CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

S1201

Project Title

Development of an Electroencephalography (EEG) Device for Evaluation of Mild Traumatic Brain Injury

Abstract

Objectives/Goals

This project aimed to develop and test a low-cost device potentially capable of detecting sports-related concussions based upon brain wave data collected from a simple electroencephalography (EEG) headset.

Methods/Materials

The device was built by integrating a Mindflex game EEG headset with an Arduino microcontroller to process brain wave data. The microcontroller was programmed and housed inside an electronics box along with an LCD and a biofeedback LED array. Data for eight brain wave frequencies was collected and analyzed. Sixty-one healthy baseline subjects were tested while at rest and twenty-eight of those subjects were again tested after physical activity to study its effect on EEG readings. For each subject, brain wave activity was recorded both while the subject was in a state of attention and in a state of relaxation/meditation. Five subjects who received concussions were tested after injury and over subsequent days to track their recoveries.

Results

Experimental results showed that concussions significantly influenced brain wave activity. The brain wave patterns for concussed subjects while relaxing/meditating were significantly altered compared to when the same subjects did not have concussions. They were also significantly different than the majority of other non-concussed subjects. In addition, the amplitude of beta and alpha waves for each concussed subject appeared to be lowered as a result of the brain injury. As the subjects recovered, these wave amplitudes increased toward normal levels. An additional finding was that baseline subjects who had previously sustained a concussion months or years before the study also displayed lower beta wave amplitudes and altered brain wave patterns while relaxing/meditating when compared to baseline subjects who had never received a concussion.

Conclusions/Discussion

The results of this project were supportive of the original goal. This device may ultimately provide a simple, affordable, and rapid sideline concussion diagnosis. Research also suggested that concussions have long-term effects in children, even after original clinical symptoms have long subsided.

Summary Statement

This project developed and tested a low-cost EEG device capable of detecting concussions in athletes.

Help Received