

Evaluating the Ergonomics in Interaction with Computers

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Given the growing incursion of different methods and devices of interaction with computers, a process of evaluation and validation of these elements is necessary to measure its impact on user ergonomics [1]. In this sense, was created the norm ISO 9241 for the ergonomics of human system interaction. Specifically, the norm ISO 9241-9 referred to the requirements for non-keyboard input devices [2].

This norm suggests a set of procedures and recommendations with the aim of evaluate some kind of tasks (pointing, selecting, drawing, dragging...) and design over non-keyboard input devices (mice, trackballs, joysticks...). The evaluation is performed through experimental essays. Some of these experiments are: the one-direction tapping test, the multi-directional tapping test, the dragging test, and the path following test in one direction and multi-direction.

These experiments evaluate not only objective parameters (execution time, throughput, number of errors...) but also subjective parameters, those concerning the way the person perceives how these tasks develops.

The objective measures obtained from the experiments are related with the trajectory done by the participants through the input interface. Some of these parameters are: the distance traveled, the execution time and the deviation from an ideal path. From the statistical analysis, after the experiments, it can be obtained a measure of the efficacy (number of errors and accuracy) and the efficiency (operating time and throughput). The workload is performed through a test that gives subjective measures from the point of view of the participant. The NASA-TLX (Task Load Index) [3] is the most cited. The TLX test contemplate six factors (mental demand, physical demand, temporal demand, effort, performance and frustration level). The ISO norm specifies twelve factors (force required, smoothness, effort, accuracy, operation speed, comfort, overall operation, finger fatigue, wrist fatigue, arm fatigue, shoulder fatigue and neck fatigue).

The objective parameters give a precise measure about the performance of the interaction. However, subjective parameters, which are less accurate and have greater variability, have larger impact on the way users perceive the interaction, the mental and physical workload, and the overall performance. The trend lies in replacing the subjective test for objective measures obtained from the user during the experiments.

Generally, interacting with computers doesn't have the same impact over the physical fatigue compared to other tasks, where some studies can obtain objective measures of the physical workload from the heartrate, blood pressure or oxygen consumption. Nevertheless, it has sense the study of the impact of the physical fatigue for some input interface devices (joysticks, mice, trackballs...) over the set finger-hand-forearm. There are studies oriented to the electrodermal activity (EDA) [4][5], others focused on the electromyography (EMG) [6].

Regarding the factors related to mental workload, it has been increasing the use of EEG signals that allow obtaining certain mental states such attention or frustration [7][8][9]. In this latter respect, the emergence of brain computer interfaces (BCI), especially those oriented to

commercial purposes, less expensive than the ones from the world of medicine, are providing an excellent tool for evaluating mental workload in interaction with computers.

References

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