TACo: Think And COnverse - Brain-Actuated Aids for the Disabled using Improved Electroencephalographic Techniques

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Over 1 billion people in the world face communication and healthcare problems due to Physical Disabilities and Developmental Disorders. They have to use Augmentative and Alternative Communication(AAC) devices to interact. But existing devices are inconvenient or fail to some health limitation of patients. Moreover, there is dearth of technological solutions to improve healthcare facilities. TACo:Think And COnverse is a highly-accurate Brain-Computer Interface-based AAC-Device and Healthcare Aid that solves these needs. The three-part project involved first, a neuroscience-based study aiming to identify brainwaves characteristic for various words. A novel two-electrode EEG technique named Hemisphere Analogue Electrode(HAE) System was designed to utilize lateralization of speech-synthesis to non-invasively classify speech-induced Event-Related Potentials. The brainwave acquired from FC5-FC6 montage (using a novel electrode-cluster that increases spacial-specificity) underwent combinatorial hashing to create a database mapping brainwaves to words. In analysing 5850 brainwaves of 39 subjects, it achieved 56% accuracy. This paves the way for future non-invasive research into the brain. Then I used a single electrode to catch brainwaves and interpret changes in attention-level as 1 or 0. The ‘Thinking in Binary’ system calculates values over 5 epochs, which are concatenated to a 5-digit binary code. It can decipher 26 English alphabets and 6 commonly-used words with 100% accuracy. I then created a system to identify if the user experiences nociceptive pain using a single electrode and trained an Artificial Neural Network in MATLAB. This initiates the first brain-actuated humanoid healthcare robot, which employs spectral analysis to locate wounds, and can provide first aid.

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