A Brain-Computer Interface Application for the Assessment of Cognitive Aging

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Timely diagnosis of neurodegenerative disorders like Alzheimer’s Disease, which is currently highly inaccessible, can reduce its medical, personal, and societal impacts; cognitive deterioration caused by illness or aging often occurs before symptoms arise. Brain-Computer Interfaces (BCIs) stimulate and analyze key cerebral rhythms, enabling reliable cognitive assessment that can accelerate diagnosis. This BCI application analyzes Steady-State Visually Evoked Potentials (SSVEPs) elicited in subjects of varying age to detect cognitive aging, predict its magnitude, and identify its relationship with SSVEP features (band power and frequency detection accuracy), which were hypothesized to indicate cognitive aging. The prototype was tested with subjects of varying age (without AD) to assess its ability to detect aging-induced cognitive deterioration. Rectangular stimuli flickering at theta, alpha, and beta frequencies were presented and frontal and occipital EEG responses were processed to count evoked potentials at stimulus frequencies and calculate SSVEP band power. A neural network was trained using the features to predict cognitive age. An interactive user-interface was then created. The prototype revealed potential cognitive deterioration through age-related variations in SSVEP features. Frequency detection accuracy declined after age group 20-40 and band power, throughout all age groups. Responses to Alpha frequencies were optimal indicators of cognitive deterioration. Frequency detection accuracy declined throughout all age groups in both occipital and frontal regions, from 94.5% to 49.75% and 55.4% to 16.5%, respectively. The neural network displayed an adequate R-value of 0.98. This application can be conducive in developing effective tools for early detection of AD.

Awards Won:
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