Low-Cost Electroencephalography Device With Open-Source Brain-Computer Interfacing and Various Applications

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Electroencephalograms (EEGs) are devices that offer a non-intrusive way to measure the electrical activity of the brain, with various applications such as monitoring neurological conditions. Paired with Brain-Computer-Interface (BCI) -a direct communication from the brain to a computer- analysis of EEG readings can be used to control electronic devices such as prosthesis. Traditional EEGs are expensive, making them inaccessible for many individuals, particularly in underdeveloped communities where hospitals often lack EEG technology. This lack of availability hinders brain disease diagnoses and delays treatment for those in need. I successfully designed a low-cost neurological research system (costingless than $11 per channel) consisting of both an EEG device and a BCI, allowing for accurate visualization of detected brain waves. Through a total of four design iterations aimed at refining the EEG device, each iteration focused on addressing the limitations identified in the previous design to enhance the device's performance and functionality. As the project evolved, the final EEG device was integrated with a Brain-Computer Interface (BCI). This addition expanded the device's capabilities and enabled real-time interaction with external devices based on detected brainwave activity. Additionally, I emphasized exploring the practical implications of the detected electrical signals from the scalp, leading to the integration of the BCI to control various external devices, such as LED lights, with around 52% accuracy in indicating concentration. Overall, the iterative design process and incorporation of the BCI enabled the creation of a versatile EEG device with enhanced functionality and potential applications in various areas.

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