

LIMBS FROM THE PRINTER: HOW 3D PRINTING AND PROSTHETICS HELP PEOPLE WITH DISABILITIES

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Анотація

В даній роботі розглянуто тему яка надалі момент важлива у нашій країні, навіть не тільки у нашай а і по всьому світі, це протезування людей які втратили свою кінцівку або ж кінцівка не виконує свою роботу.

Ключові слова

3D друк, протезування, людина.

Abstract

This paper deals with a topic that is currently important in our country, or rather not only in our country but all over the world, it is prosthetics for people who have lost their limbs or whose limbs do not perform their work.

Keywords

3D printing, prosthetics, human.

Introduction

The WHO estimates that about 30 million people need prosthetic limbs or mobility devices, but less than 20% have them. In addition to the necessary technology to create prosthetics, there is also a shortage of specialists.

The WHO claims that there is currently a shortage of 40,000 trained prosthetists in poor countries. In addition, some patients need to travel long distances for treatment, which means time and money.

The development of 3D printing and its accessibility are affecting many industries of the 21st century, including the medical sector. In this article, we will tell you how additive technologies have influenced the field of prosthetic limbs and helped people with disabilities.

At the end of the article, we will also provide links to the files for printing limbs.

Results of scientific research

To appreciate the importance of 3D printing for medicine, recall how, with the onset of the coronavirus pandemic, Italy faced a serious shortage of medical equipment at a hospital in Brescia, in the province of Lombardy.

Doctors needed venturi valves for artificial lung ventilation devices. Through the editor of the local edition of *Giornale di Brescia*, Nunzia Vallini, the doctors contacted the head of the Milan factory, Massimo Temporelli. Massimo got in touch with the director of the engineering company Isinnova, Christian Fracassi, who agreed to bring the FDM 3D printer directly to the hospital.

On the spot, Christian modeled the valve and printed the first samples. Then Lonati SpA joined the project and produced about a hundred more valves from polyamide powder on a 3D printer using selective laser sintering (SLS) technology.

Currently, doctors are successfully testing 3D-printed skin for burn victims, airway splints for infants, facial reconstruction parts for cancer patients, and orthopedic implants for pensioners.

Hearing aid cases are also mass-produced, and dental models of dental crowns and bridges are produced daily using digital tooth scanning. It has replaced traditional wax modeling methods used for centuries.

It is not surprising that this technology is of interest to prosthodontists.

From the entertainment industry to a network of printed prostheses

American artist and special effects master Ivan Owen likes to create props for puppet theaters and low-budget horror films. For a steampunk festival, he developed a mechanical metal hand that can be controlled by ropes tied to the fingers.

Owen posted the video, which was seen by a carpenter from South Africa who lost four fingers in a circular saw accident. The carpenter contacted Ivan and discussed the possibility of creating a prototype prosthesis that would function using the same simple technology as the steampunk hand.

Later, Owen was approached by a woman from South Africa, the mother of a five-year-old boy named Liam, who was born without fingers on his right hand.

She wanted a tiny version of the hand, but Owen realized that the child would quickly outgrow the prosthesis, so he turned his attention to the use of 3D printing. It occurred to him that it was possible to create a universal model that could be easily resized as the boy grew up.

Owen convinced one of the printer manufacturers to give him two machines and developed the first mechanical arm using 3D printing. He did not patent his model and allowed others to use and improve it freely.

Such prostheses are primarily aimed at children. They are lightweight, have a bright appearance, and are free from the disadvantages of using branded modern prostheses.

Availability of 3D prostheses and their disadvantages

The most important advantage is the price. A factory-made prosthesis costs about \$1,000 and needs to be replaced every couple of years as the child grows. 3D-printed versions cost about \$40.

Owen and other stakeholders' developments resulted in the creation of the Enabling the Future network, which has 7,000 members in dozens of countries and access to 2,000 printers to help make hands for those in need.

One of the achievements of Enabling the Future is the Cyborg Beast prosthesis, developed by engineers at the University of Nebraska at Omaha. If you want to assemble it, you can download the necessary files for printing [here](#) and read the assembly instructions on the research institution's website.

It is important to understand that 3D prostheses are not a panacea. Representatives of Enabling the Future are not professional prosthetists who have undergone years of training. Their products are not certified or tested. Therefore, the products break much more often than traditional prostheses.

If the mechanism is assembled incorrectly, plastic parts can easily break when the prosthesis is bent. In addition, the volunteer printers do not immediately set the correct settings on the printer, which affects the strength of the products

Faced with these problems, Enabling the Future volunteers teamed up with British engineer Steve Wood to develop something more durable and flexible. They used Filaflex material to create a successful prosthesis, but the finished product currently costs about \$2000, which is a considerable amount compared to most products in the network.

Despite the drawbacks, the main advantage of printed prostheses is that they are a way out of a difficult situation for people who have lost a limb but do not have the money to buy professionally made products.

New legs for the feeling of walking

In 2020, Exoneo introduced Upya, a prosthetic foot that can be made using 3D printing. This should make prosthetics more accessible to third world countries. The parts are made to be customizable to each wearer and easy and quick to assemble.

This prosthesis uses biomimicry to convey a gait sensation as close to reality as possible. Its shape mimics the actual anatomy of the ankle, heel, and toes, and uses a spring cushioning system to mimic the tendons of the human foot.

People who have been tested say it is the most realistic feeling of walking after losing a leg.

The prosthetic leg was developed by Sepuluh Nopember Agung Two Junior, a lecturer at the Indonesian Institute of Technology, in collaboration with Joko Kuswanto of M. Biotech. It was uploaded to the Thingiverse website, and therefore is publicly available.

This project is quite detailed. You will be able to use the specified settings to print from ABS plastic on your printer. You can also download four modified models that also turned out to be functional. Moreover, they are available in different sizes for people of different heights.

An interesting model was presented by Jonathan Yapa and Gianni Randi from Swinburne University of Technology in Melbourne. Their research is aimed at exploring the potential of 3D printing in prosthetics. They have developed a prototype foot that can be printed on inexpensive.

Conclusion

With the help of many attempts and experiments, it became clear that 3D printers are great helpers for prosthetic limbs, they give many advantages in that it becomes more accessible and cheaper, they may not be able to replace a full-fledged prosthesis made of special materials, but it is a very promising thing, as it is growing at a rapid pace.

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