

Novel EMG-IMU Sensor Array for a 5-DOF Wearable Robotic Upper-Limb Exoskeleton

(Technical Paper)

Examining the Politics Surrounding Assistive Devices

(STS Paper)

A Thesis Prospectus Submitted to the
Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia
In Partial Fulfillment of the Requirements of the Degree
Bachelor of Science, School of Engineering

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Spring, 2022

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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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Prospectus

Introduction

What is the focus of the technical project?

The goal of the technical project is to develop the system for and aid the design of a bio-exoskeleton. The ultimate goal is to create a wearable upper limb robot that can integrate various systems, including pneumatic motors, to assist individuals with limited upper-body mobility. A secondary goal for this project is to engineer a device where the sensors will be grafted directly to a wearable light-weight mesh rather than a bulky apparatus. The reason for this is to increase the user's comfort, lower the mass of the device, and take a step further in reducing the size of the device.

The project design will be done in two separate groups, the electromyographic (EMG) team, and the mechanical team. I will assist my team in the creation of the electrical systems (EMG) of this project. The first step in this design is to create a suitable sensor using a printed circuit board (PCB) schematic. The function of this sensor will be to differentiate between the EMG signals of a relaxed or contracted muscle. Additional calculations will be done to determine the correct impedance control and force magnitudes inputs for the sensor.

Concurrently, the mechanical group will create a wearable pneumatic actuator to generate the desired force based on the signal received from the EMG sensor. The air will be channeled into pneumatic tubes that will relax and elongate or contract and expand based to simulate the muscles in the human arm. This team will determine the optimal design to replicate the three degrees of freedom within the shoulders and the two degrees of freedom in the elbows for movement.

What are the politics surround evolving prosthetics/orthotics, especially from the perspective of disabled persons?

Prosthetics are becoming more powerful and capable as time progresses. How long until these very devices begin to rival the abilities of regular human organs/limbs? What will happen to the users and those associated with this technology? Will they be perceived as less than or more than human? Will they begin to associate themselves with a specific political group/bracket? These are some of the questions that I brought forth at the beginning of my capstone project. I believe that this a topic that should be discussed early on rather than down the road when human-assistive technology is far more advanced, capable, and efficient.

Contrary to other papers on this topic, this research will have a higher emphasis of sources from people who are actually using these devices rather than the usual third-party perspective. I am confident that this stance is essential in exploring the implications of the main question since first-hand experiences and sources will express viewpoints that are not commonly discussed or not even thought of.

Methodology

The primary manner in which this research question will be tackled is through the history and philosophy of assistive devices with an emphasis on experiences from the people who use these devices. I will have both the perspectives of those that are affected and also historical information about the development of the technology as a whole.

First, the history of the development of prosthetics/orthotics will be discussed and then traced to the present to depict imperative changes in the field over the past 50 years. This will

then serve as a point of reference for the progress of assistive devices and a basis to begin understanding what may occur in the future as the field advances even more.

The journal article "Electric Moms and Quad Drivers: People with Disabilities Buying, Making, and Using Technology in Postwar America" will be a primary source used to contrast the level of development of assistive technology in the 1950s and 1960s in postwar America.

Furthermore, the philosophy surrounding this topic, especially from the point of view of the users, will be utilized to outline the politics of assistive devices in the modern world. The evolution of politics will be viewed in a phenomenological context to ensure that the majority of the experiences and information are from individuals who use these devices, rather than from a secondary source.

The journal article "Transmobility: possibilities in Cyborg (Cripborg) Bodies" contains various personal accounts detailing the lives of several women who depend on assistive devices in their daily lives and their perceptions of the world.

Key Texts

Transmobility

"Transmobility: possibilities in Cyborg (Cripborg) Bodies" is an article from a journal called Catalyst that works to expand the interdisciplinary scope of feminist science and technology studies through creative scholarship and approaches from various fields such as public health, history, disability studies, and many others. This article is a collaborative work by and conversation between three disabled women who, among them, use or have used many types and configurations of mobility devices (Nelson, Shew, & Stevens, 2019).

The piece is organized with an introduction where Mallory Kay Nelson, Ashley Shew, and Bethany Stevens, establish their own perspectives within this topic, the perceived reception of this article with them all being cis-gendered white women, and define terms such as Transmobility¹ and Cripborgs.² What follows are personal accounts from each author containing a short account of their lives thus far with their respective conditions and their relationships with the assistive devices they have used over the years to improve their mobility. These accounts also contain the subtle differences in treatment from others that the women have noticed based on their conditions and also the type of assistive device they may use a certain day.

With these perspectives, I believe that a clearer picture can be illustrated pertaining to the politics that surround prosthetics since the viewpoints are directly from individuals who are affected and not from a third-party source. It is from this vantage point that it becomes more feasible to predict what will occur as prosthetics and orthotics begin to rival natural limbs.

Electric Moms and Quad Drivers

“Electric Moms and Quad Drivers: People with Disabilities Buying, Making, and Using Technology in Postwar America” is a journal article from the Mid-America American Studies Association. As displayed through the title, this text explores the advances in technology geared at improving the lives of disabled individuals living in post-war America.

¹ (1) The ability to move between various modes of mobility; use of multiple mobility methods; (2) the ability to move beyond traditional forms of movement and mobility; (3) the existence of free and disabled bodies in motion. Word derived from the prefix “trans-”, meaning beyond, across, though, surpassing, transition, transport, or transcending + “mobility,” meaning the ability to move or be moved freely. Antonym: Monomobile. Coined by Mallory Kay Nelson. Origins: her experience.

² (1) Crippled cyborg; (2) a disabled person who selects technologies whilst anticipating the world they will encounter; (3) crips who will not be resisted: you too will be assimilated.

The article has several excerpts from a retired column, the Toomey J Gazette, about the lives of respos³ and is a great source for first-person account of the technological adaptations in the 1950s and 1960s (Williamson, 2012). There are numerous examples of the scarcity of support for disabled people in this era and the different ways in which they devised to get through the days with more ease. The article also portrays the transition of assistive technology from the hospital to home, the ways how people would improve their lives at home with their respective conditions, and an overview on the access outside of their homes.

The information provided in this article is vital and a start to trace the advancement of technology developed to enrich the lives of the disabled.

Brilliant Imperfection

“Brilliant Imperfection: Grappling with Cure” is a book by Eli Clare that explores cure, the engrained belief that bodies and minds outside of the norm dictated by society need to be fixed. The main argument of this piece is that neither a world fixated on curing or one that is against it can hope to account for the complex issues that we have minds and bodies.

The book has several essays by Clare that explore the messy and complex relationships that humans have with their body-minds⁴. These essays weave various themes such as race, disability, sexuality, class, gender, and stereotypes to demonstrate the difficulty of a stance on cure to explain our relationships with our body-minds. These essays also serve the purpose of

³ Those who had had respiratory cases of polio, but eventually included people with spinal cord injuries and other “quads” and “paras,” medical shorthand for quadriplegics and paraplegics.

⁴ A term to recognize the inextricable relationships between the body and mind and the ways in which the ideology of cure operates as if they were two different things.

illustrating how most nondisabled persons believe that disabled individuals need to be repaired (Clare, 2017).

This book further enhances the perspectives that are presented in *Transmobility* where the author clearly state that they do not want to be fixed but would rather the world become more accessible to all. Additionally, the wide range of stories that Clare includes allow for a more profound infusion of phenomenology that will in turn do more justice to the disabled community and allow for a better assessment of the politics enveloping this subject.

References

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