Brain-Computer Interface: Ambient Environment Control for the Paralyzed

Trivedi, Eesh (School: Gwinnett School of Mathematics, Science, and Technology)

Patients with progressive motor neuron diseases like ALS that impair motor function and speech become dependent on caregivers. My device, a Brain-Computer Interface (BCI), detects electrical activity of the brain and uses this signal to control the ambient environment for a paralyzed person. I used a single lead electroencephalogram(EEG) headset to detect electrical activity of the brain generated by eye-blinking, which is controlled by cranial nerves that are usually spared by these diseases. Spikes in delta band corresponding to eye-blinks were parsed from the EEG output. A prototype was built by connecting a light-bulb, fan, and call-bell to the Raspberry-Pi, which uses the signal from eye-blinks to control the devices using relays via a Python script. A double eye-blink wakes the device from sleep-mode. The program then starts toggling between light-bulb, fan, and call-bell options, and an appropriately timed single eye-blink can control each option. After use, a double eye-blink sends the device back to sleep. Version-2 was created by increasing time the program takes to toggle between the three options. Comparing success rate at performing a particular set of operations in a given order, version-2 outperforms version-1 (19/20 trials vs. 13/20 trials, Fisher's exact test statistic 0.0436, $p < .05$), showing that slowing the rate at which the prototype toggles between options increases the success rate of controlling devices by blinking. This prototype provides a novel, low-cost, workable solution using a Raspberry-Pi processor to create a BCI that can control the ambient environment for paralyzed people.