CONTROLLING A ROBOTIC HAND USING A NON-INVASIVE BRAIN-COMPUTER INTERFACE

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ABSTRACT

Controlling prosthetics through traditional means requires the use of invasive brain-computer interfaces. This requires implantation of electrodes inside the brain. Although it produces the highest quality signals, it is prone to scar-tissue build up which not only can weaken the signals but also can lead to infection and damage to the brain. To avoid this, we are trying to develop a way to control a robotic hand using a non-invasive brain-computer interface. It is not only safer to use but it is also a cheaper alternative. We intend to achieve this using the OCZ Neural-Impulse Actuator (NIA) [1].

RESEARCH QUESTIONS

1. How can we design a robotic hand?
2. How can we create a connection between a robotic hand and a BCI?
3. How can we read and interpret the signals from the BCI?
4. How can we map these signals to specific actions to be done by the hand?

METHODOLOGY

Equipment and Tools:
- OCZ Neural-Impulse Actuator (NIA)
- OWI-535 Robotic Arm Edge [2]
- Visual C#
- Brainfingers Access Software [3]

SYSTEM

The structure of the system is that the NIA receives signals from the user which is then mapped to different controls that move the robotic hand. The mapping of signals was done by creating a C# program which receives and translates the signals that come from the NIA. When executed, if first checks if the NIA is connected to the computer. If it is not connected, the program would not run since it lacks the device that gives the signals that are to be interpreted. If the device is present, the program will then ask the user to follow on screen instructions in order to calibrate program for them. After the calibration, the user inputs will be matched to movements via the use of activation intervals and signal processing.

A user operating the system.

RESULTS

We gathered 10 participants (5 male, 5 female) to test the control of the robotic hand. We asked them to accomplish 8 activities in 30 minutes. Upon finishing all the activities or choosing to give up, they were asked to answer a simple questionnaire to rate their experience.

Activity	# of users
Opening the claw	9/10
Closing the claw	9/10
Holding a pen for 15 seconds	9/10
Moving the claw to the left	5/10
Moving the claw to the right	5/10
Moving the claw upwards	1/10
Moving the claw downwards	1/10
Move a pen from Point A to Point B	4/10

Number of users that accomplished each activity.

Component	Score
Overall use of the NIA as a controller	3.7/5
Using jaw movements for control	3.9/5
Using eye movements for control	3.3/5
Combining jaw and eye movements	2.9/5
Difficulty of activities	3.8/5

User experience ratings.

REFERENCES

[1] "nia Game Controller" OCZ Technology. Web. 19 February 2013 <http://www.ocztechnology.com/nia-game-controller.html>
[2] "Robotic Arm Edge" OWI Robot. Web. 2 January 2013 <http://www.owirobot.com/robotic-arm-edge-1/>
[3] "Brainfingers" Brainfingers. Web. 19 February 2013 <http://www.brainfingers.com>