A Review of Low-Cost and Machine Learning-Driven BCI Control Architectures

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ABSTRACT

The advancement of brain-computer interface (BCI)- controlled electric wheelchairs has attracted significant interest for facilitating mobility among individuals with severe physical disabilities. This review examines two notable yet distinct methodologies within EEG-based wheelchair control systems. The first approach focuses on an economical design that utilizes single-channel EEG signals to identify attention levels and eye blinks for intuitive navigation. It includes features such as destination mapping and straightforward calibration, specifically targeting users in resource-constrained environments. Conversely, the second study introduces a more complex technique that utilizes multi-channel EEG data, employs Fast Fourier Transform (FFT) for feature extraction, and applies Online Sequential Extreme Learning Machine (OS- ELM) to classify facial expressions into commands for the wheelchair, achieving a classification accuracy of 97.62%. Collectively, these studies illustrate the range of innovation in BCI-driven assistive technologies, from budget-friendly, user-centric designs to precision systems enhanced by machine learning. This review synthesizes their methodologies, performance metrics, and socio-technological implications, offering insights into current trends and future prospects in the field of smart mobility for individuals with disabilities

Keywords— Brain-Computer Interface (BCI), EEG, Smart Wheelchair, OS-ELM,Signal Processing, Assistive Technology, Low-Cost Design.