Virtual Intelligent Wheelchair Control Based on Forehead Bio-signals Using ANFIS Fuzzy Network Online Training in Different Circumstances

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Applications of bio-signals to control disabled people vehicles have been increased progressively. The most challenging part of developing a Human-Computer Interface (HCI) is to understand the environmental needs of disabled persons in order to utilize them in HCI plan. Besides, strongly time dependent nature of recorded bio-signals causes exponential error increase in pattern recognition-based control systems during long-time operations. In this study, a novel HCI has been developed to navigate and control a virtual wheelchair in which forehead EMG signals are used to define motion function and control commands; moreover, EEG signals are applied to calculate the affective measures and satisfaction level during wheelchair navigation in three various virtual reality(VR) environments. The online training effects of ANFIS fuzzy network using new signal patterns through wheelchair control process are considered on system stability and network accuracy. The aim of the proposed algorithm is to maintain the stability of the system for long time of use by evaluating the user satisfaction level during specific time intervals and retraining the network when it is necessary. In order to evaluate the effect of the online training in the proposed method two sets of experiments were done on 10+3 healthy male subjects. Due to experiments, results show proposed method achieves 92/3% recognition accuracy. In comparison with the result of the test without online training, the wheelchair's trajectory error spectrum median frequency shows salient increase which indicates unbalanced wheelchair control circumstances when the system profits the online training facility in decreasing motion errors.