SEE CC

Improving Conversational Experiences for Hearing Loss

Fall ‘18 INFO 360 Project
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Problem

Our Argument

According to the World Health Organization (WHO), over 5% of the world's population suffers from disabling hearing loss, which amounts to about 360 million people ("World Wide Hearing Loss: Stats from Around the World"). In developed countries like the U.S., "over half of the cases of hearing loss are due to genetic predisposition" ("World Wide Hearing Loss: Stats from Around the World").Thankfully, there is an abundance of technologies available to assist those with hearing impairments today, with the aim of helping these individuals get around the obstacles posed by their disability. However, while many of these devices are successful in bridging the communication gap, there are usually numerous intermediate steps that need to be satisfied to provide these individuals with "seamless" conversation; this puts them at a disadvantage because of the inconvenience of accessing and preparing these resources that are crucial to their ability to converse and listen.

In order to have a better understanding of what these intermediate steps were across different available solutions, we conducted some research on the current available resources for hearing impairments, and listed the setbacks of each:

- <u>Cochlear Implant:</u> An invasive surgical solution that implants a device that will send signals to the brain to aid with interpretation of sound waves from voices.
    - **Risk** – Surgery that has different effects on different people
    - **Expensive** – $30,000 and $50,000 for patients without insurance ("How Much Does a Cochlear Implant Cost?").
    - **Safety** – Vulnerable moving parts even when completed
- <u>CART (Communication Access Realtime Translation):</u> A service provided by the University of Washington, in which a transcriber is appointed to a student to transcribe a lecture word-for-word, which will be projected to a small monitor for the student to follow along with the lecturer in close to real-time ("What Is Real-Time Captioning?").
    - **Limited Availability** – Limited to use in the classroom setting and by appointment.
    - **Multi-tracking** – Need to keep looking at the monitor to read the spoken text, as well as the actual display if there are any visuals being explained alongside the spoken explanation.
- <u>Specialized Courses:</u> A service provided by many educational institutions, in which courses are specifically structured around the needs of the student's disability.
    - **Not Integrated** – Separated disabled students into a different class, which is not a seamless integration.

What we can infer from many of these current solutions is that they are either dependent on the cooperation of another individual, costly, invasive, or a combination of these three. While the benefits of these solutions may outweigh their respective complications for specific individuals, as a collective they fall short of providing a seamless and natural conversation experience for those with hearing impairments.

Given the results of our research on current solutions, as well as the statistics regarding the impact that hearing impairment has on a global scale, we want to design a product that can not only seamlessly fit into people's lives, but do so without the complications of those solutions. In fact, rather than a "solution" to change an individual's hearing impairment, we seek to create a product that simplifies the complications of current solutions, and serves as the single interface between a deaf user and the conversations happening around them.

Solution

Our Proposal

See CC is a hands-free smart glasses device, providing real-time closed captions of conversations for users with hearing impairments. It aims to remove the intermediate steps and complications that the current solutions involve, and help users focus on what's most important: being fully engaged in a conversation.

We provide three modes to adapt to different listening situations: lecture, conversation, and custom. These are catered for listening to few speakers who are farther away, many speakers who are close by, and for custom situations respectively. Some other unique features of See CC include eye-tracking to determine whether the user has read the closed captions, and a locking functionality to enable users to look away while continuing to listen to a speaker.

In terms of implementation, the goal is to develop the software for smart glasses devices to provide the functionality listed above. This is not only to ensure a straightforward user interface and experience, but also to address the limitations posed by the currently available solutions such as cost.

Information to Compute

<u>Text-to-Speech</u>
The most vital part of this design is to collect the auditory data coming in from the microphones, convert this into words, and ultimately project these words as text to the user's glasses. This calculation is crucial for delivering the desired behavior for a user with a hearing impairment, as the intended outcome is to simulate a conversation as someone who does not have a hearing disability.

<u>Directional Data</u>
Users will need to know where the person they are listening to is relative to themselves. This calculation is important because the glasses need to overlay the speech-to-text text bubble on top of where the speaker is displayed through the glasses. This will help explicitly tie the speaker with their respective speech.

Design Rationale

This design provides a new approach to conversation for those with hearing impairments. See CC is a supplementary tool intended to improve seamless conversation experiences for those with hearing loss, while minimizing the drawbacks imposed by current solutions. By implementing transcription right on the screen, the users can understand what is being said without actually hearing; the only thing they need is their sense of sight – the rest is up to the program itself. We made some design decisions to assist edge cases where there may be more than one person talking (multiple speech boxes overlayed on the speaker), or somebody they are listening to but not looking at (the locking functionality). These features will be discussed in detail in the following section.

Prototypes

Low-Fidelity Prototype

Our initial pipedream of "netflix subtitles in real life" didn't last long, as we realized the ambiguity that comes with it after initial sketching and reviewing. We quickly re-sketched the prototype to have a simplistic speech bubble next to the person who was talking. Another issue that was raised during the early prototyping stages is how a student would be able to listen to a professor while writing down notes during a lecture. Since the speech bubbles showed up next to the person you're looking at, looking away from the professor would render the device useless – one of the main use cases we wanted to solve in the first place. That is how we came up with the locking system.

Locking onto a specific speaker would allow the user to be able to read what the speaker is saying without having to look at them, letting them write notes without necessarily looking at the professor. Another use case of this would be in a casual conversation, where you do not have to necessarily be in a position where everybody is visible in order to know what they are all saying. Cases where the user is looking at the scenery with somebody else, and the fact that they do not need to take their eyes away from it in order to know what the other person is saying is just one of many cases where the locking system would be helpful.

One last thing we learned from the low-fidelity prototype is when someone asked us how and when the speech bubbles would disappear during our critique. Lost for an answer, we figured it would disappear after a certain amount of time. They then suggested eye tracking to track when each conversation is done being read. This was a great idea that we decided to implement, and also implement in our locking system with the new technology of "EyeOver".

High-Fidelity Prototype

Calibration

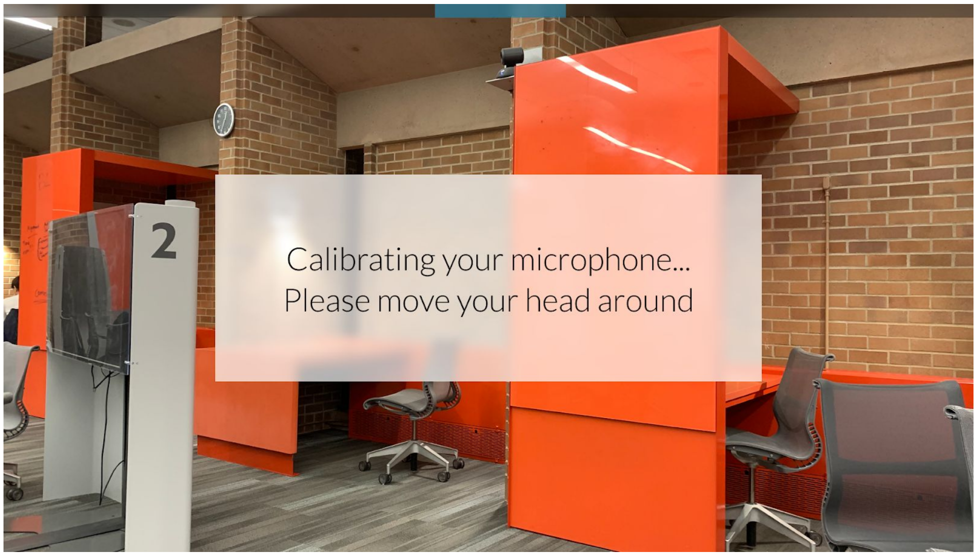	Figure 1
	Figure 2

Figure 1. We wanted to make calibration a very easy and straightforward task. Turning on the glasses for the first time will prompt the calibration screen. To finish the calibration, the user needs to look around. As the user looks around, the the blue bar on the top of the screen fills up based on how much of the calibration has been completed.

Figure 2. Once completed, the screen then briefly displays a quick “Calibration completed!” message, and a gesture indicator on the top right of the screen. It teaches the user how to lock and unlock onto people talking.

Enabling Lock/Unlock using “Eyeover”

Figure 3

Figure 4

Figure 3. The bright green tint on the unlock/lock indicates that that current person is highlighted (or “eyeovered” – mouseover but with your eyes). This happens because the user is facing her and looking at her to enable the eyeover. The female speaker is currently unlocked, but able to be locked as she is now selected. Notice that part of the text in the speech bubble is transparent, as it shows the text that has already been read by the See CC user.

Figure 4. Now the bright green tint is on the male speaker, indicating that his speech can now be unlocked (as it is locked right now). What that means will be explained in the next section – “Locking/Unlocking a speaker”.

Locking/Unlocking a speaker

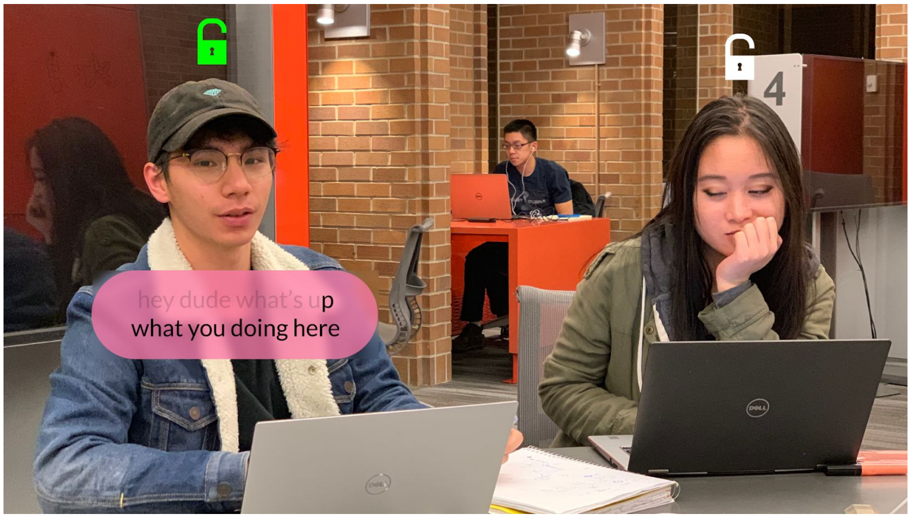

Figure 5

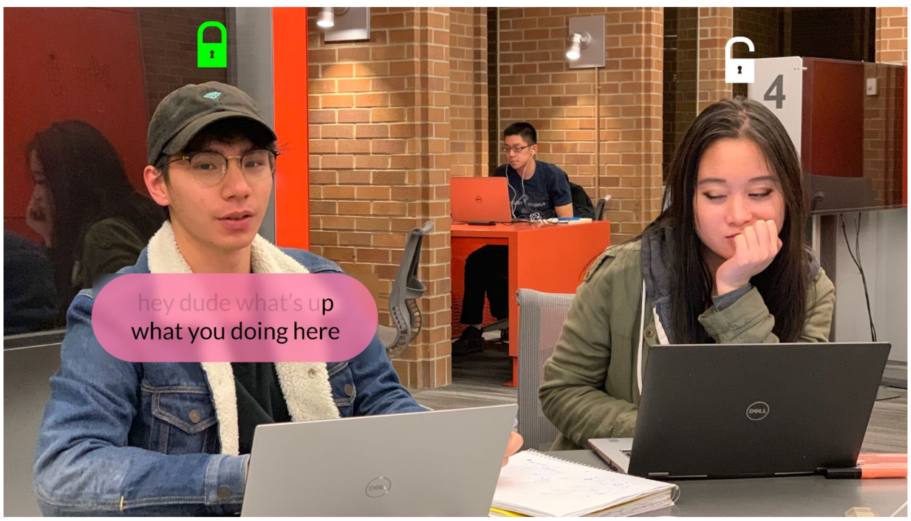

Figure 6

Figure 7

Figure 5. To enable locking or unlocking, the user must “Eyeover” onto the speaker they’re interested in locking or unlocking on. In this figure, the user is eyeovering on the male speaker, and since he’s unlocked, tapping on the side of the right side of the glasses will lock the speaker.

Figure 6. In this figure, the male speaker has been locked on. This means that the transcription of that speaker will always be available to the user even if the user isn’t looking at them.

Figure 7. When the user looks away from this speaker, the transcription of his speech appears on the bottom left or right, showing which way the speaker is relative to the user.

Here is an full interactive version of the above prototype, as well as a video prototype that simulates how the product would perform in a real world setting.

Evaluation

We chose to use the GenderMag Walkthrough as our design method in order to recognize and rectify the possible breakdowns for a typical user, represented by the personas of our design. Unfortunately, we were not able to conduct actual user testing and interviews due to time constraints. However, utilizing the GenderMag Walkthrough methodology proved to be an effective alternative. We were able to test on of the key functionalities of See CC, “locking and unlocking on a speaker.” Although simple, this was a vital feature in our product that needed to be dynamic and flexible with many different conversation situations. In cases where there many people talking, the user is not looking directly at the speaker, or where is in lecture writing notes, locking is a key feature that the user will need to rely on as it is what helps See CC provide the seamless conversation experience.

Limitations

While our design aims to help users with a range of hearing disabilities, there are some limitations that need to be addressed:

- The device will not be storing any data pertaining to the conversations that the user engages in, besides when the conversation text is being displayed to the user. This is primarily for privacy purposes that come with preserving and recording conversations without consent. As a result, we may not be able to take advantage of some of this data that could be useful for adapting the device to each user’s usage patterns.
- Implementation details were heavily overlooked throughout the course of this design process. Many of the features are assets we would ideally want to include, but could possibly be very costly or difficult to implement.
- While See CC addresses the problem that individuals with hearing impairments face when listening to conversations, it neglects the steps that follow such as responding. A great next step that could address this issue would be to upgrade See CC to a device that facilitates listening as well as responding to conversation.

References

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