EyesDrive: A Novel, Non-invasive, Brain-Computer Interface for Paralysis Sufferers

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In Italy, more than 10,000 people are affected by a motor disability (source: Italian Statistics Institute, 2018). Most of them have lost their independence, confined on a wheelchair assisted by their caregivers. With most motoneuron diseases, the eyes are one of the only organs that can be voluntarily controlled by the subject without major issues. EyesDrive is a portable BCI (Brain-Computer Interface) device for people affected by motoneuron diseases or, more generally, any people with reduced mobility. The human eyeball can be modelized as a fixed dipole characterized by a corneo-retinal standing potential generated by metabolic processes happening inside the eye. Changes in the eyeball angle cause the potential to vary accordingly to the movement made. Using a pair of Ag/AgCl electrodes a signal representing the user's eye position over time called Electrooculogram (EOG) can be recorded. EyesDrive exploits the EOG signal by amplifying and classifying it in real-time, providing devices connected to it numerical data describing the eye angle, rather than a raw waveform. Thanks to its ease of implementation, the data recorded by EyesDrive could be both used to control electronic devices such as computers or electric wheelchairs or can be used as a medical research device by setting it to output the raw EOG signal in alternative to the interpreted eye angle. By using less complex technologies rather than commercially available counterparts based on webcams and computer vision, the overall cost of the system is drastically reduced, making this new technology affordable for both patients and researchers.

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