An Electroencephalographic Brain-Computer Interface to Restore Communication to the Paralyzed

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The ability to communicate is almost entirely lost by paralyzed individuals. In patients with amyotrophic lateral sclerosis alone, 75% will need communication assistance, and in a completely locked-in state, no voluntary movement is possible. To improve the quality of life and reduce the negative psychological impact of paralysis, communication can be restored cost-effectively and conveniently by using a dry electrode electroencephalographic brain-computer interface (EEG-BCI), a system that converts consciously modifiable neural oscillation patterns from the user's brain to device commands and text. In this project, an EEG-BCI was created using commercially available integrated circuits, and a system was designed to upload the text output of the EEG-BCI onto an online server. Ten human test subjects each participated in 10 trials of measuring the accuracy and the time of creating target outputs using the EEG-BCI. The data shows an average accuracy rate of 65.2%, suggesting that the EEG-BCI is able to successfully restore communication with reasonable accuracy. There was no clear indication, however, that increased usage of the EEG-BCI increased either accuracy or speed of use. Compared to an existing dry-electrode BCI, this EEG-BCI was 61% more efficient if speed, accuracy, and the number of active electrodes are considered together. The EEG-BCI device met its goals of costing less than $200, using a dry electrode, and uploading output to the internet, and thus can restore communication to the paralyzed cost-effectively and conveniently, paving the way for the development of more efficient EEG-BCIs using more complex neural oscillation measurement and analysis methods.

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