

## **Thesis Project Portfolio**

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

(Technical Report)

**Examining the Politics Surrounding Assistive Devices**

(STS Research Paper)

An Undergraduate Thesis

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## **Sociotechnical Synthesis**

Wearable assistive devices are able to provide medical aid through the collection and utilization of biological signals from the human body. With increasing advancements in computing and the reducing cost of computational power, these devices are becoming more powerful and useful each day.

The technical component of this thesis was completed as a requirement of the MAE 4600/4700 Mechanical Design capstone course. The project focused primarily on the development of a wearable upper-body exoskeleton to allow individuals who suffer from neuromuscular disorders such as Amyotrophic Lateral Sclerosis (Lou Gehrig's Disease or ALS) to regain control of their arms. Initially, the class learned basic concepts such as printed circuit board (PCB) design, Electromyography (EMG) operation and analysis, and signal processing in preparation for whatever role they were going to take on in the creation of this device. After sufficient information, the class was divided into three groups. Two groups were tasked with the creation of the exoskeleton along with the selection and modification of the appropriate synthetic muscles to be used. One group focused their efforts on the shoulder, while the other group was responsible for the elbow. The final group was responsible for the electrical and software component of the device. The third group was assigned with data acquisition and analysis of the data from the EMG and Inertial Measurement Unit (IMU) sensors. Multiple experiments were conducted to decide the best placement for the electrodes and the IMUs to ensure the integrity of the data that was collected. The EMG sensor array provides accurate data regarding the intended muscle action of the user, meanwhile, the IMU array is used to provide the acceleration and rotational information which supplies the feedback signals needed for the actuators. The data was

then integrated with the exoskeleton from the other groups and used to control the actuators, leading to the intended movement of the arms.

Due to nature of this capstone project and the fact that the end product was going to be used by people suffering from real disorders, it was important to research the unintended/implicit effects this device would have their lives. Would this wearable exoskeleton cause the user to be perceive as less competent than an able-bodied individual, or would it be the opposite?

The research portion of this thesis focuses on the politics surrounding assistive devices (prosthetics) and their users. The goal of this paper is to elucidate readers about the dynamics (politics) surrounding prosthetics with focus on the lived experiences of disabled individuals. This paper synthesizes the historical, philosophical, and phenomenological components to create a thorough understanding of the current dynamics surrounding assistive devices and the disabled community. A perspective that is often overlooked through a third-person exploration of the disabled community is the different perceptions of various assistive devices. This perspective is becoming increasingly important as technology has advanced greatly to the point where bionic assistive devices are becoming commonplace in the disabled community.

This paper begins with a brief recount of the history of assistive devices along with the laws and acts that have been enacted to protect the civil rights of the disabled community. This recollection is then used to depict the progression of these devices, their perception, and the common themes experienced by disabled individuals. The topics are continued and then used to explore what it actually means to be disabled and the common shortcoming of society as a whole to recognize the desires of the disabled community. This exploration also provides the chance to briefly discuss what cures would look like through the eyes of disabled individuals.

Finally, there is a discussion about the future politics surrounding assistive devices and their users as bodily modifications increase and transhumanism spreads throughout the world. This discussion seeks to provide thoughtful and possible realities as humans begin to alter their bodies and different body-minds become the norm. Will these changes in the perception of the "standard" body-minds destigmatize the disabled community, or will they be further alienated? Will the spread of transhumanism lead to assistive devices being perceived as significant political objects? These and many more are questions that remain to be answered only through the passage of time.