Joe Stephens

Research Paper:

BCI and the Future

The development of BCI started as early as 1970's where scientists used Algorithims to reconstruct movements from motor cortex neurons, which control movement. This lead up to the first Intra-Cortical Brain-Computer interface was built, by implanting neurotrophiccone electrodes into monkeys. After the 90's, researchers developed Brain Computer Interfaces that decoded brain activity in monkeys and used the devices to reproduce monkey movements in robotic arms.

First lets look at what BCI means for a moment. A quick definition is that it is a brain computer interface (BCI). It is a collaboration in which a brain accepts and controls a mechanical device as a natural part of its representation of bodily movement. The idea is in healthy subjects, primary motor area sends movement commands to muscle via spinal cord. In Paralyzed people this pathway is interrupted. Computer based decoder translates this activity into commands for muscle control.

A look at the technical side of BCI reveals that brain activity is read by signals from an array of neurons. Cerebral electric activity is then recorded. These signals are then amplified and transmitted to a computer. It is transformed to device control commands using computer chips and programs. We then see the signals translated into actions and the subject sees this feedback on screen.

A brief basic component overview indicates there are four sections; the first is the implant device itself or chronic multi-electrode array. The next sequence is the signal recording and processing section, where thoughts are converted into actions. The next sequence is an external device the subject uses to produce and control motion, i.e. wheelchair, Neuroprosthetics movement. The last sequence is called feedback, this is where the subject can observe or correct their actions.

ATR and Honda develop new BCI. It enables decoding of natural brain activity and uses MRI based neural decoding. No invasive haemodynamic responses in brain with an accuracy level of 85%. The vast applications for this technology are endless. Medically alone we can reconnect patients with neuroprotheses with walking again and a sense of freedom from their current situation of a severe spinal cord injury. There are countless Military applications, counter terrorism, and multimedia and virtual reality applications as well.

The Japanese company "Honda" tests subject while he sits in a chair in front of a big white box, that contains a functional magnetic resonance imaging scanner what Honda calls new BMI, which reads brainwaves and cerebral blood flow. While conventional machine-interface uses devices such as switches, which need to be operated by a user's hands or feet, BMI uses brain activity data measured by various devices and enables non-contact control of the machines (such as robots).

The Terminator movies best demonstrates the capabilities, in the way that robots are in our near future. What this film didn't capitalize on was that they will be human controlled. Just think about that for a moment. I could be enlisted in the Army and fight in Iraq but I'd be in the comfort of my own home in Minnesota, wow. Human cyber robot wars will change the face of the Earth as we know it today. The question is how will we use this new technology, for the greater good or evil?

The negative side of BCI is that EEGs measure tiny voltage potentials. The signal is weak and prone to interference. Each neuron is constantly sending and receiving signals through a complex web of connections. There are chemical processes involved as well, which EEGs can't pick up on. The equipment is large and extremely heavy.

Your brain might be your next videogame controller. In the futuristic vision of the movie trilogy "The Matrix", human brains are plugged in to a virtual world, where they are able to interact and move freely. Lets take a closer look how close we are to this reality. A company called Emotiv has just developed the world's first brain-controlled gaming headset available now for $299.

The fact is, is that you brain works like the Internet or a network if you will. "Researchers used functional magnetic resonance imaging (fMRI) to study the

activity in peoples' brains and how different regions connect. They conclude the human brain can be visualized as a complex interacting network that relies on nodes to efficiently convey information from place to place. Very few jumps are necessary to connect any two nodes, the study found. [6]"

These scientists measured the degree of correlation between activities in tens of thousands of brain regions. Many of these nodes have few connections, and a small number of nodes were connected to many others. These nodes act as hubs like the Internet does. These findings of basic principles of brain function suggest "that the underlying properties can be understood using the theoretical framework already advanced in the study of other, disparate, networks," Chialvo said. [6]

The key of the EPOC headset is its light weight, wireless supported, comfortable to wear, and special sensors in charge with detection of your emotions and thoughts. EPOC does this using the electrical signals around your brain and processes these to let you control the game. The headset is capable of detecting more than 30 expressions, actions and emotions. [15] That might sound pretty awesome, but the prospect of brain-controlled virtual joysticks has some scientists worried that games might end up controlling our brains. As explained earlier the technology (both implanted and noninvasive versions) has been successfully tested in quadriplegics, helping patients move a cursor on a computer screen, turn switches on and off, and operate a wheelchair. [17]

As the technology improves, researchers are hoping that they will be able to process more commands in less time with the same accuracy. This would allow directional changes on the fly, rather than picking a pre-charted destination. The laser system that scans for obstructions also boasts a crash avoidance system, which allows for safe travel in the vehicle even though it is relatively slow to respond to driver instructions. To conclude nobody that we know can tell the future, but new technologies are telling us that the brain will eventually be wired directly into a computer through an invasive solution. The only questions: how soon until we get there? And what will we use it for?[7]

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