Brain Computer Interface

A brain computer interface (**BCI**), sometimes called a neural control interface (**NCI**), mind machine interface **(MMI**), direct neural interface (**DNI**), or brain–machine interface (**BMI**).

BCIs acquire brain signals, analyze them, and translate them into commands that are relayed to output devices that carry out desired actions.

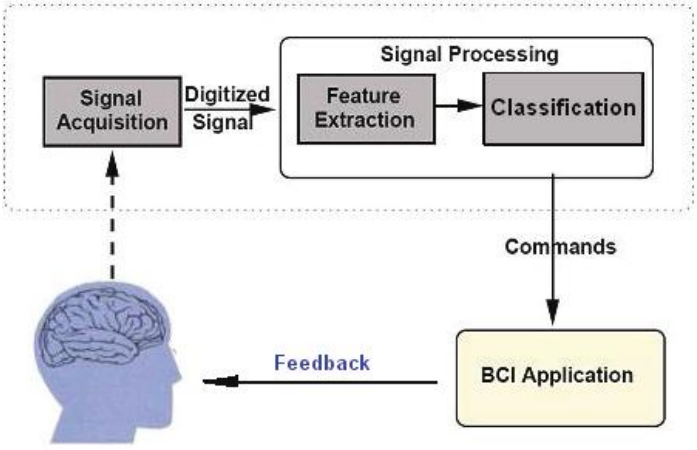
BCIs measure brain activity, extract features from that activity, and convert those features into outputs that replace, restore, enhance, supplement, or improve human functions.

- ✓ BCIs may replace lost functions, such as speaking or moving.
- ✓ They may restore the ability to control the body, such as by stimulating nerves or muscles that move the hand.
- ✓ BCIs have also been used to improve functions, such as training users to improve the remaining function of damaged pathways required to grasp.
- ✓ BCIs can also enhance function, like warning a sleepy driver to wake up.
- ✓ BCIs might supplement the body's natural outputs, such as through a third hand.

BCI System: Block Diagram

A BCI system consists of three components

1. Signal or Data Acquisition
2. Signal Processing (Feature Extraction & Translation)
3. Output Device.



1. Signal Acquisition

Signal acquisition in a BCI helps in the measurement of brain signals using a sensor modality. The sensor is basically a device implanted in the brain that records the signals. After amplification and filtering process, the signals can be digitized and transmitted to a computer.

2. Feature Extraction

Feature extraction in Brain Computer Interface (BCI) is the process of analyzing the digital signals to distinguish signal characteristics and represent them in a compact form suitable for translation into output commands.

3. Feature Translation

Resulting signal features are passed to the feature translation algorithm, which converts the features into the commands for the output device (i.e., commands that accomplish the users need).

4. Output Device

The commands from the feature translation algorithm operate the external device of the Brain Computer Interface (BCI), providing functions such as cursor control, letter selection, robotic arm operation etc. The device operation then provides feedback to the user finally, thus completing the closed loop of Brain Computer Interface(BCI).

Advantages of Brain Computer Interface:

- ✓ It allows paralyzed people to control the prosthetic limbs with their mind.
- ✓ Transmit visual images to the mind of a blind person which allows them to see.
- ✓ Transmit auditory data to the mind of a deaf person which allows them to hear.
- ✓ It allows gamers to control the video games with their minds.
- ✓ It allows a mute person to have their thoughts to be displayed and spoken by computer.

Disadvantages of Brain Computer Interface:

- × BCI research is still at initial stages and not at matured stage.
- × BCIs are currently fairly inaccurate in terms of classifying neural activity.
- × BCIs placed outside of the skull have a limited ability to read brain signals.
- × They can be placed under the skull, but this requires pretty drastic surgery.
- × Reading people's inner thoughts comes with a massive amount of ethical issues.

BCI Applications

1. Gaming: In this field BCIs could be used in video games. For instance, players could control their avatar using only a BCI.

2. Lie detection, Brain Fingerprinting, Trust assessment.

3. They may restore the ability to control the body, such as by stimulating nerves or muscles that move the hand.

4. BCIs can also enhance function, like warning a sleepy driver to wake up.

5. BCIs might supplement the body's natural outputs, such as through a third hand.

6. Communication & Spelling Devices: Spelling devices allow severely disabled users to communicate with their environment by sequentially selecting symbols from the alphabet.

7. Environment Control: Environment control systems allow to control electrical appliances with a BCI.

8. Wheelchair Control: A BCI can potentially be used to steer a wheelchair. Because steering a wheelchair is a complex task and because wheelchair control has to be extremely reliable.

9. Replace lost functions: We can use BCI for controlling movement of limbs and to restore motor function. BCIs may replace lost functions, such as speaking or moving.