

MEDICAL ELECTRONICS

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Annotation. Medical electronics helps doctors to cope with dangerous diseases. The article describes in detail all spheres in medicine where electronic devices are used. Much attention is given to the ways of therapeutic electronics development.

Keywords: medical electronics, decision support systems, wearable electronics, different electronic devices, equipment, medical engineers, 3D prototyping and 3D printing, artificial intelligence, drones, doctors.

Introduction. Since the middle of the 20th century, dangerous diseases that can become pandemics have been appearing more frequently. Some viruses, such as the flu or HIV, are constantly changing and adapting that leads to arising new strains and subspecies. Furthermore, the world's population increasing makes it probable to enhance the new infections spread.

Medical electronics actively helps to cope with these problems. Due to the scientific and medical technology development, scientists and doctors have possibility both to research in detail new diseases and viruses and to develop vaccines and diagnostic methods. Electronics benefits the improving diagnosis, treatment and patient's care.

In the article, the role of electronics, its variety and application in medicine, the servicing and medical electronic devices diagnostics are examined.

Main part. Electronics is getting smarter and smarter every year. Information technology is penetrating into the most conservative professions. It managed to penetrate into even one of the most humane areas – medicine. Nowadays, electronics is being introduced in the doctors' daily life and it can completely change the approach to their work in the future.

Medical electronics makes it possible to diagnose diseases qualitatively, measure health indicators and analyze them, for example, measuring pulse. It also enables doctors to restore the patients' health. For example, implantable hearing aids restore auditory function, and electrical implants can be used to stimulate muscles. Electronics is also used to monitor the patients' health condition. Medical devices can transmit patient's health data to the remote server or doctor's mobile device.

It is very important to say some words about a modern approach called Decision Support. Its essence lies on the fact that the computer makes recommendations to a person without making decisions for him. It should be noted that the final choice is under the competence of a specialist. Today, such systems are used by sea vessel captains and medical staff and airport control tower services as well [1].

Decision support systems are implemented in surgery to diagnose and to assign or select the treatment, to assess the quality of treatment and to evaluate the patient's condition at a given time. Computer systems allow the surgeon to test his own prognoses and to employ artificial intelligence technologies in many complex cases [2].

There are also medical wearable electronics used in every day life. This type of electronics has already been mentioned earlier, but it should be dwelt on in more detail. Medical wearable electronics are devices worn or attached to the body and using sensors to monitor, analyze and record physiological changes in the human organism. They monitors blood glucose level, body temperature, arterial tension, heart rate and the state of the body during sleep. In recent years, medical staff have been using such devices as smart watches, headphones, rings, augmented reality glasses and smart patches.

Nowadays, medical wearables such as sleep and activity trackers, as well as special devices for diabetics, are in great demand. According to Global Markets Insights, these devices are 86% of the global market. This is due to the increasing interest in productivity, healthy lifestyle and taking care of the body, which encourage consumers to control their body condition [3].

Decision support systems and wearable devices represent two specific examples demonstrating how electronic technologies help modern healthcare workers and their patients.

In medical practice, a huge number of different electronic devices (picture 1) are trivially divided into groups according to disease or area of medicine.



Picture 1 - Electronic devices:

a - electrocardiograph; b - glucose meter; c - electrical stimulator machine; d - CT scan; e - magnetic therapy unit; f - dental diode laser.

Depending on generally accepted medical purposes, medical electronic devices are classified as:

- preventive;
- diagnostic;
- therapeutic;
- rehabilitation;
- surgical [4].

Preventive medical electronics is an equipment used to conduct the preliminary patients' examinations in order to avert the development of disease. It may include various electronic devices such as medical blood analyzers, electrocardiographs and glucometers, which make it possible to detect early health problems and undertake appropriate medical actions.

Diagnostic medical electronics contributes to research in medical sphere and disease diagnosis. Such equipment involves various types of devices, such as computerized tomographs, electrocardiographs, X-ray machines and other devices for assessing the patients' health status. This equipment allows doctors to obtain detailed information on the patient's health and to make correct medical decisions [5].

Therapeutic medical electronics is employed to carry out various medical procedures and treat patients. It consists of physical therapy devices, laser and ultrasound devices, electrical stimulators, magnetic therapy devices and other ones helping doctors to improve patient's condition and provide effective treatment of various diseases.

Rehabilitation medical electronics is a specialized equipment used for the rehabilitation treatment of patients after injury, surgery or illness. It includes various devices, such as electrical

stimulators, magnetic therapy devices, laser therapeutic devices, exercise machines and other types of equipment aimed to restore body functions and to improve the quality of patients' life. In addition, such medical electronics helps specialists to use more effective physical rehabilitation methods and to speed up the recovery process after injuries and operations.

Surgical medical electronics is an equipment used during surgical procedures to ensure their accuracy, safety and efficiency. Such equipment embraces surgical lasers, vital sign monitors, surgical microscopes, devices for ultrasound and laparoscopic surgery, as well as other types of specialized equipment that help surgeons perform operations with high efficiency, minimizing risks to patients.

Medical electronics involves a large amount of devices and something new is always appearing in this area.

It should be noted that professionals called medical engineers are needed in order to control the efficient equipment operation. Medical engineers have to be present near the equipment around the clock. After every surgical operation, the equipment must be technically tested and maintained. In addition, engineers must be present during operations because of malfunctions that may occur. Medical engineers are also involved in installing and configuring new equipment and training medical staff. They are developing new medical technologies and tools that improve the patients' diagnosis, treatment and rehabilitation. They play an important role in ensuring the safety and quality of medical care, so professional competence and responsibility are an integral part of the modern medical industry [6].

The constant technological development in the field of medical electronics opens up new opportunities for improving the medical therapy processes. The expansion of mobile health care, artificial intelligence, telemedicine, drones, computer-assisted diagnostics, 3D prototyping and 3D printing are expected to lead to significant changes in modern medical practice.

The usage of artificial intelligence in medical electronics permits to analyze automatically the large volumes of medical data identifying connections and patterns that may be unnoticed by humans. This leads to earlier detection of diseases and can greatly improve prognosis and treatment.

Doctors have the possibility to consult their patients in remote diagnostic mode. This phenomenon is called telemedicine. It is very convenient for the patient because he is diagnosed in his usual home environment. The patient himself is not subjected to additional psychological stress, his time and personal finances are saved. Doctors increase their productivity and efficiency by paying more attention to patients having more severe illnesses.

Drones can significantly improve access to medical care, enable rapid drug delivery and provide assistance in critical situations where speed reaction is crucial. The drone is equipped with a webcam, microphone and speakers, which allows the doctor who controls the drone to give precise instructions to passersby to give resuscitation to a person suffered, for example, from sudden cardiac arrest.

In medical electronics, computer diagnostics are based on specialized software solutions and algorithms that analyze medical data, images and other parameters to accurately identify diseases, predict outcomes and select appropriate treatments. This includes medical image processing, biomedical signal analysis, as well as molecular diagnostics and other innovative methods that significantly expand diagnostic and treatment options.

3D prototyping and 3D printing is changing medical industry. They allow not only creating unique devices and components but also increasing the development speed and reducing production costs. These innovative technologies are applied to produce customized prosthetics, printing microelectronic devices and prototypes of medical instruments [4].

Conclusion. So, medical electronics gives to doctors new tools and affords opportunities to improve the effectiveness and quality of medical care. It allows doctors to measure more accurately patients' health indicators. Modern medical devices facilitate testing and effective treatment as well as support doctors' decision-making by offering computer recommendations. Medical

equipment, consisting of computers, servers and electronic equipment, is constantly being improved due to new technologies.

Although medical electronics is the breakthrough expanding capabilities of specialists in medical practice and opens up new opportunities for solving healthcare problems, it is impossible to replace doctors and nurses.

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