Undergraduate Thesis Prospectus

Custom Software to Automatically Caption Computer Audio

(technical research project in Computer Science)

Deaf Disparity: How the Deaf Community Uses Technology That Expects Them to Hear

(sociotechnical research project)

by

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.
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General Research Problem

How can the quality of life for deaf and hard-of-hearing (DHH) people be improved?

As remote work and learning proliferate, disabled individuals need digital tools and software more than ever. One significant group is the DHH community, who account for approximately 1 in 20 Americans (Mitchell, 2005). Supporting this group with accessible tools is essential so that the social and intellectual gap between them and abled individuals doesn't widen.

Custom Software to Automatically Caption Computer Audio

How can DHH individuals effectively manage a career or schoolwork remotely?

Because I am a CS major doing the capstone process in the spring, this proposal is for a project that I am interested in, but it is not yet official. My technical advisor is Aaron Bloomfield, and I will be working with the Computer Science Department. I will not be collaborating with other students.

Due to the COVID-19 pandemic, people quickly adapted to a virtual environment, but remote work will remain an option for many after the pandemic ends due to its convenience and effectiveness (Ogawa, 2020). Therefore, DHH individuals must be able to productively manage their careers remotely, and my project provides this through computer software. The goal for this project is to explore accessibility in software development, which is often overlooked but still crucial to people with disabilities.

Right now, the best option DHH individuals have is to let their boss or instructor know of their disability and have a third party provide captions or interpretation. If a particular video is not captioned, then the person is out of luck unless they can contact the owner of the video.

Services like YouTube have automatic captioning systems, but they are restricted to videos on their platform. Another option is to use hearing aids that are synced with the user's computer audio, but these are expensive and don't work for completely deaf users. With such limited access to resources, the social disparity for DHH individuals expands in a virtual environment.

My plan is to build software that captures any computer audio source and automatically transcribes it to readable text that is displayed on a movable overlay on the user's monitor. Since so many people already use computers in the workplace and in school, this will not require any additional devices; the software can simply be installed on the user's machine. With captioned audio for videoconferences and instructional videos, DHH users can better navigate a fully virtual setting.

The user's screen will display captions on an overlay that appears on top of any other program a user has open (think of the "Share Screen" user interface on Zoom). Generating the captions will be done with natural language processing (NLP), which is an area of artificial intelligence focused on interpreting human language. I would begin with a ready-made, open-source speech recognition dataset such as the one offered by VoxForge (VoxForge, 2020), and use it to build a model that transcribes audio into human-readable text. This model would then translate snippets of sound from the user's computer audio as it is spoken.

If the project is successful, I will have a complete plan for software that creates human-readable text from any computer audio source. Full implementation is not required for the Computer Science capstone, so a blueprint on how it would be built is sufficient. With this software, DHH individuals will be equipped to handle virtual work and learning without any external devices or third parties.

Deaf Disparity: How the Deaf Community Uses Technology that Expects them to Hear

How do DHH individuals adapt to interfaces that expect them to hear, and try to adapt such interfaces to their needs?

Devices and programs that rely on audio or speech input, such as Amazon's Alexa and Zoom meetings, are difficult for DHH persons to use (Glasser et al., 2020), and online informational or entertainment videos, livestreams, and podcasts are all only sometimes captioned (Maiorana and Pagliaro, 2014). Videoconferencing tools that aid with remote work and learning skyrocketed due to COVID-19, but these tools don't have first-party support for automatic captioning (Anderson et al., 2020). How can DHH individuals adapt to use programs with interfaces that aren't adapted to their needs?

Research on how DHH people use technology in the workplace is not new. With video consumption up 660% from 2011 to 2012 and with Americans spending over 20% of internet time watching videos (Mairoana and Pagliaro, 2014), the need for universal closed captioning is higher than ever. This is exacerbated by videoconferencing platforms presuming that their users can already "see, hear, and speak verbal English" (Reid, 2020). Requesting accommodations that aren't supported by default, such as third-party ASL interpretation and captioning, can elicit a social stigma from coworkers and peers. ASL grammar can also be difficult with the pandemic, since face masks cover facial expressions (Katz, 2020). Captioning software would remove the need to lip-read and interpret facial expressions, increasing accessibility for DHH individuals.

Major participants include several classes of advocacy groups that provide education and employment solutions for the DHH community. One class focuses mainly on schooling and education (NDC, 2020), while others expand their scope to build communities (CSD Inc., 2020). Another participant are self-advocacy groups, who help deaf and hard-of-hearing people set their

own goals, describe their own needs, and ask for their own assistance (Hands and Voices, 2020). Participants also include DHH persons who are frustrated with their current accessibility options, worry about their employability, and find the increase of challenging scenarios such as virtual meetings difficult (Marshall, 2016). Another important participant group are advocates for the deaf who try to close the "division" from the "hearing world" and the "deaf and hard of hearing community" by ensuring they have access to usable technology (Taylor, 2020). The final participant are software companies that value accessibility and work to provide solutions for the DHH community (Lovett, 2019). With the current global pandemic furthering the divide between abled and disabled individuals, creating technology that allows DHH users to adapt to new environments is necessary for their inclusion in society.

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