Physiological Recording Device for Presence Research [++]

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The purpose of virtual reality (VR) systems is to give the illusion of being in a different place rather than the real world. The illusion of being somewhere else is essential for the effectiveness of VR. For this illusion or subjective experience, the term presence has been defined. Presence shows the level human respond to a virtual environment (VE).

There are two aims that should be solved. The first one is to construct a physiological monitoring device to measure the level of presence in an objective way [Slater 2000] and the second one is to feed neuro-physiological parameters back to the VE. This allows to investigate effects of the VE on the subject and to modify the "flow" of the VR by the subject's physiological responses. This combination allows to use the system for various kinds of therapies and for medical displays. Furthermore the feedback of brain activity enables the subject to control the VE just by thoughts. Such a device is known in the literature as EEG-based Brain-Computer Interface (BCI) [Guger 2001].

Therefore, a suitable neuro-physiological processing system must be able
(1) to monitor subject responses in the VE and
(2) to analyze the biosignal data in real-time for feedback or control of the VE.

A corresponding biosignal amplifier for the acquisition of EEG, ECG, EMG and EOG signals was developed. Furthermore, the system allows the acquisition of blood pressure, skin conductance, respiration, pulse and external signals (e.g. switches). The recording device has additional inputs for the synchronization with the VE. After amplification the biosignals are passed to a PC/notebook to the **Feature Monitor** for raw data acquisition and visualization. The Feature Monitor extracts on-line the heart-rate and the heart-rate variability out of the ECG channel. From the EEG signals compressed spectral array and cerebral function monitor signal are calculated. All parameters are displayed on the Feature Monitor window during the experiment and give a time compressed report of the experiment. The window is updated at certain intervals (e.g. every minute) depending on the time frame of the experiment and results can be printed out for documentation. The recorded raw-data can be used for off-line analysis.
Additionally the **Real-Time System g.RTsys** allows real-time parameter extraction and classification of EEG data for feedback and for BCI applications. The BCI allows just by imagination of e.g. a left or right hand movement to realize a 2 dimensional control. The BCI calculates bandpower values of 2 EEG channels in the alpha (8-12Hz) and beta (16-24Hz) regions of the EEG. This bandpower estimates are classified by a linear discriminant analysis yielding a control signal that can be used to control the VE [Guger 2001].

References:

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