CALIFORNIA STATE SCIENCE FAIR
2003 PROJECT SUMMARY

Name(s)
Keerthi K. Prabhala

Project Number
S0713

Project Title
Brainwave Derived Electronic Control

Abstract

Objectives/Goals
The main goal of this project is to demonstrate the feasibility of building a low-cost Brain Computer Interface (BCI) for electronic control of devices using Electroencephalographic (EEG) techniques. I hypothesize that it is possible to achieve enough control for people with neuromuscular disorders to gain independence, and for normal people to gain improved efficiencies in their daily lives.

Methods/Materials
I pasted passive electrodes on my scalp using 10-20 Conductive Paste in bipolar configuration to sense the Mu-Rhythm of a single channel EEG. Imagining pressing a button was used for forward control and computing an intensive math problem was used for backward control in several epochs. I amplified these signals using AD620 instrumentation amplifier and OP90 Operational Amplifier, and digitized them using a 12-bit ADS7806P Analog-to-Digital converter. I used mathematical techniques like linear regression, Hamming Window, and computed FFT to acquire 7.5-12 Hz frequency components. Then I trained a 3-layer Artificial Neural Network and used test samples to recognize forward and backward commands. Finally, I modified the remote control of a R/C car, and applied the forward and backward electronic commands to move the car. In subsequent sessions, I used the trained Neural Net of previous session to retrain for improving recognition rates.

Results
At the end of my first session, I obtained 40% successful recognition rate. Using this trained Neural Net, I achieved 72% success rate on my second session, and 74% success rate on my third session. It's noteworthy to observe the dramatic improvement on the second, and third sessions compared to the first.

Conclusions/Discussion
The results prove that it is possible to achieve the BCI control to a useful degree. By carefully controlling the quality of materials, processes, and processing, I believe more than 95% success rate is possible. Compared to the subjects used in the research community above 21 years of age, I am only 16. My first trial success rate of 40% was way above the 20-30% reported in the research community probably because of better intuition. Also, I haven't used any active feedback. I think this technology is critically important even for ordinary people to improve their working efficiency just like a cell phone!

Summary Statement
Brain to Computer Interface for controlling electronic devices is a very important technology for handicapped and ordinary people.

Help Received
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