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Brain-Machine Interface

The brain is composed of millions of neurons. These neurons work together in complex logic and produce thought and signals that control our bodies. When the neuron fires, or activates, there is a voltage change across the cell, (~100mv) which can be read through a variety of devices.

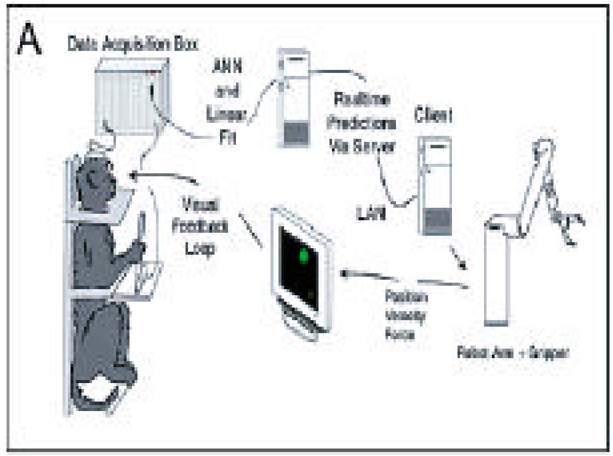
When we want to make a voluntary action, the command generates from the frontal lobe. Signals are generated on the surface of the brain. When we ***imagine*** ourselves doing something, small signals generate from this area of the brain. These signals are not large enough to travel down the spine and cause actual movement. These small signals are, however, measurable. A neuron depolarizes to generate an impulse; this action causes small changes in the electric field around the neuron. These changes are measured by the electrodes as 0 (no impulse) or 1 (impulse generated).

The BMI consists of several components:

1. The electrode array in the subject's brain.
2. An external device the subject uses to produce and control motion.
3. A main processor that produces the visual feedback and processes the information coming from the chip and external device.

The main computer measures both the brain signals from the chip and the external device. The computer (using a program developed by Miguel , Nicolelis Ph.D.) compares the two inputs. The subject eventually stops using the external interface, and starts controlling the computer with just the signals from the brain.

In the Biomedical Center at Duke University, trials of the BMI using monkeys



have started. Rhesus, Macaque, and Owl monkeys are being used in trials. These trials consist of monkeys with brain chips moving joysticks. The monkeys use the joysticks to move dots across a screen. When the monkey moves the dot to the target, they get a drop of fruit juice as a reward. This gives the monkey incentive during trials.

The main computer reads what is going on in the brain and compares this data to the movements generated by the joystick. As the monkey learns to control the system with its brain, the movements it generates become much smoother and precise, and error correction happens much quicker.

There are devices that are being developed by independent groups and universities. These devices will consist of a full-body brace that will be eventually controlled by the patients brain. Different forms of feedback (other than visual) are being researched. On patients who still have skin sensory, a small pressure plate can be used to tell the patient how hard he or she is grabbing an object.

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