P300-Based Speller Brain-Computer Interface

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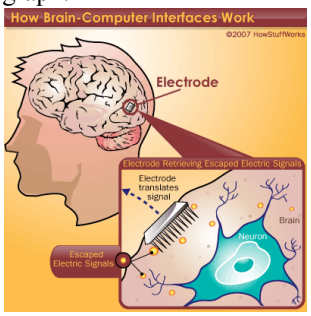
***Abstract*—a Brain-computer interface (BCI) is a partnership developed between a person's brain and a mechanical device. Such a device permits signals from the brain to direct some sort of external activity, such as operating a prosthetic limb or moving a cursor on a screen.**

I. Introduction

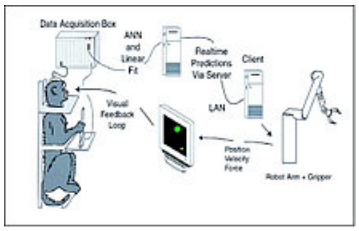
THE brain is one of the most amazing organs in the human body. It contains over one hundred billion neurons, and produces enough energy while a person is awake to light a light bulb. Research on Brain-Computer Interfaces began in the 1970s at the University of California Los Angeles under a grant from the National Science Foundation. Since the early experimentations in the 70s, the field of BCI research has concentrated principally on neuro-prosthetic applications; the objective being to restore damaged senses, such as hearing, sight and movement.

II. Methods

The procedure by which brain-computer interface works is extremely complicated, and has not yet been perfected. The main idea behind the process is utilizing a device called an electroencephalograph.



This device is connected to a person's head, whether invasively or un-invasively, and works to relay a signal to a computer. The P300 BCI monitors conscious brain activity through EEG signals, and then uses digital signal processing algorithms to turn these signals into commands. Simply put; there is an input, a pattern recognition algorithm, and an output.

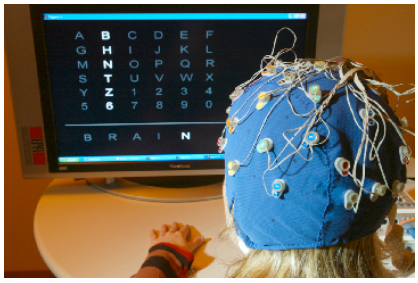


This output of the BCI system is connected to a computer, or a device that's purpose is to be controlled by the user's brain signals.

Among these devices, one of the most successful has been a Virtual Keyboard designed by Farwell and Donchin.

III. Results

One of the major challenges facing brain-computer interface researchers today is the basic mechanics of the interface itself. The electrodes connected to the brain can read brain signals. However, the skull blocks a lot of the electrical signal, and it distorts what does get through. Recently, many research groups have been working to improve both transfer rate and accuracy. In recent tests with the P300, subjects have been asked to focus their attention on a group of letters. They are then told to think about these letters one at a time, in order to spell the same words on another screen using just their thoughts.



Results showed that of all test subjects, an average of 65% of all letters were transferred correctly through EEG signals to the output device.

IV. Discussion

It is essential to recognize that BCI technology remains largely experimental at this time. The thought of implementing Brain-Computer Interfaces around the world is an extremely stimulating idea. BCI pioneer Jonathan Wolpaw of the Wadsworth Center at the New York State Department of Health in Albany said, "…it's a very exciting time; a lot of people are getting involved."

BCIs continue to be investigated as assistive tools for those individuals with momentous physical disabilities. BCIs like the P300 can help give these people back their speech and writing, as well as their ability to control their environment. As research continues and prototypes become more and more useful, we move closer and closer to the implementation of BCIs becoming a reality.

References

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