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The effects of bionics on mankind and the challenges faced by the biomedical industry

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ABSTRACT

The purpose of this paper is to discuss the advancements in the field of biomedical engineering and the effects of prosthetic implants and 3D skin on humans. This research aims to explore possibilities related tobioengineering and prosthetics. It also includes information on the potential challenges that the industry might face and how it can advance further, to be more beneficial to mankind. The following is a detailed study of the uses of artificial organs, 3D printers, how we might come up with artificial skin that is able tocomprehend sensations and mimic natural skin more accurately.

Keywords: *Informative, Detailed, Innovative Ideas*

1. INTRODUCTION

Evolution hasn't stopped just because we are here. We are probably the only species that is capable of influencingits own evolution according to its needs. With the introduction of bionics in our society, we can modify our bodiesto achieve whatever we want. For instance, if a person wants to experience how a squid is able to function with itstentacles, they can replace their arm with a prosthetic (human designed) tentacle. Where once there was the stigma attached to being "disabled", amputees are now empowered and independent. From low cost 3D- printed designs to million-dollar budget research projects, we can change mankind with the help of the biomedical industry.

But certainly, there are challenges the industry has to face as well, such as ethical battles, incompatibilities of the human nervous system with artificial organs, and inadequate infrastructure which make the fascinating world of bionics a bit difficult to navigate through. Prosthetics is quite a challenging product to develop, since it can't really replace or 'surpass' the natural human body parts, but is supposed to aid the the person using it exactly how a human body part does. Easton LaChappelle, founder and CEO of Unlimited Tomorrow, made approximately 5 prototypes over the span of 10 years, before releasing the first commercial product in June of 2020. But, the landscape of prosthetic offerings today is a spectrum, starting from simple passive devices (simply for cosmetic purposes), through body powered prosthetics (classic hook and claw system, where you have to move your body to make the implant work), to the obotic/myoelectric models.

In fact, artificial organs have been developed so much so as to come in a multitude of sizes, shapes, designs, and aesthetic features for the person in need of it to choose with complete liberty and ease. We have come so far from where we started, that a man living in the the past century never would have imagined a person creating fully functional arms for someone else with the help of a printer, which was, even two decades back, used for printing pieces of paper and not plastic. We're talking about 3D printers and the power they hold today.

One of the most appreciable features of prosthetic limbs is that they aren't as uncomfortable as people deem them to be. They camouflage with other body parts quite well over time, and are not a hassle for the person wearing them. Furthermore, 3D printers let people create their own artificial limbs at the ease of their homes, with minimal effort.

The earliest models of prosthetic arms were made with simple household tools, like legos and basic batteries. But it validated that we could use motors and tendons to open and close fingers and joints. The next prototype was more functional since it contained silicon finger pads, which helped in gripping things better. The third prototypewas even more advanced, using a mechanism called an EEG headset, which measures brainwaves to control the prosthesis. The key to making functional arms is to eliminate the cognitive bandwidth that someone experiences when using a prosthesis. The creators just want to create natural feedback loops to

the brain, supplementing the brain, and not control it or produce a secondary brain. Thus, one of the most important segments of an artificial body part is its feedback system.

Myo-electrics work on muscle movements which induce motor signals, transferred by the neurons to the brain for coordinated movements. There's an enormous amount of research going on in this field- a field where robotics, science and medicine merge to form something better. Scientists and engineers of some of the leading universitiesof the world are working on advancements in this area, particularly on sensors which are micro-wires implanted in the brain to record the electrical signals produced by neurons. More advanced electronic methods are applied on top of this to amplify their functions and broadcast them better. Experiments are done on animals similar to us, like monkeys, with utmost care and precision, to form accurate conclusions of theories.

The next advancements amputees are keen about, are sensitive prostheses i.e to be able to differentiate hot from cold, light from dark via those prosthetic implants. In the words of MIT engineer Hugh Herr,"Technology has the power to heal, to rehabilitate, and even extend human capabilities."

Along with advancements in prosthetic limbs, research in the field of bionic skin is also gaining traction. Nearly 85% of amputees experience a phenomenon called Phantom Limb Syndrome: It's a sensation where, even though you've lost a limb, you can still feel it, and everything around it. Similarly, prosthetic skin helps you 'feel' your missing limbs again. It works on the principle of aiding the transfer of nerve signals from body parts to the centralnervous system. E-dermis, developed by Dr. Luke Osborn, is a flexible sensor, that can, for some prosthetic users,provide a sense of touch. Dr. Osborn started by developing a flexible sensor that could mimic the sensory qualities of human skin. On closely examining the cross-section of our skin, we'll see that all the receptors are in different layers of the skin (receptors are unevenly distributed). The E-Dermis is built keeping that in mind. When the top layer of skin/ the nociceptive layer experiences something painful, it sends some information back to the brain. In short, nociceptor provides you with information about pain. Further down in our skin, we have mechanoreceptors,which tell us about how hard you're pressing or pulling an object. To help the amputee regain a sense of touch, the prosthetist maps the nerves in the specified region, so that they can send signals from the E-Dermis to the brain.

Prosthetic skin provides amputees with the ability to touch and feel things, thus helping them feel like they're not disabled.
This research is important because advancements in this industry will take human experiences further, extending human potential, and being aware of the challenges and knowing the areas where we can improve will lead us there.

2. MATERIAL AND METHOD

1) Prostheses: The study included information regarding various prosthetic limbs and bionic skin and how to utilize them. Their functions, developments, and prototypes are discussed above. Before their inclusion, all the information about prostheses was carefully examined to make sure they contributed positively to the paper. The data ranges from the earliest models of prosthetic arms developed in 2010 to the newest invention of prostheticskin.
2) History: A detailed history of the evolution of bionics was looked through and provided in the introduction. Allthe methods were taken into effect and various other substitutes for the same were analysed.
3) Approach:- The data includes various statistics and accounts of scientists on their inventions which further develops our knowledge about bionics and informs us about its impact on mankind and the areas of business it has affected the most.

3. CONCLUSION

The research reveals the significance of bionics and how it uplifts and makes the lives of amputees better. Prosthetics is a state-of-the-art, futuristic approach to evolution. Bionics has come a long way from where it started, and definitely has room for improvement even today, but anyone can say with certainty that bionics is the next big thing. It is necessary for us to keep looking for better prosthetic limbs in order to extend human potential, and help people with disabilities become independent.

4. REFERENCES

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