Enabling Oral Communication and Accelerating Recovery: The Creation of a Novel Low-Cost Electroencephalography-Based Brain-Computer Interface for the Differently Abled

Ambavanekar, Rishabh (School: Vista del Lago High School)

Expressive Aphasia (EA) is an oral disability, common among stroke victims, in which the Broca's area of the brain is damaged interfering with verbal communication abilities. EA currently has no technological solutions and its only current viable solutions are inefficient or only available to the affluent. This prompts the need for an affordable, innovative, solution to facilitate recovery and assist in speech generation. This project proposes a novel concept: using a wearable low-cost electroencephalography (EEG) device-based brain-computer interface (BCI) to translate a user's inner dialogue into words. A low-cost EEG device was developed and found to be 10 to 100 times less expensive than any current EEG device on the market. As part of the BCI, a machine learning (ML) model was developed and trained using the EEG data. Two stages of testing were conducted to analyze the effectiveness of the device: a proof-of-concept and a final solution test. The proof-of-concept test demonstrated an average accuracy of above 90% and the final solution test demonstrated an average accuracy of above 75%. These two successful tests were used as a basis to demonstrate the viability of BCI research in developing lower-cost verbal communication devices. Additionally, the device proved to not only enable users to verbally communicate but has the potential to also assist in accelerated recovery from the disorder.