Thesis Project Portfolio

Tongue Drive System for Assistive Control

(Technical Report)

Comparing Perceptions of Disability through a Characterization of Attitudes towards Assistive Technology

(STS Research Paper)

An Undergraduate Thesis

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Table of Contents

Sociotechnical Synthesis

(Executive Summary)

Approaching Disability from the Perspective Preferred by the Disabled

"It is not our differences that divide us. It is our inability to recognize, accept, and celebrate those differences." – Audre Lorde, Sister Outsider: Essays and Speeches. 1984

Disability is a sensitive topic within our society as the concept of disability itself is heavily stigmatized. As someone working on an assistive technology meant for quadriplegics, I felt it was necessary to examine the differences in how I, as an engineer who is not disabled, view disability differently then someone with a disability themselves. How one perceives disability impacts the development of an assistive technology from the onset of the design process when identifying what needs a device should meet to the end when writing about it. In recognizing the differences, I hope to better be able to accept and celebrate them in the pursuit of improving the quality of life for these individuals.

In my STS research I examined the manner in which engineers versus disabled individuals view disability differs. I did this by investigating what attitudes towards assistive technologies these groups had using Kerschner and Ehlers framework of attitudes toward technology. Using this attitude characterization I was able to delve into their underlying assumptions and opinions regarding disability. I discovered that while both groups were overall enthusiastic about assistive technology - disabled individuals held a more nuanced view while the minority attitudes for engineers consisted mostly of skepticism. This led me to believe that engineers view assistive technologies as a way to "fix" disability as evidenced by the skepticism towards existing

solutions leading to enthusiasm as they “improve” on existing technologies. However, this implies disability is a problem which perpetuates negative stereotypes about disability and is counterintuitive to the purpose as defined by disabled individuals of assistive technology. They view the role of assistive technology as a way to expand their natural capabilities and as a way to meet emotional needs such as freedom, independence. This difference is important because viewing disability as a lack of ability versus a condition held by individuals with a specific set of needs places more of an emphasis on the technical perspective of granting ability versus the arguably more important part of meeting all their needs - both physical and emotional. Representing thoughts about disability in this manner of representing disabled individuals as people with nuanced emotional needs contributes to a climate of destigmatizing disability.

The technical portion of my research produced a control device that allows motorized wheelchairs to be controlled using the tongue. The significance of this device is that it allows quadriplegics to use their wheelchairs in a more intuitive way than conventional alternative control systems like sip and puff. Furthermore, it is more accessible in terms of cost and less work to maintain for the caretakers. How it works is the patient gets a magnetic piercing on their tongue and wears a headset that I designed which mounts an array of hall effect sensors along their jaw. These sensors interact with magnetic fields and using this data the real-time position of the tongue within the mouth can be ascertained. This real time position can then be mapped to a corresponding wheelchair command using a K-Nearest Neighbors algorithm to classify the position of the tongue within different regions of the mouth which correspond to different commands for the wheelchair. Below, in Figure 1, is an example of how commands might be mapped within a mouth.

Tongue-Command Interaction Example

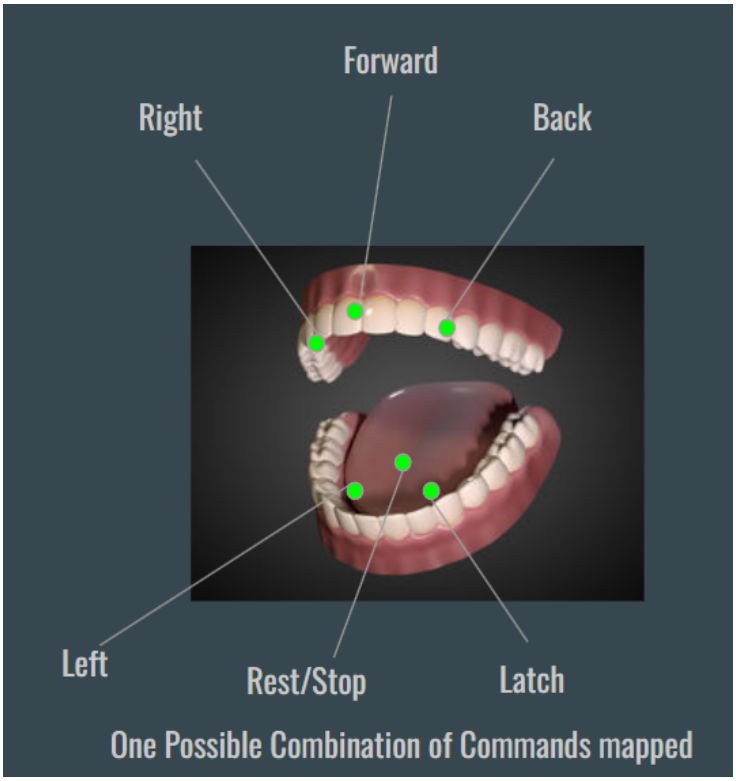

Figure 1: Example of how different regions of the mouth correspond to different commands

My STS research impacted my technical project by shaping the vocabulary and framing of my writing on my technical research and by emphasizing a patient-centered approach to the design process. In completing my technical research, which involved writing multiple presentations and papers, I became very aware of how I framed the problem statement or niche that my device addressed. I had to move past my initial predisposition to view disability as a problem and was able to change the verbiage of my writing so I could contribute to a climate for individuals with disabilities devoid of stigmas. In recognizing disabled individuals as people with nuanced emotional needs I was able to better consider other factors while designing beyond simply bridging gaps in ability. For example, the idea that existing sip and puff systems cover more of

the face and make it harder to interact with people led me to design a sleek non-intrusive form factor conducive to social interaction even at the cost of reduced technical capability for the device. It's important to consider these alternative impacts that technology has and how technical decisions can impact how users fit within society.