EMOTIONALLY DEPENDENT OCULOGRAPHIC AND BRAIN-COMPUTER INTERFACES BASED ON ADDITIONAL CHANNEL OF HUMAN-COMPUTER COMMUNICATION

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Annotation: The paper presents a model for evaluating the emotional state based on the involuntarily controlled signals of the user of oculographic and neurocomputer interfaces.

Key word: oculographic interface, brain-computer interface, emotionally-dependent interface

The paper presents a model for evaluating the emotional state of the user of oculographic and neurocomputer (brain-computer) interfaces based on the involuntarily controlled signals. As such signals, the values of variability of heart rate, skin-galvanic reaction response, and respiratory activity patterns were considered. The heart rate variability parameters were selected, whose recording is well-proven both at the firmware level and from the point of view of processing and interpretation of the results. As for the signals being recorded, emphasis was placed not so much on the RR-intervals requiring electrocardiographic recording and therefore sensitive to the position and quality of fixation of the electrodes on the subject, as on the pulsometry data obtained by the photoplethysmographic channel. Such a solution, although being less accurate, benefits considerably in terms of ergonomics and simplicity: the user can fix the sensor on the ear, finger, or forearm. As markers for evaluating the user's emotional state as a compromise between the interface rate, the accuracy of the obtained results and the resource intensity, were chosen the values of the mean-square deviation of the pulse indicators (RR intervals) that can be associated with the spectral estimate of the total power of the heart rate variability spectrum. The issue was considered of the possible formation of an additional human-computer channel, carrying the information about the success of recognition by the firmware part of the user command interface. As such a channel, an approach was proposed based on the estimate of the user's emotional state, marked by the heart rate variability characteristics. Taking into account the promising approaches to the control over external devices (computer, drone, or self-propelled chassis) using several algorithms, each of which specializes in solving their own tasks, based on game theory was proposed a model for selecting by the firmware part of the interface of one of several competing algorithms for processing the signals coming from the user and carrying the control commands. The possible parameters for evaluating the "gain" of the firmware suite were considered, which allow executing a set of algorithms transforming the physiological user's signals into commands. It was demonstrated that the option containing the indicator that reflects the value of the difference between the dispersion of the heart rate variability at rest and when working with interfaces, in the process of execution of the strategy, weighted for the time of implementation of this strategy, is more preferable for formation of the channel controlling the selection of the algorithms of processing the patient signals by a firmware suite. In this case, an important issue is the time window during which the user's emotional state is evaluated. With an excessively great window size, the feedback operation efficiency significantly reduces due to a slower reaction in the case when a certain algorithm loses or, conversely, increases its efficiency. With an excessively short time interval, a situation is possible when a short-term success of a generally insufficiently efficient algorithm may lead to its selection for quite a long time. The obtained results make it possible to significantly expand the human-computer interaction capabilities.

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