Prosthetics and the Advancement of Touch

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# Abstract

We as humans thrive on the sensation of touch, it is one of the most fundamental ways we interact with the world around us. However, not all of us can experience these feelings anymore due to traumatic injury or otherwise. Prosthetics were made to restore limbs for those who have lost them. Most people who have them feel out of touch with others as they do not feel life-like at all. Great advancements have been made to combat this issue since the sixteenth century. Technology has made them able to replicate the sense of touch and pain as well as new materials used to make them look and feel more human-like than ever. Neuro-prosthetics have also been researched and developed to help restore nerve damaged areas anywhere on the body. Algorithms and machine learning have been able to determine how our minds send signals throughout our body and have accelerated how features like this can be implemented to help people with amputated limbs and such. These efforts have been researched over decades and are still not fully realized and could be expanded upon more.

Keywords: Somatosensory, Tactile Restoration, Peripheral Nerve Injury, Triboelectric Effect Nano Generator, Implanted Biosensor, Prosthetics

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# Introduction

The use of prosthetics for amputees is heavily favored towards lower limb amputees, this is most likely due to the complex nature of trying to replicate the sheer complexity of hands and arms without making them feel too robotic or rendering the user unable to complete basic tasks anymore due to the prosthetic being too limiting. Many factors affect upper limb prosthetics such as being unable to use their sense of touch, gripping objects too hard or letting objects fall without knowing. These issues all revolve around the central idea of losing one of our most powerful senses, the sense of touch. In this paper, algorithms and new advancements in technology will be shown and how they improve the overall issues with prosthetic limbs. The ten articles given in this paper will provide strong evidence towards this hypothesis and support it.

# Narrative

In an article by Gentile (2020), research was focused on algorithms that newly developed resistors could use as a way to combat people with prosthetics crushing objects and dropping them on the ground. The algorithm was made to be as efficient as possible as well as precise. It was also made in mind of cheap materials to keep costs down. Gentile and his coworkers tested this algorithm in three different ways, the first test was on the variation of normal force applied, the second was to test the threshold of when the algorithm would pick up that there would be slippage in the object, finally, it was then tested on a real system. The results were outstandingly positive and his team was on track to believing it could apply to real systems and sent to the public.

Another article by Shlomy (2021), goes into the idea of tactile sensation and also includes neural implants. The Triboelectric Effect Nano Generator or s they call it, (TENG) is a promising step toward making the prosthetic footprint very minimal. They can be implanted directly into the damaged nerve ending with a cuff electrode and it translates tactile pressure into an electrical pulse that can be felt by the remaining nerves and thus partially restoring the lost sense of touch.

Finally, an article by Khoshmanesh (2020) provides research and evidence in external, wearable sensors. Advancements in these sensors have allowed us to monitor nearly every single activity inside our body and some are even able to predict any life-threatening problems that could arise as time goes on. Three major areas were focused on during this research, personalized healthcare monitoring, smart gloves to register the sense of touch and pain, and other assistive technologies to give aid to disabled people in a way to help them operate motorized equipment.

# Conclusion

With all the results found, technology has made tremendous strides in making prosthetics look, feel, and function much more human-like than ever before. The ability for sensors to take the place of nerve endings and connect them to our brain signals would have taken exponentially longer without the use of these new techniques that Cosimo Gentile et. al have found. Also, neuro-prosthetics being able to just be implanted under the skin to correct these issues can help people get over the stigma of only having the choice of bulky, robotic-looking implements to replace lost limbs or severe nerve damage.

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# Appendix

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Figure 1TENG-IT illustration depicting its capabilities and how it works