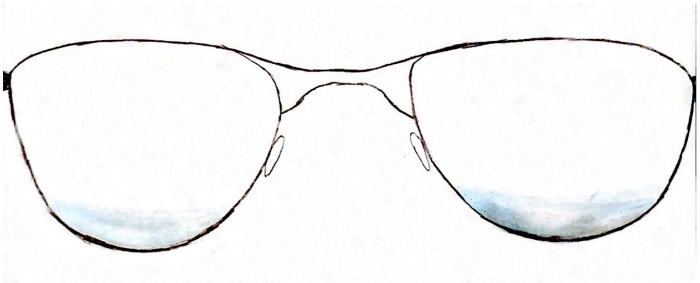
Left



Right



Behind

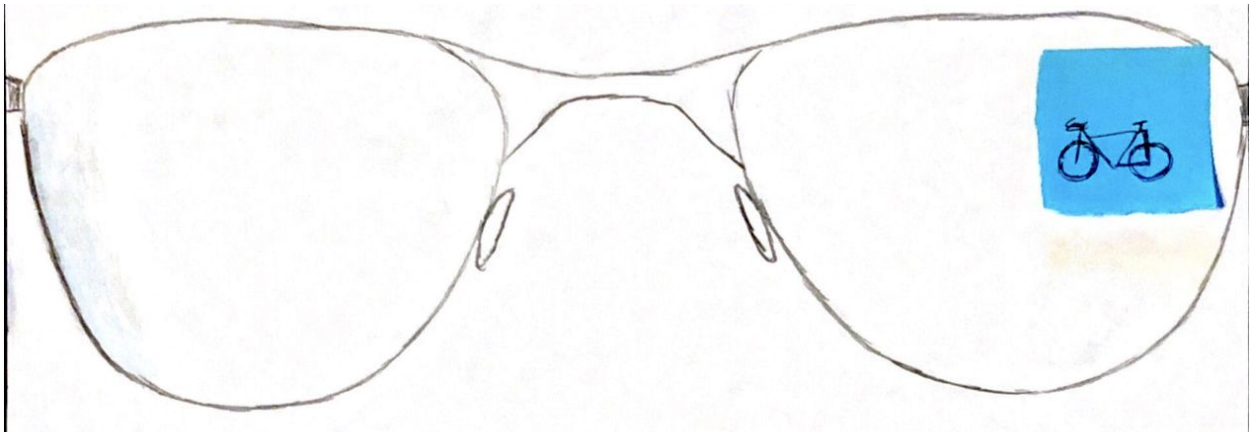


Tasks

Notify user when someone is trying to pass them.

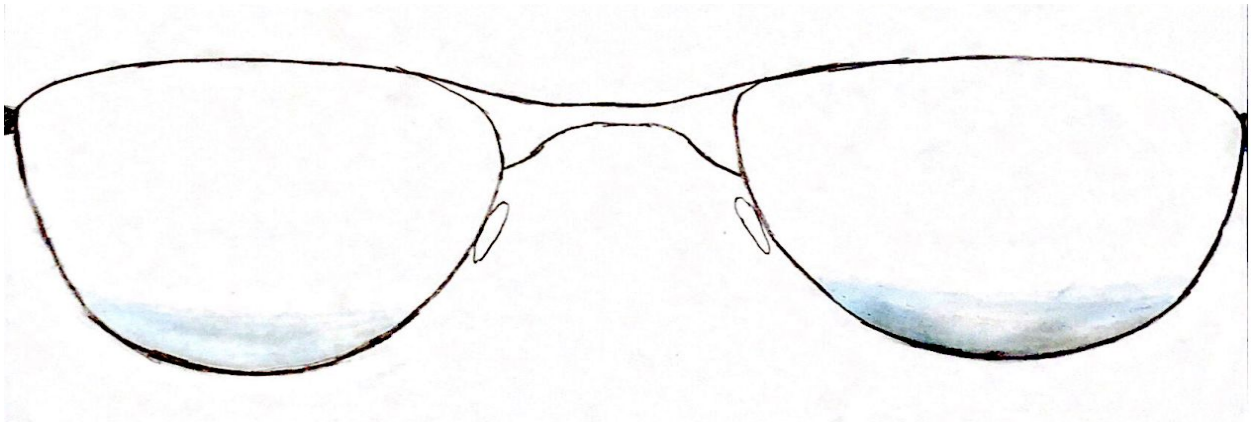
The directional display on the glasses will notify the user when someone is trying to pass them, in this case a biker trying to pass of the left. Below is an image with the left lens showing a blue tint. The lightness of the blue indicates that the bike is still relatively far away. As the bike gets closer the blue color fills in.

Using Intel's vaunt technology the user can then glance over at the display and will be able to see the notification area in the right lens informing the user that it's a bike that's approaching them

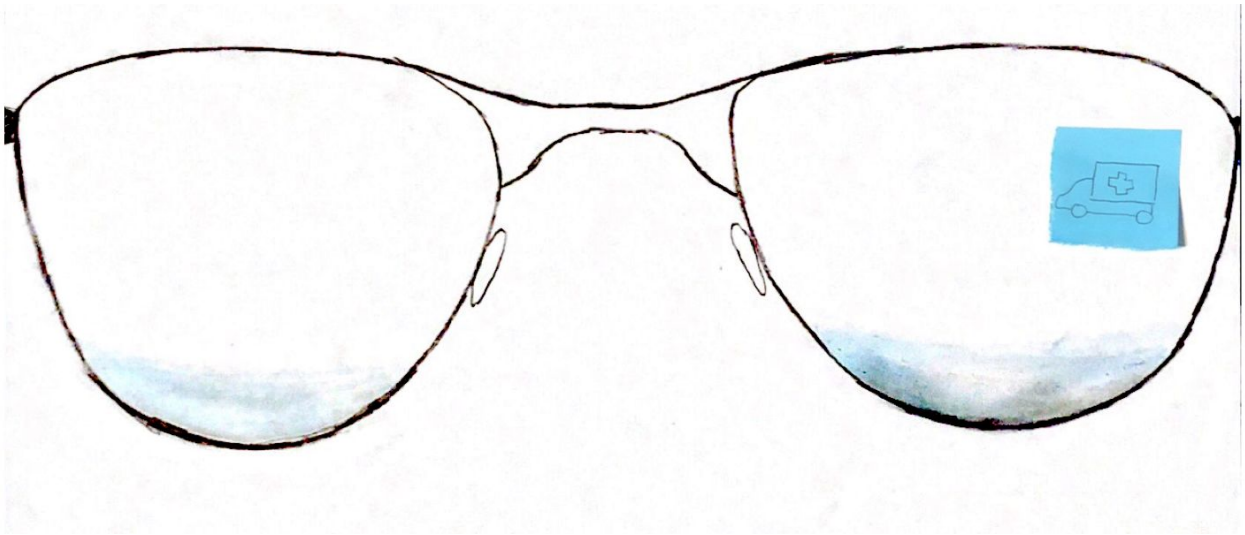


Informing user that an emergency vehicle is approaching

The sensors the user placed on the back of their car to sense the sound of the emergency siren. The glasses notify the user when the sensors sense an emergency vehicle approaching. In this case, the emergency vehicle is approaching the user from behind. The glasses display the location of the sound on the lenses with blue tint.

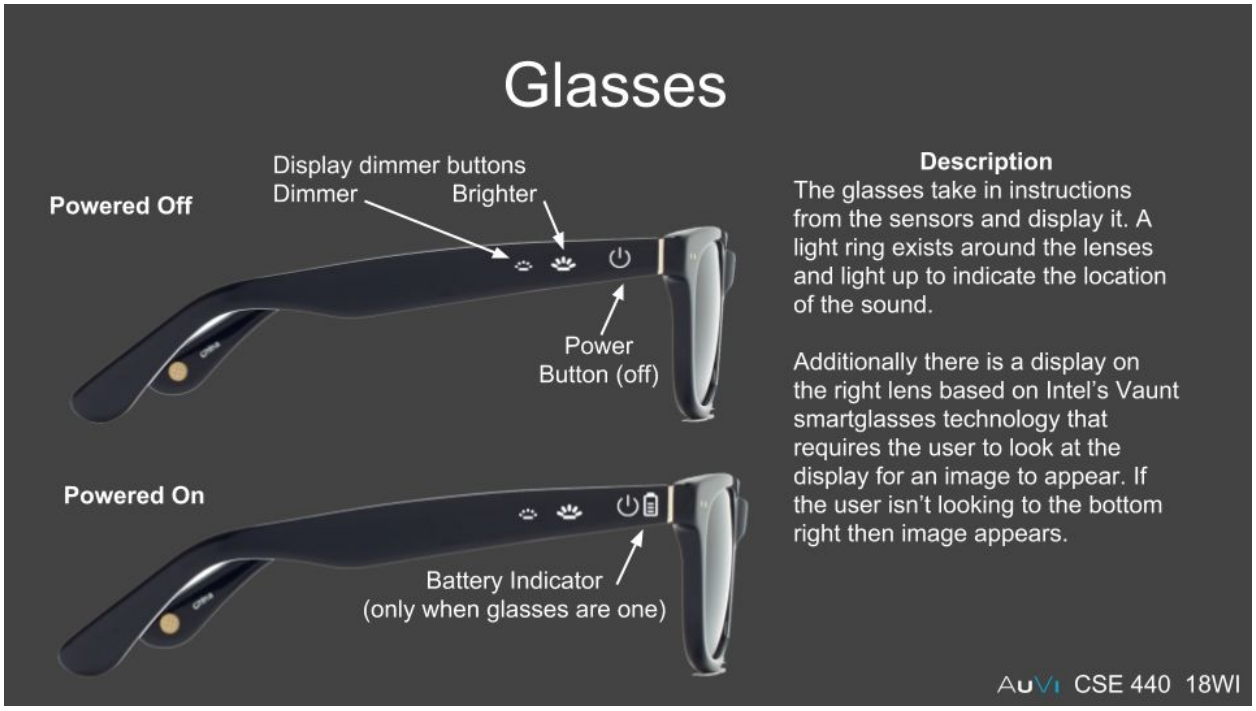


To inform the user of what's making the sound, a small logo of an ambulance is presented in the upper right of the right lens when the user looks in that direction. Below is a full representation of the glasses when this happens.



Digital Prototype

Glasses



Sensors

Sensors

Top View

Front View

Description

The sensors come in pairs and function best together to ease with pinpointing sounds. The system functions with only one sensor as well in the case of a bike. The sensors handle the detection and signal processing and sends it wirelessly to the glasses for displaying.

The sensors have magnets and a clip on the back to make it easy to attach to a bike, car, or backpack.

AuVi CSE 440 18WI

Attaching Sensors

AuVi CSE 440 18WI

Discussion

What did you learn from the process of iterative design?

We found that the ability to quickly create a low fidelity prototype and test it to be incredibly helpful. This quick iteration allowed us to gain meaningful feedback that we could then incorporate in our design right away. When designing, it's easy to let our own "expertise" blind us from design flaws. As such, initial designs are innately flawed, and the process of iterative design allowed us to find the flaws early.

How did the process shape your final design?

In the early stages, we designed multiple solutions in parallel. This parallel design process allowed us to create a better final solution, as each of the intermediate solutions were compared against each other. In the end, we decided to take the best aspects from the intermediate solutions and merge them together into our final solution. Once we decided on a solution, critique and general feedback from user testing helped us iron out a prefered design. Conducting usability tests with users in person gave us insights into our designs we wouldn't have otherwise. Overall, both the parallel and iterative design processes helped shape our final design.

How have your tasks changed as a result of your usability tests?

Originally, our tasks were extremely specific. We included too many extra details to the task that, in the end, didn't matter or even hindered our design process. Specifically, we included the specific mode of transportation to our tasks. We quickly realized that our tasks would be move helpful if we generalized them to all modes of transportation. We changed one of the tasks from "notifying a biker that they are being passed" to "notifying the user that they are being passes." Generalizing the task to drivers and even pedestrians helped us design a more useful product.

Do you think you could have used more, or fewer, iterations upon your design?

The number of iterations of the design was ideal. There were not too many iterations that we would meticulously design every aspect of the solution and not too few iterations that we would miss major design flaws. These iterations helped us come to a complete and useful design.

Appendix

User manual given to participants of the usability tests: