Thesis Project Portfolio

Enabling Overground Walking During Motion Capture Pulling Force Trial

(Technical Report)

Constructing Hierarchies: How the Built Environment of a University Contributes to Power Differentials Between Able-Bodied Students and Students with Disabilities

(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science

University of Virginia • Charlottesville, Virginia

In Fulfillment of the Requirements for the Degree

Bachelor of Science, School of Engineering

Anne Felipe

Spring, 2023

Department of Biomedical Engineering

Table of Contents

Executive Summary

Two projects were conducted to fulfill the requirements for the degree Bachelor of Science, School of Engineering throughout the course of the 2022-2023 academic year, one a technical capstone project and the other a Science, Technology, and Society (STS) research paper. Both projects are centered around the theme of mobility and physical disability in the built environment. The technical project looks at progressing a project to create a power walker in order to aid those with limited mobility, specifically those with Cerebral Palsy (CP). The STS research paper looks at how a hierarchy of students between those who are able-boded and those who are disabled. This research specifically looks at how the hierarchy exists, in part, due to the physical built environment of a university campus along with what a university could do to dismantle said hierarchy. These projects both aim to understand the how "disability" is defined in relation to the built environment and how divisions based off that definition, whether they be social hierarchies or the ability to stand, walk, or engage with peers for extended periods of time, can be dismantled, through technical and social means.

For the technical project, a bidirectional assisted walking system was developed. Cerebral palsy is the most common cause of physical disability in children affecting 2 to 3/1000 children worldwide. 31% of children with CP in the US use special equipment of some kind. When it comes to mobility, many individuals with CP rely on walkers or wheelchairs. As part of his PhD project, Evan Dooley is designing a power walker to allow children with CP to spend a longer amount of time per day on their feet, by decreasing the amount of effort it takes for people with CP to get around. In order to properly decrease the amount of effort that individual's with CP exert while walking, there is a need to know how much pulling force the walker will need to apply based on the person's body weight. Typically, these types of measurements are done via

treadmill walking, however treadmill walking elicits different gait patterns than normal, or overground walking. Such as differences in stride length and phase durations. Our goal was to create an overground walking system that will allow for continuous data collection. In order to do this a bidirectional system was constructed that has a pulling force on each end applied by a weighted pulley system and a belt that allows for turning 180 degrees. The system is also compatible with a VO2 measurement system so the metabolic cost of different body weight percentages of applied forces could be examined.

The topic for the STS Research Paper is the perception of disability within an academic setting and what physical factors may contribute to that perception. Individuals with disabilities are often considered as "other" when it comes to architectural design. The paper looks to determine whether that sense of "otherness" translates from the physical built environment and into feelings of students with disabilities and views held by able-bodied students along with social and interpersonal relationships between students. The question that the paper focuses on is: how does the physical built environment of a university campus contribute to hierarchical power differentials between able-bodied and students with disabilities? To analyze this question the STS framework of political artifacts developed by Langdon Winner is used as it suggests that technologies play an integral role in cultural and the establishment of power hierarchies. The discussion centers around the University of Virginia (UVA) and uses discourse and documentary research. The physical built environment of UVA at one point contributed to a power differential between able-bodied and students with disabilities. However, over time with renovations and improvement projects, the Grounds of UVA will allow for a more inclusive space; the case of the Lawn was specifically looked at to highlight change over time. The research being done seeks to highlight how environments and the technology associated contribute to the view people have of

others. It may be unintentional, however the space that has been made or the technology being used holds power to create differences between people that must be acknowledged to create a more equitable society.

Both of these projects have presented a unique look at disability through different perspectives. By conducting the technical and STS projects at the same time knowledge that was learned through one could be applied to the other. For example, the technical project demonstrated the health benefits of standing and walking for extended periods of time and the STS project in a way demonstrated the social importance of being able to stand and walk among peers. These projects being completed concurrently gave insight into the perception of disability in both respects to technical and social aspects that aided in the research efforts for both.