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КІБЕРФІЗИЧНА СИСТЕМА ДЛЯ ЕКСПРЕС-АНАЛІЗУ ПСИХОФІЗІОЛОГІЧНОГО СТАНУ НА ОСНОВІ ПУЛЬСОКСИМЕТРІЇ

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CYBER-PHYSICAL SYSTEM FOR EXPRESS ANALYSIS OF PSYCHOPHYSIOLOGICAL STATE BASED ON PULSE-WAVE EXAMINATION

The paper presents the architecture of a cyber-physical system for express analysis of the human psychophysiological state based on pulse-wave (PW) studies of the central and peripheral pulse. The integration of sensor devices, a transmission channel, and a data processing and visualization unit is performed in the form of a single cyber-physical platform with elements of artificial intelligence.

Assessment of the psychophysiological state plays an important role in the methodology of studying the general condition of a person. Such studies, in particular, are relevant for athletes under conditions of increased physical and psychological stress, for example, during training and participation in competitions [1]. Such a dual nature of psychophysiological processes requires an integrated approach to building a research strategy that will combine psychophysical testing methods (for example, assessment of neurodynamic properties of higher nervous activity, the balance of nervous processes, state of basic mental functions, autonomic regulation of heart rate), as well as purely psychological testing methods (assessment of motivation, mood, well-being, activity, and anxiety) [1]. It is proposed to consider methods of assessing the psychophysiological state based on statistical analysis of heart rate variability (HRV) according to PW studies. These parameters include, in particular, the coefficient of variation of cardiac intervals, mode, standard deviation, and tension index [1].

The architecture of the levels of the cyber-physical system (Fug.1) is presented in the form of a 5-level platform, which includes the following components [2]:

1) means of interaction with the surrounding world (in this work, represented by high-precision pressure sensors based on piezo resonance transducers [3]);

2) means of data collection and delivery – the control unit and software of the sensor node, which is based on a small-sized, low-power microprocessor (MP) device and integrated with the electronic communication module;

3) primary data processing tools – a set of hardware and software designed to process the results of telemedicine measurements in real-time in order to prepare data for intelligent analysis (extraction of important information, increasing the level of protection, data compression, etc;)

4) decision support tools – intelligent software tools based on artificial intelligence models integrated into the cloud environment; the main task of such systems is the post-processing of data received from the lower levels of the cyber-physical system in order to make a technological decision in accordance with the user's request;

5) service tools – a set of end devices and software interfaces that implement human-machine interaction between the user and the system, including the use of neurolinguistic models of communication simulation, for example, ChatGPT [4].
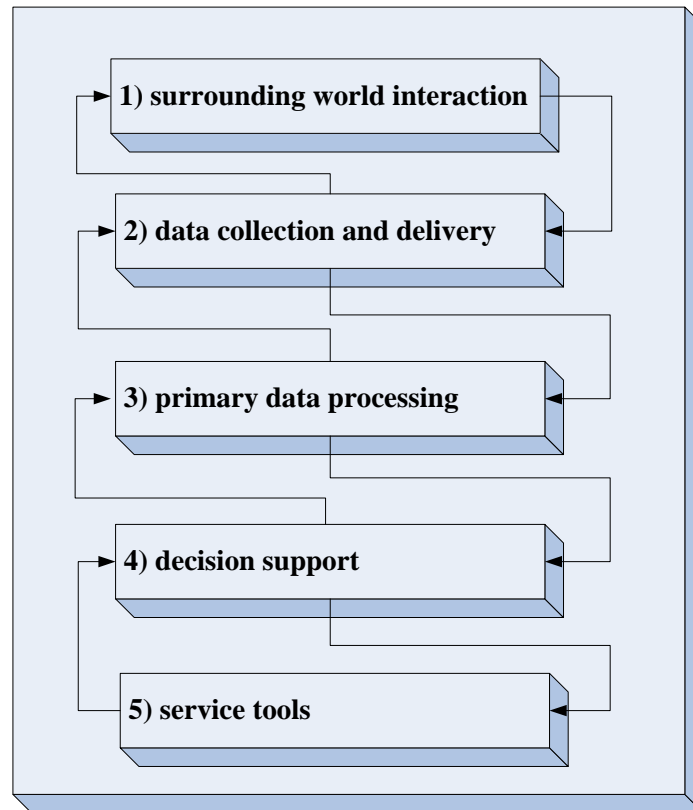
Figure 1. System architecture

The proposed architecture of the cyber-physical system can be used for further development of intelligent cyber-physical systems for rapid analysis of the psychophysiological state of people based on the analysis of HRV indicators.

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