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Brain-Computer Interface
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"It was clear to me that the weakest link in utilizing technology to help people with disabilities is the human machine interface. It is the ability of someone with a disability to be able to control the technology that is the limiting factor, not the technology itself. The ideal interface would be to tap directly into the brain signals." ~ Dr. Gary Birch

A brain-computer interface (BCI), or brain-machine interface (BMI) is any type of processor based device that either connects directly into the brain or interacts closely with it. The idea behind the BCI is closely related to the field of neuroprosthetics. The main difference is that BCI is in much more experimental phases than neuroprosthetics. In addition, neuroprosthetic often connect to the PNS or spine, while a BCI is controlled directly by the brain. Main non-evasive brain imaging technologies can be analyzed and interpreted into data and are therefore considered a form of BCI. Examples of this are the MEG and the fMRI.

Research behind these types of devices started long before many of the modern technologies were even recognized. In the 1970s, doctors were analyzing monkey and human brain waves to better understand our complex nervous system. In the mid-1990s, doctors at Duke University measured the brain

Macaque monkey connexted to BCI device

waves in a macaque monkey using a joystick to play a game in which a dot chases another dot and a mechanical arm. The doctors then connected electrodes into the monkey's brain and tried to see if the monkey could now control both devices without use of the joystick. Not only could it be managed, but it did not take much longer for the tasks to be completed.

The next major step in BCI evolution was done at the University of British Columbia by Dr. Gary Birch. His device was a sort of head cape the measured impulses from outside of the skull. This had a low success rate due to interference from the skull, among other things, but it was
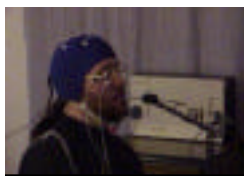

Electrode Head Cap

a step in the right direction. Later a similar idea was implemented at a different institution, using electrodes implanted under the skull. This had a greater success rate, but the electrodes were not precise enough to differentiate between neurons. They could only pick up activity in regions.

Today's main players in the BCI industry are Cyberkinetics Neurotechnology Systems, Inc. and Brown University. Cyberkinetics and a company that bases its research and products on neural signal processing and analysis, neural signal reading, and deep brain interface and manipulation. These two institutions are currently working together on a product known as BrainGate™.

The BrainGate is a very small device that is basically a chip with one hundred pins on it that interfaces with a computer processor. The chip is connected into different area in the brain by long micro-fiber electrodes. The chip sits on a small podium on the top of the patients head. The patient, with a little practice, only has to think to perform actions on

BrainGate Chip

the computer like using a mouse or playing the game Pong.
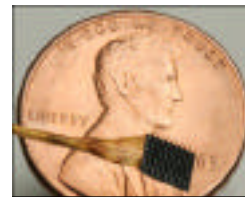
A few years ago, Matt Nagle was stabbed in the neck at a football game. It severed his spine after C_4. He

Matt Nagle

is paralyzed from the neck down and is on a device to help him breath. He volunteered as the trial candidate for the BrainGate. He now enjoys life a bit more than before, knowing he is leading the world to a more advanced field to cure him and others of their paralysis. Matt can successfully play pong and draw on the computer screen, though many things, like circles still take a lot of effort.

The idea of brain mapping and brain interfacing brings to reality some ethical issues. Is this field leading to more advanced Artificial Intelligence? Will we be able to one day record someone's memory or personality into another human being or onto a computer? What are the religious aspects of this, dealing with the idea of a "soul"? Only the future can tell, but on theing is for sure – the future is coming fast.

Resources
- http://www.wired.com/wired/archive/13.03/brain.html?pg=2&topic=brain&topic_set=
- http://www.ece.ubc.ca/~garyb/BCI.htm
- http://phx.corporate-ir.net/phoenix.zhtml?c=182802&p=irol-newsArticle&ID=754068&highlight=
- http://www.cyberkineticsinc.com/content/technology/platformtechnology.jsp
- http://www.sciam.com/article.cfm?articleID=000D5CA6-D59B-118F-91DD83414B7F0000&pageNumber=2&catID=9