Гурьянов Артем Анатольевич
Тюменский государственный университет
Институт математики и компьютерных наук
Кафедра иностранных языков и межкультурной
профессиональной коммуникации
Студент группы 25МиР1610
legogop@yandex.ru
Гаркуша Надежда Анатольевна
Тюменский государственный университет
Институт Математики и Компьютерных Наук
Кафедра иностранных языков и межкультурной
профессиональной коммуникации
Доцент, канд. пед. наук
n.a.garkusha@utmn.ru

ЭКЗОСКЕЛЕТ. ПРОШЛОЕ, НАСТОЯЩЕЕ И БУДУЩЕЕ СУПЕР КОСТЮМОВ

Guryanov Artem Anatolyevich
University of Tyumen
Institute of Mathematics and Computer Sciences
Foreign Languages and Intercultural
Professional Communication Department
Student of 25MiR1610 gr.
legogop@yandex.ru
Garkusha Nadezhda Anatolievna
University of Tyumen
Institute of Mathematics and Computer Sciences
Foreign Languages and Intercultural
Professional Communication Department
Associate Professor, Candidate of Pedagogic Sciences
n.a.garkusha@utmn.ru

EXOSKELETON. THE PAST, THE PRESENT AND THE FUTURE OF SUPER SUITS

АННОТАЦИЯ

Целью данной статьи является рассмотреть историю создания и развития экзоскелетов. Экзоскелеты применяются во многих областях науки и техники, существуют достаточно интересные области применения экзоскелетов в медицине и вооружении стран. В будущем экзоскелеты, возможно, станут неотъемлемой частью нашей жизни, поэтому необходимо изучить базовую информацию о них. Автор дает определение, что такое «экзоскелет», который повторяет биомеханику человека для пропорционального увеличения усилий при движении.

КЛЮЧЕВЫЕ СЛОВА: экзоскелет, каркас, биомеханика.

ABSTRACT

The purpose of this article is to consider the history of creation and development of exoskeletons. Exoskeletons are used in many fields of science and technology, there are quite interesting areas of application of exoskeletons in medicine and arming countries. In the future, exoskeletons may become an integral part of our lives, so you need to learn basic information about them. The author gives a definition of "exoskeleton", which repeats human biomechanics for a proportional increase in effort during movement.

KEY WORDS: exoskeleton, framework, biomechanics.

Introduction

Throughout our history, man has always lacked the strength to lift heavy objects, to possess greater force of impact and stamina. But thanks to science and technology people were still able to increase their power capabilities. So there were exoskeletons - special suits, increasing the strength of man through an external frame.

A feature of these devices is their lightness and the ability to mechanically repeat all human movements. You must admit, this is a great and significant achievement in modern technologies, which finds application in medicine, military purposes, places with radiation hazards, construction and industry.

With the help of an exoskeleton, a soldier can carry more weapons on himself, he is largely protected from enemy bullets, faster and more active in his movements. Since the basic strength of a suit takes over, a person saves more energy and, of course, his health.

And think only, so exoskeleton is useful in medicine. It's just a find for the disabled, who completely gave up on their ability to walk again, and paralyzed people can move their limbs with the power of thought, being in a special suit.

Since exoskeletons are universal devices, they can be used in any field of a human life, where additional strength is needed. You can meet them in sci-fi literature, comics, video games, and movies ("Strangers", "Iron Man", "Avatar" and others).

Despite the fact that exoskeletons have already been used by people in various situations, they are still being developed, require improvement in laboratories and are very expensive. Let's see how the exoskeletons have been developed from their creation to this day.

History of development of exoskeletons

The first inventor of the exoskeleton is the Russian engineer Nikolai Yagn, who lived and worked in the US, and in the 1890s patented a number of technologies that facilitated walking, running and jumping. Yagne planned to send his developments to help the military.

In the 1960s, General Electric introduced the development of the Hardiman suit to the world. This device was a model of a modern exoskeleton, which could lift objects weighing up to 110 kg, work on water, on land and even in space. But with all these high aspirations, the development had not been crowned with success because of the too heavy design and slow work.

In the 1970s, the Yugoslav scientist Myomir Vukobratovich created an exoskeleton with a pneumatic drive, which was supposed to help the paralyzed people to get back on their feet. Russian and European scientists subsequently took

Vukobratovich's project as a basis for the creation of their technologies. So, in the early 1980s there was an exoskeleton for the disabled from the N.N.Priorov Central Institute of Traumatology and Orthopedics.

The shortage of energy carriers, the slow progress of scientific and technological progress, the development of materials science and other related sciences significantly slowed the development of exoskeletons. And only in the 2000s there were real achievements in this field.

The scientists from the American agency of scientific and military research DARPA in 2007 created the project Lady Warrior. This device was an unarmored and unarmed full exoskeleton, which was supposed only to strengthen the hands and feet of a person.

Later in 2008, Cyberdyne introduced the robotic HAL suit to the world, which was distinguished by significant improvements, in particular a lightweight case, built-in computer, and work from autonomous batteries, which were enough for a couple of hours of continuous operation. The main purpose of the exoskeleton is to help disabled people and paralyzed people.

Nowadays, the development of exoskeletons is gaining momentum, and companies such as Panasonic, Ekso Bionics, Lockheed Martin, DARPA and others present their devices at exhibitions every year, impressing with ever increasing productivity and technological innovations.

Areas of application of exoskeletons

As you already know, the main spheres of application of exoskeletons are military and medical. But these devices are very useful also in such areas of activity as places with a radiation hazard, or in the conquest of ocean depths, where the robocopy will be lighter and more efficient than a conventional spacesuit, and also when analyzing debris after an earthquake and in construction.

The military sphere of application of exoskeletons

Many companies are engaged in the development of exoskeletons in support of the military these days. This is due to the fact that the military sphere is being developed more and more technologically, and exoskeletons are auxiliary equipment for the modern soldier, which provides him with additional strength, endurance and security.

One of the leading companies for the production of exoskeletons for the military is Sacros. The XOS device weighs up to 80 kg and provides lifting up to 90 kg of cargo. This allows one person in the exoskeleton to replace three soldiers. A distinctive feature of this costume is its mobility. The latest models (XOS 2 and 3) allow a person even to play with the ball. But there are drawbacks: an external power source, high energy consumption, and an excessively high cost - $ 150 thousand. However, these problems are relevant for almost all existing exoskeletons.

It is impossible not to mention the famous eco-skeleton from the company Lockheed Martin - HULC (Human Universal Load Carrier). The basis of the costume is hydraulics and lithium-polymer batteries. A user wearing an exoskeleton can carry up to 140 kilograms. It is assumed that soldiers will be able to continuously use HULC within 72 hours. The price of this robot is about 80 thousand US dollars.

The present and future of exoskeletons

Like all robotic devices, exoskeletons on their way to perfection face many problems. If you disassemble the traditional exoskeleton into components, you will get a power source, a mechanical skeleton and software. And if everything is clear with the last two items, then the first one presents a serious problem.

Any of the modern power sources today can provide an exoskeleton only a few hours of battery life. Further, the device works either from a wire or from a solar battery. There are exoskeletons working on non-rechargeable batteries, which often have to be changed. In this regard, developers are trying to find a suitable power source for exoskeletons in the form of a powerful battery or, oddly enough, wireless power transmission. In the future, this process can be carried out from a large reactor, including nuclear. It remains only to invent the method of this transfer.

When it comes to the frame, most exoskeletons are made of aluminum and steel. But these are too heavy materials, which greatly reduce the effectiveness of the costume. Easier and more durable materials such as titanium or carbon fiber can provide lightness and high performance of the exoskeleton. For today it is very expensive materials, but we hope that in the future they will be more accessible.

The next problem with exoskeletons is the drives. Usually, the robotic suit uses hydraulic cylinders. They are powerful enough and can work with high accuracy. But these cylinders are very heavy and require the presence of hoses and tubes. The solution to this problem can be pneumatic drives, as well as servo-drives on an electronic basis. These mechanisms will work from magnets, consuming a minimum of energy.

The enormous complexity in creating an exoskeleton is the control and adjustment of the user's movements. Usually, the sensors read the movements of the human body, and the mechanism responds synchronously to them. But this is not enough. Any random movement can disrupt the synchronization in the control, and the suit simply can cripple the user. Therefore, the control components must detect in advance the random movements of the user, such as a sneeze or a cough, so that there is no failure in the system.

More and more scientists are working on the brain-machine interface, which allows controlling the exoskeleton with the power of thought. A striking example of this is the newly developed brain-computer interface from the Korean University and the Technical University of Berlin.

The interface interacts with the exoskeleton through a special cap on the user's head, recording the EEG. So, the brain signals are read and determine the necessary mode of motion. This technique allows you to manage the exoskeleton even for those patients who are deprived of voluntary control of their body. This is a great achievement, and now scientists only need to finalize the technology to implement it.

Conclusion

Having examined the features of exoskeletons, we note that this is a real miracle of technology, turning things into reality that were previously impossible. This is not only a tool for obtaining super-strength, but also the last hope for independent walking for a paralyzed person. In addition, any tasks in industry, construction and even space can also be solved by these technologies.

But on the way to mass introduction into our life exoskeletons must overcome a number of problems, including high cost. We are confident that in the future these devices will be more affordable for ordinary people and become a familiar phenomenon, like computers and mobile phones, providing us with life on a new technological level.

References

1. Bochner BH, Sjoberg DD, Laudone VP. A randomized trial of robot-assisted laparoscopic radical cystectomy. The New England journal of medicine. 2014; 371(4):389-90. Epub 2014/07/24.
2. Emmanuel E. Falling for Fake Innovation. New York Times. 2012.
3. Park JS, Choi GS, Park SY, Kim HJ, Ryuk JP. Randomized clinical trial of robot-assisted versus standard laparoscopic right colectomy. The British journal of surgery. 2012;99(9):1219-26. Epub 2012/08/07.
4. Sarlos D, Kots L, Stevanovic N, von Felten S, Schar G. Robotic compared with conventional laparoscopic hysterectomy: a randomized controlled trial. Obstetrics and gynecology. 2012; 120(3):604-11. Epub 2012/08/24.