

Using an EEG Device as a Method of Cursor Navigation for Users with a Motor Disability

Abstract

Society is becoming increasingly dependent on computers for everyday life. However, many individuals are unable to interact with personal computers easily due to physical disabilities such as dyspraxia, Parkinson's disease, or paralysis, which limit a person's ability to use a mouse and keyboard. The objective of this project was to investigate how those with motor disabilities can more effectively interact with computers. A software solution was created using Java and the Emotiv Cognitiv Suite, a part of the Emotiv SDK that allows programs to interpret a user's thoughts and intents. Users "train" the program by first demonstrating to the Emotiv by associating a thought in their mind with a different command to be performed on the computer (e.g., click mouse, move cursor up, down, left, and right). After training the device, the software is able to accurately determine how to control the cursor based on the user's thoughts. This program can be used with the Emotiv Headset as a replacement for a mouse that allows all people, including those with a physical disability, to use a computer. This was successful in achieving its goal of allowing a person to control a computer's cursor, though this control is slower than that of a mouse. Currently, training the program takes significant time and dedication of the user, though a motivated user is able to successfully perform all six cursor actions and fully use their computer.

Introduction

- Computers are tools that are often necessary for everyday life and their prevalence is always increasing with new advances in technology.
- A user of a computer must be able to control a cursor, often with a mouse or touchscreen.
- Mice and touchscreens can be difficult or impossible to use for people that have physical disabilities such as Parkinson's disease, dyspraxia, or paralysis.
- EEG headsets are relatively inexpensive ways to monitor the real-time brain activity of a person.
- The data gathered from an EEG headset can be interpreted as input which can be used to control a cursor, and therefore control a computer, without requiring the user to move.
- By not requiring a user to move to control the computer cursor, even people with paralysis can operate a computer.
- Being able to control a computer greatly increases the independence and quality of life of a person with a physical disability.

Engineering Goals

- Create a program in Java that can:
 - Receive cognitive data from an Emotiv EEG headset
 - Interpret this data based on past "training" data and map the user's thoughts to the cursor commands: move cursor up, move cursor down, move cursor left, move cursor right, left click at current position, and right click at current position
- This program should be easy to use and allow full control of the cursor

Materials

- The Emotiv EPOC is a low-cost EEG headset that enables this program to receive signals from the user's thoughts. It's relatively low cost helps make this a viable solution for people with physical disabilities who want to use a computer.
- The Emotiv SDK Lite is a free software development kit that allows this program to connect to the Emotiv and receive signals from it.
- Java is an object-oriented programming language developed by Sun and now maintained by Oracle. Java code executes in the Java Virtual Machine, which is free, also contributing to this being a low-cost system.
- Eclipse is a free, open source Integrated Development Environment for Java with which the CursorController class was written, compiled, and debugged.



Emotiv EPOC Headset
<http://digitalalchemysystems.com.au/sites/default/files/blog-img/EPOC.jpg>

Procedures

- Study existing research focused on providing computer accessibility to people with motor disabilities
- Download and install JDK 7, Emotiv SDK Lite 2.0, Emotiv EPOC Control Panel, and Eclipse Kepler IDE
- Configure Emotiv EPOC Headset
- Code the CursorController class
- Test and debug code
- Train program to recognize the cursor commands
- Test program's ability to recognize commands correctly

Results

After practicing using the Emotiv headset and program written for this project, the program was tested for how many times it could correctly identify a command from the user

Cursor Command	Thought Command	Successful Attempts in Ten Tries
Left Click	Push	9
Right Click	Pull	9
Move Cursor Left	Left	9
Move Cursor Right	Right	10
Move Cursor Up	Lift	9
Move Cursor Down	Drop	8



Conclusions

This program in conjunction with an Emotiv Headset can successfully be used to operate a computer's cursor, and when used in conjunction with an onscreen keyboard allows a user to perform basic tasks such as sending emails and checking the news online without needing to move. Though this program does not always correctly identify and execute commands, the accuracy is high enough that a user can correct for these mistakes by trying the action a second time and complete their main task with little hindrance. A user's ability to successfully execute commands increases over time and a user may eventually be able to achieve virtually perfect accuracy at command recognition.

Though it requires a sizeable effort to train this program to recognize commands at high accuracy and commands may still be occasionally misinterpreted, this program in conjunction with the Emotiv headset successfully presents a low cost method for people with physical disabilities to use a computer.

Future Research

- Improve the accuracy of detecting commands
- Add an alternative method to control the cursor through facial gestures detected by the Emotiv headset
- Add an alternative method to control the cursor through hand gestures detected by a camera
- Use facial and/or hand gestures to supplement the thought control to increase accuracy and decrease learning time

Sources

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