3. Educational Challenges in Yemen: How the Conflict Puts Education at Risk? [Electronic resource]. –https://brokenchalk.org/educational-challenges-in-yemen-how-the-conflict-puts-education-at-risk/– Access date: 25/02/2024.

BIOENGINEERING APPLICATIONS FOR ENHANCING PROSTHETIC LIMBS [MINI REVIEW]

Wilaya H.A. (student of group No. PE-21)
Gomel State Medical University, Gomel, Belarus
Scientific Supervisor – **M. F. S. H. AL-Kamali**
(Ph.D., Associate Professor of the Department of "Industrial Electronics" Sukhoi State Technical University of Gomel)

Abstract: This mini report focuses on the utilization of bioengineering in enhancing prosthetic limbs. In recent times, a combination of technical advancements has significantly improved the comfort, efficiency, and realism of artificial limbs compared to earlier iterations. Future advancements in this field are expected to rely on the interplay of three influential factors: the demands expressed by amputees, progress in surgical and engineering techniques, and adequate healthcare funding necessary to support the development and implementation of technological solutions.

Key words: technical innovations, artificial limbs. Innovations, interaction, amputees. Technological solutions, innovative prostheses, developments.

Introduction

A prosthesis is an artificial replacement for a missing or lost body part, whether due to birth defects, accidents, amputation, or medical conditions such as cancer, diabetes, or severe infection. Prostheses can be used as an alternative to reconstructive surgery, such as creating a prosthetic breast after breast removal due to cancer. Modern prostheses, particularly for hands, feet, and the face, are designed to appear natural and improve appearance. Technological advancements have also enhanced the functionality of limb prostheses, with some incorporating battery-powered motors for improved movement, such as prosthetic hands with articulated fingers.

Prostheses can include surgically implanted artificial body parts like replacement heart valves, bones or joints (e.g., hip replacements), and cochlear implants. Following such surgeries, medical professionals provide guidance on maintaining health and adjusting to the lifestyle changes associated with these artificial body parts.

The term "orthosis" or "orthotic" refers to external support provided to a limb or body part, whereas a "prosthesis" replaces the missing or lost part. For instance, an artificial leg is classified as a prosthesis, while a splint used to support a leg is considered an orthosis.

Results and discussion

Biomedical engineers play a crucial role in the creation and enhancement of artificial body parts and prosthetic limbs, which aim to improve the quality of life and functionality for individuals who have experienced limb loss. Each prosthetic is meticulously designed to meet the specific requirements of the individual in need.

Engineers are instrumental in transforming society by effectively solving real-world problems through the utilization of technology. They employ scientific and mathematical principles to advance various fields and contribute to the development of numerous products that are integral to modern life. Biomedical engineers specifically apply their expertise in science, medicine, and mathematics to address medical challenges. They are involved in the design of machinery and equipment for medical diagnosis, as well as the creation and improvement of artificial body parts and prosthetic limbs. Prosthetics, in particular, utilize artificial limbs to enhance the lifestyle and functionality of amputees. Each prosthetic is custom-designed to cater to the unique needs of the individual.

Prosthetic limbs are constructed using a range of materials, including plastics and metals. The reasons for requiring prosthetic limbs vary, with some individuals being born without limbs, while others lose them due to accidents, injuries, vascular disease, or cancer. Notably, a significant advancement in prosthetics is the development of bionic and myoelectric limbs. These innovative prosthetics incorporate sensors that detect electrical signals from the user's residual muscles. The signals are then converted into movements, enabling users to control their prosthetic limbs through their own muscle contractions. This breakthrough has significantly improved the range and fluidity of movements available to amputees, facilitating tasks such as object grasping and natural walking.

In the realm of prosthetics, 3D printing has emerged as a pivotal technology. Customization is paramount when it comes to prosthetics, as each patient has unique needs. 3D printing enables the rapid production of personalized prosthetic limbs, tailored to the specific requirements of each user. This technology not only expedites the manufacturing process but also reduces costs, making advanced prosthetics more accessible to a wider range of individuals.

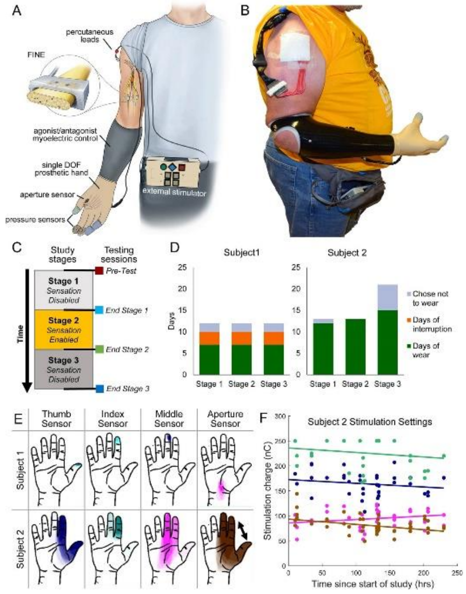

Figure 1 illustrates the sensory restoration system

Figure 1 showing [1-3] in (A), participants wore their own prosthetic socket controlled by agonist/antagonist myoelectric signals. They were given a VariPlus Speed™ prosthetic hand augmented with Flexiforce™ pressure sensors embedded in silicone pads of the thumb, index, and middle fingers. A custom aperture sensor beneath a cosmetic glove encoded the position of the prosthetic hand's single degree of freedom. The sensor data was transmitted via a cable to an external nerve stimulator, which converted the information into electrical stimulation pulses. Percutaneous leads delivered the stimulation to the median nerves using Flat Interface Nerve Electrodes (FINEs) implanted in the participants. Image (B) shows a subject wearing the sensory restoration system. (C) depicts the study timeline, consisting of three stages with crossover design, where subjects used the system at home with or without sensation. Functional metrics were assessed during laboratory testing sessions at the beginning and after each stage. (D) displays the durations of each stage for subject 1 and subject 2, with subject 2 wearing the system for almost twice as many days per stage. Subject 1 experienced interruptions of 3 days per stage due to component breakage. (E) shows the reported locations of sensory percepts associated with each sensor on the prosthetic hand. Opacity represents the frequency of reported sensations. (F) presents the stimulation charge delivered to each channel for subject 2 during the sensory-enabled stage. Participants had the option to calibrate stimulation settings, and the filled dots indicate recalibration points, with color corresponding to the percept locations. The regression slopes for the thumb, index, and middle channels were not significantly different from zero, while the aperture channel had a slope of -0.11 nC/hr, significantly less than zero.

Conclusion

The future advancement of prostheses will be heavily influenced by demand. The market will witness a growing expansion of low-cost, limited-function devices in order to meet the requirements of developing nations and accommodate funding limitations prevalent across all economies. Simultaneously, innovative technologies derived from the aerospace and computer industries will be incorporated and tailored for high-performance artificial limbs, aiming to closely mimic the functionality of the missing limb.

Initially, prosthetic innovations are predominantly utilized by amputees with private funding, particularly competitive athletes. As experience is gained, manufacturers learn how to apply the same principles to moderately priced devices intended for less active individuals. Consequently, the overall performance of prostheses will gradually improve.

Likewise, certain new materials and applications will be employed to benefit amputees in developing countries, despite variations in the causes of amputation and individuals' specific needs. The rate of progress in prosthetic rehabilitation is primarily hindered by financial constraints. Thus, one of the significant challenges for the new millennium will be to establish the necessary resources and means to fund the widespread implementation of prosthetic innovations.

References

1. Verhoeff TT, Poetsma PA, Gasser L, Tung H. Evaluation of use and durability of polypropylene trans-tibial prostheses. Prosthet Orthot Int. 1999; 23:249–255.
2. Steen Jensen J, Heim S. Evaluation of polypropylene prostheses designed by the International Committee of the Red Cross for trans-tibial amputees. Prosthet Orthot Int. 2000; 24:47–54.
3. Schiefer, M., Tan, D., Sidek, S. M. & Tyler, D. J. Sensory feedback by peripheral nerve stimulation improves task performance in individuals with upper limb loss using a myoelectric prosthesis. J. Neural Eng. 13, 16001 (2016).

BASIC PRINCIPLES OF INTERACTION IN COLLABORATION BIM AND IOT [MINI REVIEW]

Timoshkevich I.V. (research assistant)
Poltavtsev K.A. (PhD student & junior researcher)
Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus
Scientific Supervisor – **Muhurov N.I.**
(Doctor of Technical Sciences, Professor, Head of the Laboratory of Micro- and Nanosensors of BSUIR)

Аннотация: This paper provides a mini-review of the basic principles of collaboration between Building Information Models (BIM) and the Internet of Things (IoT). BIM and IoT are two different technologies that have the potential to be integrated to enable management that is more efficient and operation of buildings. The work examines the basic principles of interaction between BIM and IoT, such as data exchange, sensor network, automation and analytics. The benefits and advantages that can be achieved when BIM and IoT work together are also discussed, such as increasing management efficiency, optimizing the use of resources and increasing the comfort and safety of buildings.

Ключевые слова: BIM, IoT, collaboration, building information model, internet of things, collaboration, building management, efficiency.

Introduction

BIM (Building Information Modeling) is the process of creating a digital representation of a building that includes information about its construction, materials, heating, ventilation, air conditioning, lighting, and electrical systems. This information can be used to create a virtual building model that aids in planning, designing, constructing, and operating buildings [1].

IoT (Internet of Things) is a network of physical objects connected to the internet that can exchange data. In the context of buildings, IoT can include sensors that measure temperature, humidity, air quality, lighting levels, and other environmental parameters within the building [2].

BIM and IoT can work together to enhance building management and improve comfort and safety for occupants. For example, using data from the BIM model, IoT sensors can be strategically placed throughout the building to gather information about environmental parameters. This