Enhancement of a Braingate System

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Abstract: *In 2003, the biotech company Cyber kinetics was developed a device called braingate. This device is used to help those with severe disabilities such as those who have lost the control of their limbs and other bodily functions. There is a computer chip which is implanted into the brain of the patient,to monitor the brain activity. This device can recognize patient's intention by analyzing their brain activity. This technique is based on mind uploading or mind copying or mind transfer. The principle operation of this system is that the generated brain signals are not able to send to the arms, hands and legs. These signals are interpreted and translated to cursor movements. But it is very risky surgery and expensive. Making use of arduino can reduce the complexity of the system.*

Keywords: brain computer interface, brain signal acquisition, signal processing, mind uploading, Arduino

1. Introduction

The braingate system is a brain implant system built and previously owned by the biotech company Cyber kinetics, currently under development and in clinical trials, designed to help those who have lost control of their limbs, or other bodily functions, such as patients with amyotrophic lateral sclerosis (ALS) or spinal cord injury. The aim of a brain gate system is to provide a significant quality of life improvement to the users with severe disabilities. The computer chip, which is implanted into the brain, monitors brain activity in the patient and converts the intention of the user into computer commands.

Mostly these chips uses around 100 hair thin electrodes which sense the neural signals in the specific area of the brain. The neural signal is then converted to electrically charged signals. These signals are then sent and decoded using program. The decoder connects to an external device and can use the brain signals to control an external device, such as a robotic arm, a computer cursor, or even a wheelchair.

Now the braingate is recruiting patients with a range of neuromuscular and neurodegenerative conditions for pilot clinical trials in the United States. The whole system technology based on mind uploading.
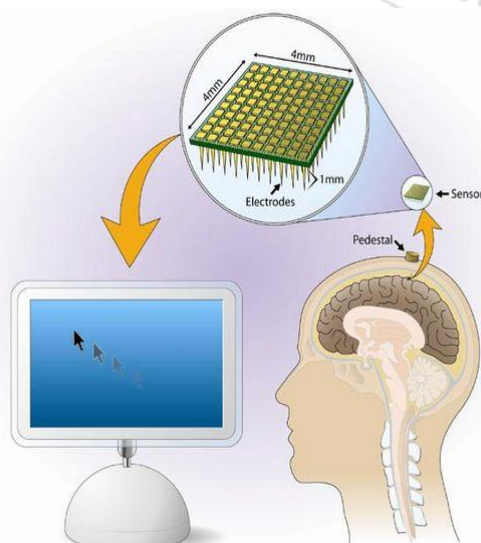
In essence, braingate allows a person to manipulate objects in the world using only the mind. In addition to real-time analysis of neuron patterns to relay movement, the braingate array is also capable of recording electrical data for later analysis. A potential use of this feature would be for a neurologist to study seizure patterns in a patient with epilepsy. There are many challenges in BCI control for real world applications

a) Information rate : Currently used BCI's have a maximum information rate of 10-25 bits/min
b) High error rate: High probability of errors results slow information transfer rate of BCI.
c) Autonomy: most of these systems are system-initiated i.e. the user cannot turn on and off the system independently.
d) Cognitive load: The system users have to deal with many complex situations, includes cognitive load of the task being performed, the emotional responses etc, affect the efficiency of the system.

2. Brain Computer Interface

A brain-computer interface (BCI) also called a direct neural interface or a brain-machine interface, is a direct communication pathway between a brain and an external device.

Like any communication or control system, a BCI has input (e.g. electrophysiological activity from yhe user), output (i.e. device commands), components that translate input into output, and a protocol that determines the onset, offset, and timing of operation.
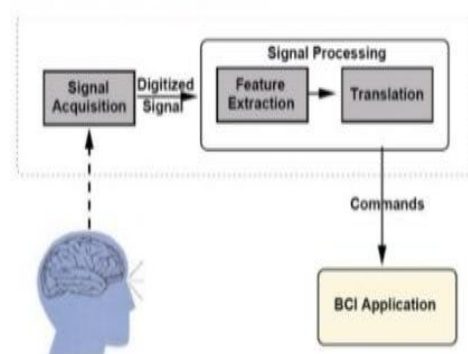

Figure 1: The sensor is implanted in brain's percental gyrus.

Figure 2: Basic block diagram of a BCI system.

All BCIs consist of four elements, that are signal acquisition, feature extraction, feature translation and the device output. The brain electrical signals are acquired by thee electrodes gets amplified and digitalized in the signal acquisition. In the feature extraction the signals are processed by accurately extracting the signals which provides information on patient's intent. Using an algorithm, the signal is further processed by translating the extracted signal features into commands. The commands thus obtained can be used to operate an external device.

3. Mind Uploading

Whole brain emulation (WBE) or mind uploading, sometimes called "mind copying" or "mind transfer" is the hypothetical process of scanning mental state (including long-term memory and "self") of a particular brain substrate and copying it to a computational device, such as a digital, analog, quantum-based or software-based artificial neural network. The computational device could then run a simulation model of the brain's information processing, such that it responds in essentially the same way as the original brain (i.e., indistinguishable from the brain for all relevant purposes) and experiences having conscious mind.

4. The Arduino

The specific field of Interaction Design involved with Arduino is Physical Computing or Physical Interaction Design. Physical computing or physical interaction design involves the design of interactive objects which can communicate with humans using sensors and actuators controlled by a behavior implemented as software running inside a microcontroller or a small computer on a single chip.

Figure 3: Arduino

The arduino is asmall microcontroller board. The braingate system has a complex structure. Introducing an arduino in the braingate system will reduce its complexity.

5. Conclusion

The braingate system allows the person those who have lost control of their limbs, or other bodily functions to communicate with the external world. The BCI operation depends on the interaction of two adaptive controllers,the user must maintain close correlation between user's intent and these phenomena, and the BCI, which must translate the phenomena into device commands that accomplish the user's intent. To implant the computer chip into the brain is a risky surgery and also the system has a complex structure. Use of arduino in this system can improve its performance and can reduce the complexity.

There is an issue with mind uploading that the uploaded mind is really the same sentience or simply an exact copy with the same memories and personality and also there are many ethical issues in mind uploading.The BCI is used to control all the signals passed through mind into computer.

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