МАТЕМАТИЧЕСКИЕ МЕТОДЫ И ИНФОРМАЦИОННЫЕ ТЕХНОЛОГИИ В МЕДИЦИНЕ

ELECTROPHYSIOLOGICAL METHODS TO ASSESS EMOTIONAL STRESS OF HUMAN BODY

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Abstract: The analysis of existing systems and methods to assess psychoemotional state of a person was carried out. Subjective and objective methods, tests of Luncher, Tsung, Spielberg-Hanin, Hamilton scale are considered in the paper. The considered methods are analyzed in terms of its effectiveness and information content. It was concluded that nanoelectrodes enable the possibility to expand the possibilities of methods significantly due to advances in nanotechnology through sharing the subjective and objective methods.

Keywords: electrocardiography, electromyography, electroencephalography, electrooculography, and galvanic skin response.

Good health is essential to human welfare. At present, it is well-known that a great number of diseases are caused by stress. Emotional state of a person has a significant impact on health due to the direct and inverse relationship between all systems and organs of a human body and emotional state of a person. Emotional stress is one of the urgent health and social problems. Emotional stress is a real danger to health, because it often causes sudden cardiac death, myocardial infarction, hypertensive crisis, violation of cardiac and cerebral circulation, and gastric ulceration. In addition, emotional state can greatly affect the functioning of the body systems [1].

Psychoemotional state is a special form of a human psychical state with the dominance of emotional responses. Emotional displays are essential to response to real-life situations, because they regulate health and functional state of the body. Emotional deficits reduce the activity of the central nervous system, and may cause performance decrement. Excessive impact of the emotiogenic factors can precipitate mental stress or even mental disturbance. Preparedness for the activity is favorable for mental health and requires optimal emotional stimulation.

The objective methods, which are independent of the opinion of a person being examined, and are the most effective to assess psychoemotional state. These methods enable to investigate electrophysiological parameters reflecting psychoemotional state of a person. Currently, there are a lot of methods to detect and record the electrophysiological parameters of a person. The adequate choice of the method and appropriate use of its results are essential to conduct psychophysiological research successfully. The research is crucial for both medicine and engineering.

Electrocardiography (ECG), electromyography (EMG), electroencephalography (EEG), electrooculography (EOG), and galvanic skin response (GSR) are basic methods allow recording muscles stimulation, palpitation, the blood outflow from the skin surface, brain activity, etc. according to the research conducted by the psychological services, these methods allow recording changes in the emotional state.

ECG is a method for recording potential differences in the electric field of the heart, which occur during the heart activity. Recording is performed by using the electrocardiograph. The device consists of an amplifier: voltmeter, power system, the recording device, electrodes and wires connecting the object with it. The averaging of all vectors of action potential occurring at a certain moment of the heart's activity influences the ECG results. The deflections from the normal ECG shape can be found in one or more leads, and this greatly helps to diagnose the heart failure.

EEG is a method focused on brain research using the recording of the electrical potential differences arising during the brain activity. EEG characterizes some states of a person (calmness, stress, excitement) because different parts of the brain respond to different emotional state [3].

By frequency and amplitude characteristics separates the following rates of the EEG: alpha-rate prevailing at rest; beta-rate occurs when solution of the problem, as photic- and acoustic stimulation; gamma-rate occurs when excessive emotional activation; theta-rate is observed when dropping-off to sleep; delta-rate is recorded in deep sleep or under general anesthesia [5].

GSR is a sensitive indicator of emotional state. It is determined by the changes in the bioelectric parameters of the hand skin (potential differences and impedance). GSR is caused by vibrations of pre-secretory sweat gland activity, controlled by the central nervous system. The factors of emotional and mental activity primarily influence GSR. Since the GSR amplitude depends on the problem and environmental conditions, it is used to assess the emotional stress of a person.

EMG is a method of bioelectric potentials research arising in skeletal muscles in the excitation of muscle fibers; recording the electrical activity of muscular. EMG recording allows revealing the intention to start movement a few seconds before the movement. Moreover, myogram serves as an indicator of muscular tension. For example, when a person is experiencing strong emotions, he is excited, and when he is calm or tired, his muscles are relaxed.

EOG is a graphical recording of potential differences arising from changes in the eye movements. The anterior pole of a human eyeball is electrically positive and the back one is negative, therefore, there is a potential difference between the bottom and cornea of the eye which can be measured. The eye movements cause changes in the position of poles. The arising potential difference characterizes the direction, amplitude, and velocity of the eye movements.

In contrast to the objective methods of assessment psychoemotional state of a person, the subjective methods are carried out using specialized tests. The test of Luscher, Tsung, Spielberg-Hanina, and Halmiton scale should be considered. Typically, the indicated tests are implemented as computer programs which enable to automate the process of testing. There are two groups of the applied testing methods: obvious and unobvious testing. The first group involves the direct presentation of questions, drawings and other visual images to the person. The second one implements unobvious presentation of the rest information. The typical example is the Luscher color test which is based on the fact that the choice of color often reflects the bent of the person under examination to a certain activity, mood, functional state, and his most stable personality traits. The Spielberg-Hanina test consisting of 40 questions is used for self-assessment of anxiety and trait anxiety. The Hamilton scale is designed to accurately measure the severity of alarm symptoms using common psychometric tests. The Zung scale and Akhmedzhanov scale are designed for screening diagnostic in mass health examination. In addition, the Izard method can be also used to diagnose the dominant emotional state using the scale of importance of emotions. The methods is designed for self-assessment of the intensity and frequency of ten basic emotions according to the Izard scale.

The above mentioned subjective methods show the advantages of the testing methods under consideration. The scales are applied to more objectively assess psychoemotional state of a person. The disadvantage of the considered methods is the difficulty of questions adapting to the individual characteristics of the testee, because the concept of major life events has significant social background [4].

The improvement of resolution means to assess psychoemotional state of a person is currently very important. The Institute of Nondestructive Testing, Tomsk Polytechnic University, plans to combine objective and subjective methods to more precisely investigate psychoemotional state of a person. For objective methods, the institute is developing medical nanosensors to pick-up biopotentials with higher stability of electric potential, stable contact and polarization potentials, and lower interference and impedance. The existing methods of assessment of psychoemotional state of a person, which combine subjective and objective testing methods, are to be used in examining patients.

REFERENCES

1. Health [Electronic resource]. 2002-2009. Access mode: http://www.o5a.ru/page,3,31-ponyatie-psixoyemocionalnogo-sostoyanya-cheloveka.html

2. Bezrukih M. M. Psychophysiology. Dictionary / M. M. Bezrukih, D. A. Phaber. // Psychological lexicon. Encyclopedic dictionary. – Moscow: PER SE, 2006. – 128 p.

3. Rusinova V. S. Brain biopotentials of a person. Mathematical analysis / V. S. Rusinova. – Moscow: Medicine. 1987. – 256 p.

4. Review of electrophysiological methods to assess state of a person. D Q Nguyen, M. A. Iuzhakova // Materials of II International Conference "Foreign Language in the context of issues of professional communication", 27-29 April 2015 - Tomsk: TPU, 2015 - p. 199-201.

MICROCONTROLLER SYSTEM HEALTH MONITORING

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Annotation: In this article the model solutions of diagnosis of human health. For this purpose sensors and programmable Arduino board.

Key words: medicine, microcontroller, programming, sensor, Arduino, temperature, pulse

Health status is an important indicator of social orientation of society and social guarantees, characterizing the degree of responsibility of the state to its citizens. Our government is taking all possible methods and experience of foreign countries to improve it. A striking example of this is the reduction of the degree of infant mortality and abusive, starting from 2005, there has been a rise in births. At the same time, they remain high indicators of socially significant diseases. Healthcare today is more directed to the therapeutic nature of the action, rather than disease prevention, and the population is not fully focused on the protection of health. This, in particular, by the growth of tumor detection of diseases at advanced stage, as well as a high rate of mortality from cardiovascular disease. For the prevention and treatment of such problems is already in many foreign clinics actively start using new technological solutions based on microcontrollers.

Applications microcontrollers and united health analysis systems allow you to use built-in algorithms and their teams to manage different systems, to specify the exact parameters for collecting and processing the necessary information for the health care worker. As an objective assessment of the precision and the resulting automated system of information about the disease can help not only to save the patient's vital signs, but the end of history. Using the latest technical solutions in different areas of medicine can reduce the impact on the patient, improves the accuracy of the information content and control and diagnostics. So now important to use modern technology in order to preserve human life to complications of the disease. Our task is to research and development of medical bracelet, fitted with sensors. In foreign hospitals medical bracelets are the main method of control for attending. And this is not the limit of their application. [1] But, unfortunately, in our country these bracelets are not used. Russian and foreign scientists experimentally demonstrated the possibility of the use of technical purpose sensors for temperature monitoring and the human heart.

The range of areas for the use of medical bracelets extensive. They can even be used as identifiers for patients with sharp jumps disease patients to provide the necessary medical care immediately. Equipped with the necessary technological solutions bracelet not only informs about the name of the diagnosis, but can also transmit signals to the attacks of diseases. These bracelets are used in somnology [2], for deep analysis of apnea during sleep and other respiratory disorders associated with sleeping.

We, in turn, want to analyze the most important human organ - the heart, receiving data from the arterial pulse. Arterial pulse is determined in the projection of large and medium, superficial arter-