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A BRIEF STUDY OF BRAIN COMPUTER INTERFACE ADVANTAGES & ITS DISADVANTAGES

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ABSTRACT

A brain-computer interface (BCI), sometimes called a direct neural interface or a brain-machine interface, is a direct communication pathway between a human or animal brain and an external device. In one-way BCIs, computers either accept commands from the brain or send signals to it (for example, to restore vision) but not both. Two-way BCIs would allow brains and external devices to exchange information in both directions but have yet to be successfully implanted in animals or humans. In this definition, the word brain means the brain or nervous system of an organic life form rather than the mind. Computer means any processing or computational device, from simple circuits to silicon chips. Research on BCIs began in the 1970s, but it wasn't until the mid-1990s that the first working experimental implants in humans appeared. Following years of animal experimentation, early working implants in humans now exist, designed to restore damaged hearing, sight and movement. With recent advances in technology and knowledge, pioneering researchers could now conceivably attempt to produce BCIs that augment human functions rather than simply restoring them, previously only a possibility in science fiction.

Keywords: Brain Computer Interface, Computational Device, Human Augmentation, Neural Engineering

I INTRODUCTION

The idea of interfacing minds with machines has long captured the human imagination. Recent advances in neuroscience and engineering are making this idea a reality, opening the door to restoring and potentially augmenting human physical and mental capabilities. Medical applications such as cochlear implants for the deaf and deep brain stimulation for Parkinson's disease are becoming increasingly commonplace. Brain-computer interfaces (BCIs) (also known as brain-machine interfaces or BMIs) are now being explored in applications as diverse as security, lie detection, alertness monitoring, telepresence, gaming, education, art, and human augmentation. This introduction to the field is designed as a textbook for upper-level undergraduate and first-year graduate courses in neural engineering or brain-computer interfacing for students from a wide range of disciplines. It can also be used for self-study and as a reference by neuroscientists, computer scientists, engineers, and medical practitioners.

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1.1 Key features include

- Essential background in neuroscience, brain recording and stimulation technologies, signal processing, and machine learning.
- Detailed description of the major types of BCIs in animals and humans, including invasive, semi- invasive, non-invasive, stimulating, and bidirectional BCIs.

1.2 BCI Model

Brain-computer interface (BCI) is a fast-growing emergent technology, in which researchers aim to build a direct channel between the human brain and the computer.A Brain Computer Interface (BCI) is a collaboration in which a brain accepts and controls a mechanical device as a natural part of its representation of the body.Computer-brain interfaces are designed to restore sensory function, transmit sensory information to the brain, or stimulate the brain through artificially generated electrical signals shown in the following “Fig.1”.

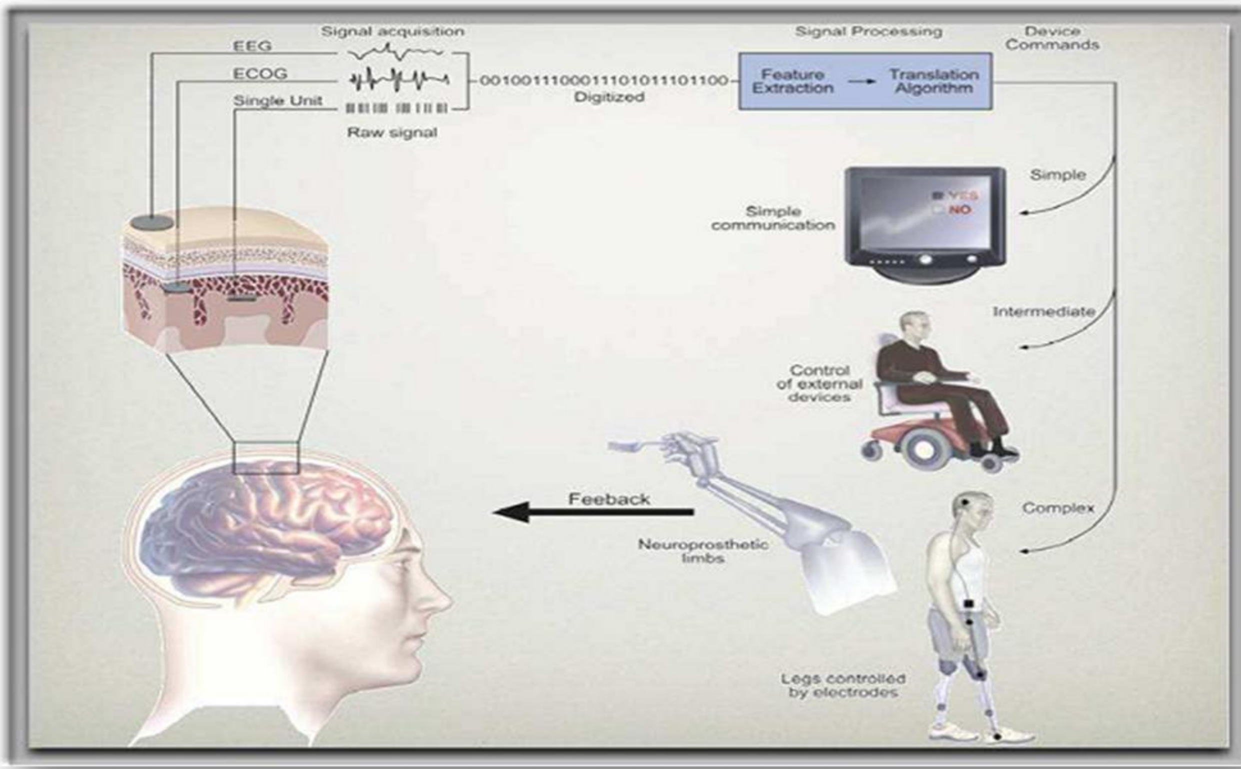

Figure 1. BCI Model

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II EARLY WORK

Algorithms to reconstruct movements from motor cortex neurons, which control movement, were developed in 1970s. The first Intra-Cortical Brain-Computer Interface was built by implanting electrodes into monkeys.After conducting initial studies in rats during the 1990s, researchers developed Brain Computer Interfaces that decoded brain activity in monkeys and used the devices to reproduce movements in monkeys and used the devices to reproduce monkey movements in robotic arms shown in “Fig.2& Fig.3”.

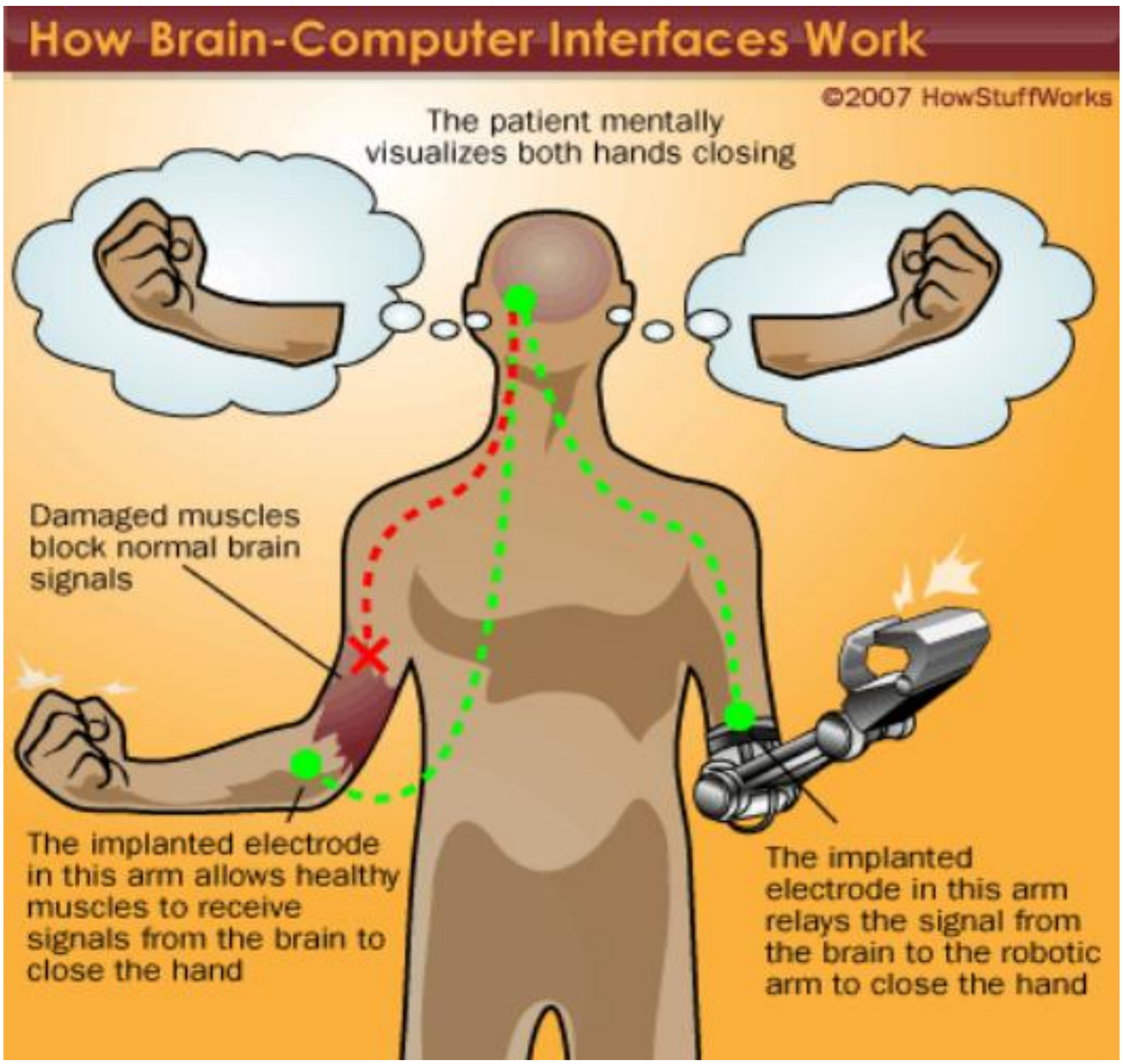

Figure 2. BCI Interface Work

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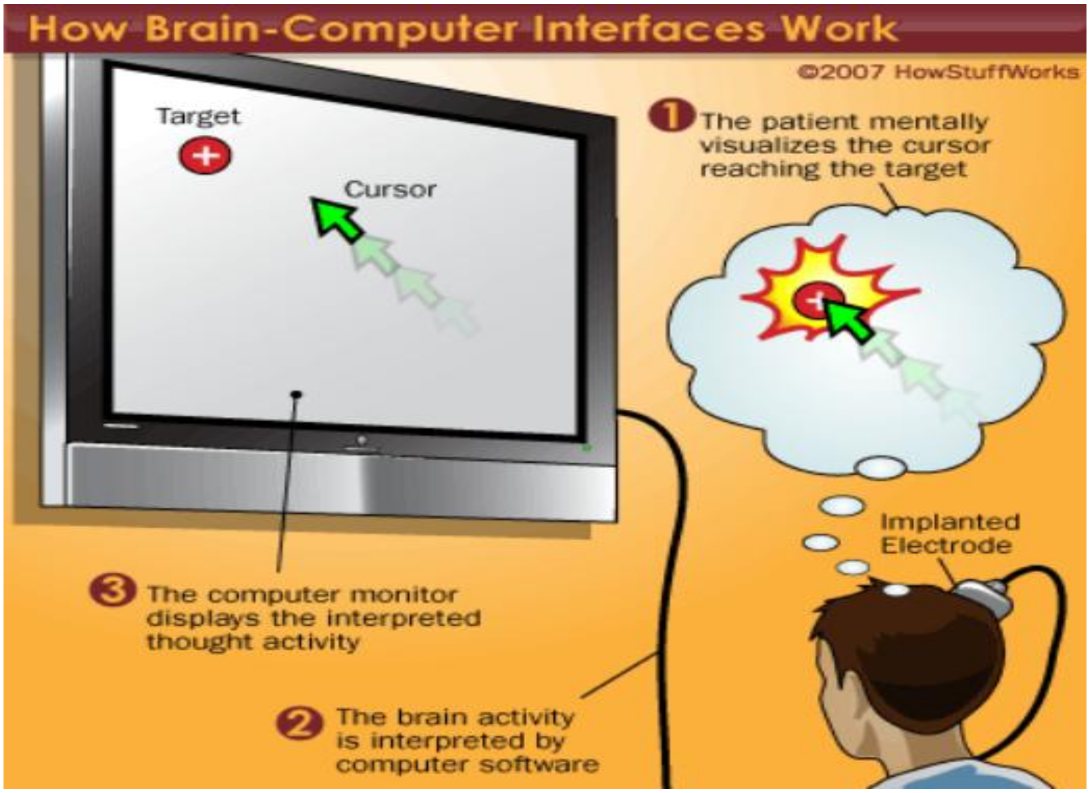
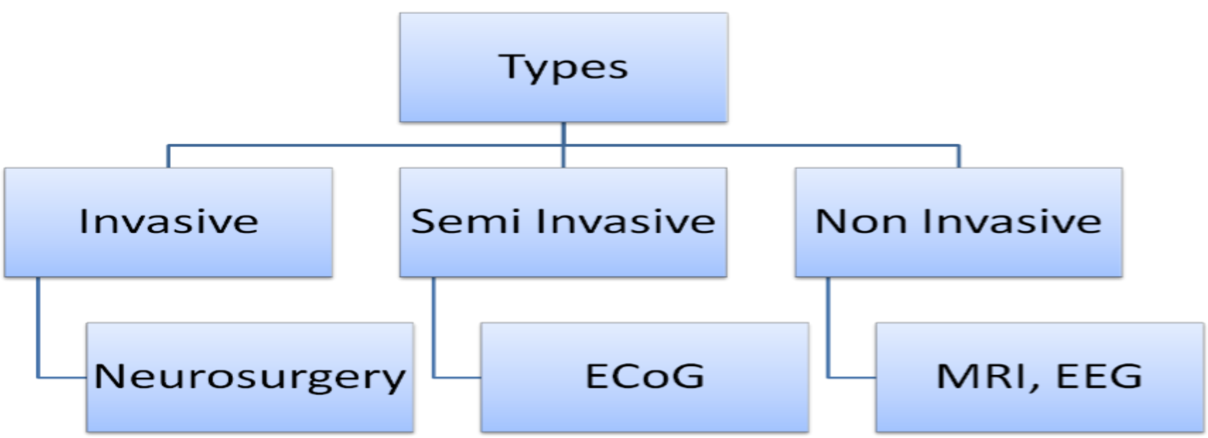


Figure 3. BCI Interface Work

III BCI Types



3.1 Invasive BCI

Invasive Brain Computer Interface devices are thoseimplanted directly into the brain and have the highest quality signals. These devices are used to provide functionality to paralyzed people. Invasive BCIs are also used to restore vision by connectingthe brain with external cameras and to restore the use of limbs by using brain controlled robotic armsand legs.As they rest in the grey matter, invasive devices produce the highest quality signals of BCI evices but are prone to scar-tissue build-up, causing the signal to become weaker or even lost asthe body reacts to a foreign object in the brain [1].

3.2 Semi and Non Invasive BCI

3.2.1 Electrocorticography(ECoG)

Measures the electrical activity of the brain takenfrom beneath the skull in a similar way to non-invasive electroencephalography but the electrodes are embedded in a thin plastic pad that is placed above the cortex, beneath the Dura matter.

3.2.2 Electroencephalography (EEG)

In conventional scalp EEG, the recording is obtained by placing electrodes on the scalp with a conductive gel or paste, usually after preparing the scalp area by light abrasion to reduce impedance due to dead skin cells. Many systems typically use electrodes, each of which is attached to an individual wire.

3.2.3 Functional Magnetic Resonance (FMRI)

ImagingFMRI exploits the changes in the magnetic properties of hemoglobin as it carries oxygen. Activation of a part of the brain increases oxygen levels there increasing the ratio of ox hemoglobin to deoxyhemoglobin.

3.2.4 Magneto encephalography (MEG)

MEG detects the tiny magnetic fields created as individual neurons "fire" within the brain. It can pinpoint the active region with a millimeter, and can follow the movement of brain activity as it travels from region to region within the brain.

IV BCI APPLICATIONS

- Provide disabled people with communication, environment control, and movement restoration.
- Provide enhanced control of devices such as wheel chairs, vehicles, or assistance robots for people with disabilities.
- Provide additional channel of control in computer games.

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- Monitor attention in long-distance drivers or aircraft pilots, send out alert and warning for aircraft pilots.
- Control robots that function in dangerous or inhospitable situations (e.g., underwater or in extreme heat or cold).
- Create a feedback loop to enhance the benefits of certain therapeutic methods.
- Develop passive devices for monitoring function, such as monitoring long-term drug effects, evaluating psychological state, etc.

4.1 Brain Gate

The sensor, which is implanted into the brain, monitors brain activity in the patient and converts the intention of the user into computer commands.

4.2 Honda Asimo Control

Researchers have developed an interface for Honda's Asimo robot that allows individuals to control it simply by thinking [2]

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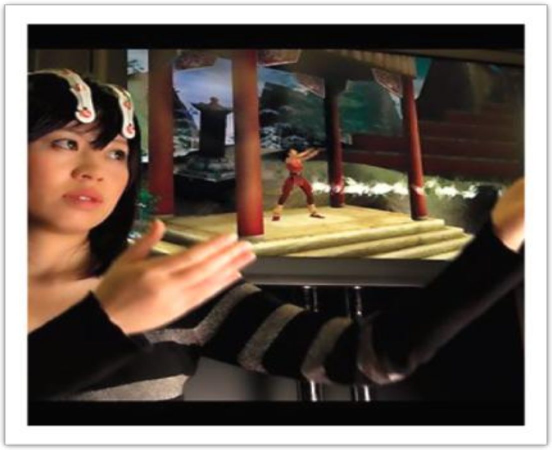
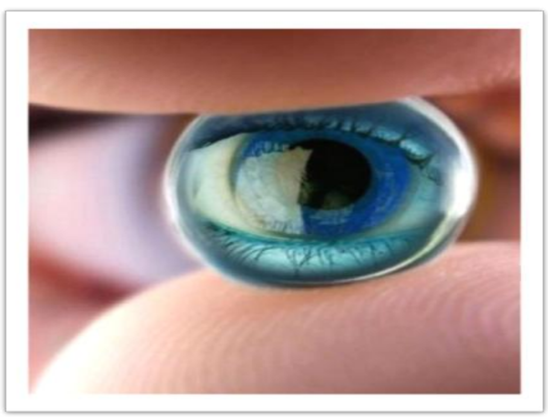
4.3 Gaming Control

Gaming control using a wearable and wireless EEG-based brain-computer interface device with novel dry foam-based sensors [3].



4.4 Bionic Eye

A visual prosthesis, often referred to as a bionic eye, is an experimental visual device intended to restore functional vision in those suffering from partial or total blindness [4].



V ADVANTAGES

- Allow paralyzed people to control prosthetic limbs with their mind
- Transmit visual images to the mind of a blind person, allowing them to see
- Transmit auditory data to the mind of a deaf person, allowing them to hear
- Allow gamers to control video games with their minds

- Allow a mute person to have their thoughts displayed and spoken by a computer

5.1 Disadvantages

- Research is still in beginning stages
- The current technology is crude
- Ethical issues may prevent its development
- Electrodes outside of the skull can detect very few electric signals from the brain
- Electrodes placed inside the skull create scar tissue in the brain

VI CONCLUSION

A potential therapeutic tool. BCI is an advancing technology promising paradigm shift in areas like Machine Control, Human Enhancement, Virtual reality and etc. So, it's potentially high impact technology. Several potential applications of BCI hold promise for rehabilitation and improving performance, such as treating emotional disorders (for example, depression or anxiety), easing chronic pain, and overcoming movement disabilities due to stroke. Will enable us to achieve singularity very soon.Intense R&D in future to attain intuitive efficiency.

VII ACKNOWLEDGMENT

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