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MOBILE HARDWARE AND SOFTWARE COMPLEX FOR MONITORING HUMAN VITAL SIGNS

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Abstract. The research is aimed at developing methodological solutions and their scientific justification for application in human life and activity in various fields, as well as for the implementation of an industrial design of a telemetry software and hardware complex with its practical testing in real conditions in everyday processes, in hazardous production sites, in military service and operational work of special units, including detachments for elimination of natural and man-made situations.

Key words: hardware and software complex, monitoring, human vital signs, mobile application, medical and technical characteristics.

ПРОГРАММНО-АППАРАТНЫЙ КОМПЛЕКС МОНИТОРИНГА ПОКАЗАТЕЛЕЙ ЖИЗНЕДЕЯТЕЛЬНОСТИ ЧЕЛОВЕКА

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Аннотация. Исследование направлено на разработку методологических решений и их научное обоснование для применения в жизни и деятельности человека в различных сферах, а также на реализацию промышленного образца телеметрического программно-аппаратного комплекса с его практической апробацией в реальных условиях в повседневных процессах, на опасных участках производства, в военной службе и оперативной работе специальных подразделений, включая отряды по ликвидации стихийных и техногенных ситуаций.

Ключевые слова: программно-аппаратного комплекс, мониторинг, показатели жизнедеятельности человека, мобильное приложение, медико-технические характеристики.

Introduction. One of the innovative and significant areas of research in the field of practical application of information and communication technologies and microcontroller systems today is the direction of biotelemetry, a field of science and technology dealing with the development and operation of telemetry systems and complexes of automated means that provide reception, conversion, transmission over a communication channel, reception, processing and registration of telemetry information of vital signs and human life support for the purpose of remote control.

All indicators of human vital activity with the help of a wide range of sensors produced today by various manufacturers of electronic equipment can be recorded and transmitted using telemetric communication channels [1]. The most promising solutions are based on radio telemetry, since it makes it possible to study the functional state of a person in natural conditions, including and especially at hazardous production sites, during emergency response, during the protection of facilities and other critical situational and general processes, while the controlled entity can freely move around the territory. The quality of the radio telemetry systems used is assessed by their medical and technical characteristics.

Telemonitoring uses various information technologies (IT) for remote monitoring of patients, usually at home. Such monitoring may include, for example, the transmission of blood pressure, heart rate or body weight indicators using technology. In this case, telephone lines, broadband, satellite or wireless networks are used.

In addition, electrocardiographic signals, indicators of blood oxygen saturation or pressure in large arteries of the body can be monitored and transmitted to a medical professional. Measurements are carried out using special sensors, on which the type of telemonitoring depends.

Probably the easiest and most effective way to monitor patients is to regularly communicate with them by phone. During a phone call, you can check the patient's well-being and find out the physical indicators tracked by him independently (for example, body weight, the appearance of edema, increased symptoms). If patients have the opportunity to measure their blood pressure and pulse, these indicators can also be discussed during a telephone conversation. By phone, you can inform the patient of additional useful information and promptly solve possible

problems. However, only a limited amount of information can be regularly reported and recorded in this way. In addition, only a limited number of patients can be observed in this way due to the insufficient number of specialists.

Therefore, new telemonitoring systems have been developed that allow wireless transmission of information that is important from a medical point of view.

The research is aimed at developing a software and hardware complex based on solutions of the electronic industry that are publicly available for commercialization in terms of monitoring human health and vital activity indicators and processing the data obtained through a real-time telemetry information transmission system with forecasting, modeling and decision support functions for medical and administrative personnel.

Remote monitoring of vital signs is an integral part of telemedicine systems. However, there are no developments of own multifunctional diagnostic complexes in the Republic of Kazakhstan.

Scientific review. Scientific reviews of the effectiveness of telemedicine technologies indicate an increase in the diagnostic significance of the proposed systems, an increase in the quality of life of patients. Technological progress ensures the creation of new generations of wearable miniature wireless sensors of various physiological parameters, including biochemical ones [2,3]. Thus, the importance of the project is obvious in terms of creating domestic mobile telemedicine complexes that work remotely and are not inferior in diagnostic value to foreign analogues. At the same time, the adaptation of the accumulated world experience of remote monitoring of vital signs with the use of modern scientific approaches to methods of analysis, forecasting and preventive analytics, including decision support functions for medical and administrative personnel, is a fairly high-tech process that ensures the novelty of the project.

The implementation of the project will give an impetus to the trend of development of telemedicine technologies in domestic medicine and electronic industry, and may become the main one for the formation of regional and republican telemedicine networks. Such networks, on the one hand, will develop deep into the territories, covering an increasing number of medical institutions, and on the other hand, they will unite with each other. When creating telemedicine networks, almost all available means of communication will be used - terrestrial and satellite, fiber-optic and wireless, broadband data transmission networks and mobile telephone networks. As part of such systems, methods of remote monitoring of vital signs will not only improve the effectiveness of diagnostics, but also provide remote access to

qualified medical care for almost all groups of patients at risk, as well as for personnel of critical facilities and spheres of vital activity in order to prevent accidents and emergencies caused by a sharp deterioration in health managing an object or an aggregate of a person [4].

Architecture of the hardware and software complex. The concept of creating a multi-level mobile personalized system with a combination of architectures is proposed in [5]. The authors' proposed architecture is client-server. Structurally, part of the publication/subscription architecture for the tasks of personality-oriented medicine provides for the implementation of user identification procedures; data transmission from medical sensors or entering measurement data from the keyboard; a module for local computing and displaying results.

The authors proposed a client-server architecture. Structurally, part of the publication/subscription architecture for the tasks of personality-oriented medicine includes the implementation of the user identification procedure; data transmission from medical sensors or input of measurement data from the keyboard; a module for local data processing and display of results.

The architecture of the hardware and software complex includes 4 modules, shown in Figure 1.

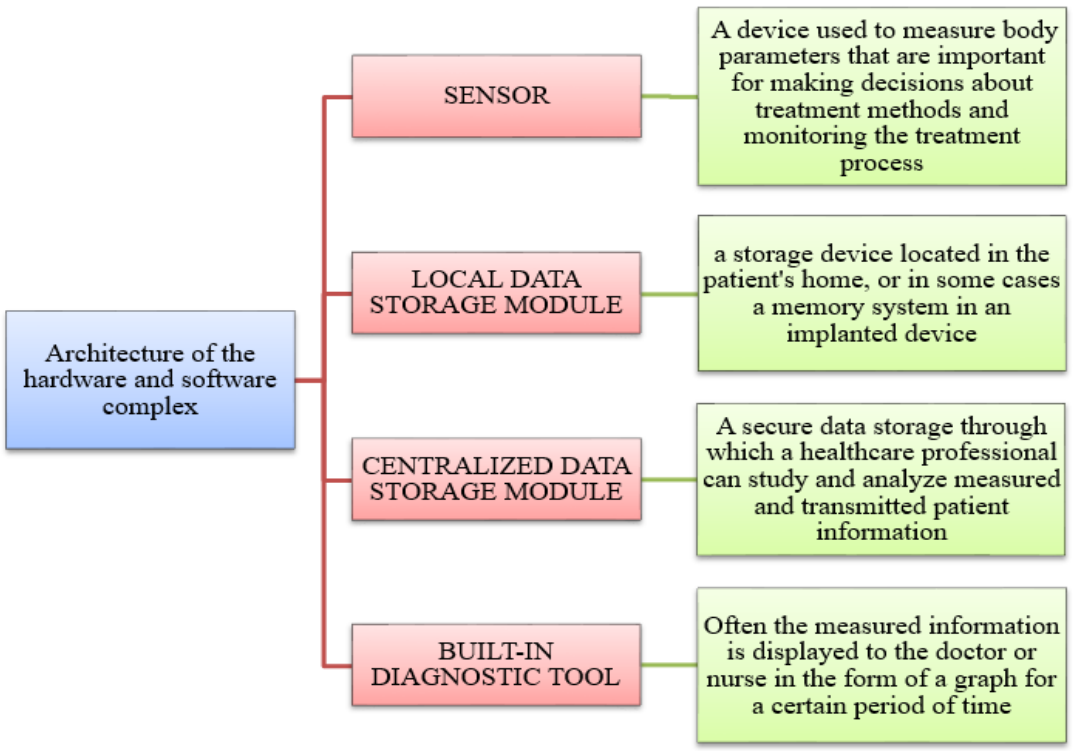

Figure 1. The architecture of the hardware and software complex

Expected result. As direct results of the project, it is expected to develop, create and pilot operation of a mobile hardware and software complex for monitoring the main and related human vital signs, with online, express functions.- and cumulative monitoring, the possibility of integration with the data collection hub on the territory of the deployment in regular, field or combat conditions with the transmission of telemetry to the control point in real time within a radius of up to 15 km, the availability of comparative analytics on energy indicators of vital activity based on neural networks, and preventive detection of a single or mass deterioration of the control group analysis of parameters.

The scope of the project is not limited to the above conditions and can be expanded in almost any area, for example, train drivers and metro trains, tower crane drivers, bus drivers and other public transport, etc., which will eventually contribute to reducing the number of accidents and preserving people's lives and health [6].

Conclusion. The results of the project can be further used in appropriate tests in medicine, to monitor the condition of patients from risk groups for the purpose of emergency response of monitoring organizations and the provision of timely medical care.

The project fully complies with the second priority policy of the Strategic Plan of the Republic of Kazakhstan until 2025 "Technological renewal and digitalization", the state program "Digital Kazakhstan", other fundamental legislative and legally binding acts and resolutions of the Government and the President of the Republic of Kazakhstan and ensures the solution of urgent tasks of socio-economic and scientific-technical development of the Republic of Kazakhstan.

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