**How Computer Science is Aiding the Advancement of Prosthetics and Spinal Cord Treatment**

Assignment #5

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**Introduction**

Bionic limbs is something we’ve seen in science fiction films for many years. As technology advances, limbs controlled with your mind become more reality than science fiction. In December of 2017, Johnny Matheny became the first person to live with a robotic arm controlled by the mind (Gohd, Chelsea). John Hopkins Applied Physics Lab developed the Modular Prosthetic Limb (MPL) that works by reading electrical signals that are sent by the brain when you want to move a limb (“Mind-Powered Prosthetic Limb.”). A microprocessor deciphers these signals and moves the limb based on the signals that were read.

Another piece of technology aiding the disabled is an electronic implant that helps paralyzed people walk. A device comprised of 16 electrodes and a battery is inserted into the body below the location of the injury. When the device is activated, it sends electrical signals to muscles that no longer can receive signals from the brain and the person is able to control those muscles (England, Rachel). A snowmobile accident left Jered Chinnock paralyzed from the chest down. With the help of this implant, Jered can stand and walk short distances with a walker.

These new technologies are far from perfect. Matheny was given the MPL for a year to test its functionality in day-to-day activities. In the first three months, Matheny had more than a dozen technical issues that resulted in the arm needing to be sent in for repairs. Even when the arm works as intended, it is still much more unresponsive than an actual human hand as it takes time for the device to decipher the movements and execute them. The electronic implant helps paralyzed people stand and walk again, but those people can’t do these things without a considerable amount of assistance. Although these devices don’t provide functionality that’s on the level of the human body, they will most likely lead to new technologies that will function on a level comparable to the human body.

**History of Prosthetics**

Prosthetics date back all the way to 950-710 B.C.E as a prosthetic big toe was found in Egypt. Prosthetics saw little to no improvement from BC era to the 15th century as the most common prosthetic was an iron hand for soldiers and knights. It wasn’t until the early 16th century that doctor Ambroise Paré developed a hinged prosthetic hand and a prosthetic leg with a locking knee joint (“The History of Prosthetics.”). From the 16th century to the 20th century, we again saw very little improvement on Paré’s initial creations with minor comfortability and functionality improvements. Only in the last 10 years have we started developing prosthetics that are controlled with thoughts. The MPL was the first prosthetic controlled with thoughts to be tested on people. These tests began in 2010 and the MPL still continues to be the most advanced prosthetic arm as sense of touch has been added as a function. As for implants for spinal cord injuries, the first man to stand and walk using one of these devices was just last year. These devices are in their infancy and we are just now scratching the surface on surface on how we can artificially enhance the human body.

**Advantages of Prosthetics**

The advantages that come with this technology are obvious. For people that have lost limbs or were born without limbs, there aren’t really any options that come close to a real human leg or especially arm and hand. The National Center for Biotechnology Information (NCBI) conducted a study on the percentage of people that use a prosthetic for upper limb amputation (ULA) and the percentage of people that use a prosthetic for lower limb amputation (LLA). Out of the 107 respondents with a ULA, 56 percent of them regularly used a prosthetic (Raichle, Katherine A, et al). Reasons for not using a prosthetic included cost, the prosthetic being clunky and cumbersome, and the amputee not liking the look of the prosthetic. For the 752 respondents with a LLA, 84 percent of them used a prosthetic regularly. The reason for the higher use in lower limb prosthetics is that they are more practical right now than upper limb prosthetics. If an affordable, functional, and aesthetically pleasing upper body prosthetic were to be created, there most certainly would be a considerable increase in the number of amputees that use an upper body prosthetic. With more amputees with highly functioning prosthetics, they’ll be able to complete tasks faster and complete tasks that they otherwise wouldn’t be able to complete. Without the use of an upper limb, amputees are limited on what they can provide to society. If that limb were to be restored, they would be able to contribute to society in ways that best suits their skills.

**Disadvantages of Prosthetics**

One major disadvantage of these prosthetics is cost. The cost to make one MPL is $500,000, so the price to sell one would be much higher than that (“Prosthetic Limbs, Controlled by Thought.”). It’s safe to say that most people wouldn’t be able to afford a top of the line prosthetic. Alternative design methods will have to used to decrease the cost of creating these prosthetics so that the general public can afford them.

If prosthetics one day were to become as good or better than a human hand, legal and ethical issues are sure to follow. If a non-amputee wanted a prosthetic, should he/she be able to get one? Also, if prosthetics come to surpass what the human body can do, legislation will have to be created to regulate what people can do with their prosthetics. Questions on what it means to be human will arise with the introduction of other bionic augmentations. If we have the ability to artificially enhance our body, should we do it?

**Role of Computer Science**

The MPL includes over 100 sensors, 26 joints, and 17 motors, all controlled by software. During Matheny’s year of living with the MPL, he ran into multiple software glitches associated with the arm. Whenever he would discover one of these glitches, he would call Robert Armiger, the lead researcher on the MPL project. Matheny then could plug the arm into his laptop and Armiger could find, fix, and update whatever software issue there was. One of these software glitches included whenever Matheny tried to pinch his index finger and his thumb together, the index finger would go over the top of the thumb. Armiger was able to look at the issue occurring, find the defect in the software and fix it so that Matheny could pinch his thumb and index finger together successfully. Without software, we would not be able to create the advanced prosthetics and prosthetics would not be able to advance past already existing, simple prosthetics.

**Future of Prosthetics**

Prosthetics will continue approach the level of functionality of human limbs and implants to treat spinal cord injuries will get to the point where people will be able to walk again independently. This will lead to other the further development of other bionic enhancements such as bionic eyes for the blind and exoskeletons to increase human strength. Responsiveness of prosthetics is the area that needs the most improvement. We have prosthetics that can decipher electrical signals from the brain and execute the movement of the limb, but the movement is slow and unresponsive compared to a normal human limb movement. Once there is a prosthetic that can decipher and execute a movement as quickly as human hand, that will be the breakthrough needed to take prosthetics to the next level.

**References**

* Gohd, Chelsea. “Florida Man Becomes First Person to Live with Advanced Mind-Controlled Robotic Arm.” *Futurism*, Futurism, 3 Feb. 2018, futurism.com/mind-controlled-robotic-arm-johnny-matheny.
* “Mind-Powered Prosthetic Limb.” *Johns Hopkins Health Review*, [www.johnshopkinshealthreview.com/issues/fall-winter-2015/articles/mind-powered-prosthetic-limb](http://www.johnshopkinshealthreview.com/issues/fall-winter-2015/articles/mind-powered-prosthetic-limb).
* England, Rachel. “Electronic Implant Helps Paralyzed People Walk Again.” *Engadget*, 25 Sept. 2018, [www.engadget.com/2018/09/25/electronic-implant-paralyzed-people-walk-again/](http://www.engadget.com/2018/09/25/electronic-implant-paralyzed-people-walk-again/).
* “The History of Prosthetics.” *UNYQ The History of Prosthetics Comments*, unyq.com/the-history-of-prosthetics/.
* Raichle, Katherine A, et al. “Prosthesis Use in Persons with Lower- and Upper-Limb Amputation.” *Journal of Rehabilitation Research and Development*, U.S. National Library of Medicine, 2008, [www.ncbi.nlm.nih.gov/pmc/articles/PMC2743731/](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2743731/).
* The New York Times. “Prosthetic Limbs, Controlled by Thought.” *The New York Times*, The New York Times, 20 May 2015, www.nytimes.com/2015/05/21/technology/a-bionic-approach-to-prosthetics-controlled-by-thought.html.