

## Brain Computer Interface

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**Abstract:** Years have gone by where humans were imagining a supernatural world where the power to act with completely different machines was doable. Most of the folks believed this supernatural world as a fiction. However through the recent advancement in neurosciences and engineering the interest has been shown by scientists to create this concept. As an upcoming technology, it's thought-about as one of the alluring developments for the society in medical world, technical industry and even the military sector will be benefitted by it. As a result, people will directly interact with machine that is feasible through Brain Computer Interface (BCI). Whereas for interacting with computing devices or machines we've to use interfaces like mouse, keyboards, joystick, etc. What if these interfaces aren't obtainable to you? You can't interact with machines, for this purpose Brain Computer Interface is going to be used. The thought of interfacing minds with machines has interested the human imaginations.

**Keywords:** *neuroscience, alluring, interfacing*

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### 1. INTRODUCTION:

The possibility of interfacing minds with machines has been on the human being's imaginations. Late advances in neuroscience and engineering are making this idea a reality. Medical applications for the deaf and deep brain stimulation for Parkinson's disease<sup>1</sup> is on a rise. Brain-computer interfaces (BCIs) (also called BMIs or brain-machine interfaces) are currently being explored in numerous areas like security, lie detection, alertness monitoring, gaming, education, art, and human augmentation. It will be used for self-study and as a reference by, computer scientists, neuroscientists, engineers and health care providers. BCI are systems that help in interaction between people and the machines. BCI's will be used, as an example, by people to manage external device like a wheelchair. A huge objective of BCI is to unscramble the musings from the cerebrum movement of a man, and flags speaking to the decoded plan are then used in different approaches to talk with an outside gadget. BCI's guarantees to help individuals with extreme engine inabilities.

*Human-Computer interfaces (HCIs)*-has turned out to be ubiquitous. Interfaces like consoles are utilized for communicating. There is an up and coming requirements for Human Computer Interfaces which might be utilized as a part of circumstances where these ordinary interfaces aren't useful. Coordinate mind PC interface (BCI)- could be an up and coming

field that adds common sense to HCI. BCI has developed a totally extraordinary correspondence channel, especially for those people who can't make required solid developments to utilize general HCI gadgets. A BCI could be a H/w or S/w system of communications which permits people to interact with their environment, while not involving the peripheral nerves and muscles by using control signals generated from electroencephalographic<sup>2</sup> activity. It can even be called a brain-machine interface, direct neural interface, or a mind-machine interface. It is a cooperation between a mind and an apparatus that enables signals from the cerebrum to direct some outside action, similar to control of a cursor. The interface permits coordinate correspondence pathway between the mind and in this way the protest be controlled inside the instance of cursor control, for instance, the flag is transmitted uniquely from the cerebrum to the instrument coordinating the cursor, as opposed to taking the customary course through the body's neuromuscular framework from the mind to the finger on a mouse. Brain-computer interface could be a system of communication in light of neural activity created by the brain and is independent of its general output pathways of peripheral nerves and muscles. The neural activity utilized in BCI will be recorded with help of invasive or non-invasive techniques. The ability of BCI frameworks for serving the disabled people is apparent. There are various PC interfaces

proposed for handicapped individuals. Dominant part of those framework require some assortment of solid strong control like neck, head, eyes, or elective facial muscles. It's essential to see that however requiring neural action, BCI utilizes neural action created purposefully by the customer. Interfaces in light of automatic neural movement like those created in an epileptic seizure, use few of an indistinguishable parts and standards from BCI, and however aren't encased in this field. BCI frameworks, in this manner, are especially useful for extremely crippled, or secured, individuals with no solid strong control to interface with their condition. The mind flag qualities utilized for this reason for existing are known as flag highlights, or just highlights.

<sup>1</sup>a progressive disease of the nervous system leading to muscular rigidity, tremor, mostly affecting elderly people and middle-aged

<sup>2</sup>is an electrophysiological monitoring method to record brain's electrical activity.

### 1.1 HISTORY OF BCI

In 1924, Hans Berger Discovers the electroencephalography Analyses the interrelationship of electroencephalography and Brain diseases. In 1970, Initial developments to use brain waves as input.

In 1990, First successful experiments was with monkeys by implementing electrode arrays into Monkey's brains and thus the monkey's brain waves were recorded.

The historical backdrop of BCI begins with Hans Berger's discovery of the electrical activity of the human brain and this way the advancement of EEG. In 1924, Berger was the first individual to record human brain activity by use of EEG. Berger's initial recording device was damn simple. He embedded silver wires underneath the scalps of his patients. These were later replaced by silver foils hooked up to the patient's head by rubber bandages. Berger associated these sensors to Lippmann capillary electrometer, with dissatisfactory outcomes. Berger analysed the interrelationship of alternations in his EEG wave diagrams with brain

diseases. EEGs permitted completely new possibilities for the examination of human brain activities. Research on BCIs started within the 1970s at the UCLA under a grant from the National Science Foundation, trailed by a agreement from DARPA3. UCLA Professor Jacques Vidal coined the term "BCI" and created the first peer-reviewed publications regarding this matter. Jacques is notable as the pioneer of BCIs inside the BCI community.

## 2. TPES OF BCI SIGNALS

There are numerous signals utilized in BCI. Signals are arranged into two sections:

- Spikes
- Filed potentials.

Spikes: It reflects the actions possibilities of individual neurons and are expanded through microelectrodes implanted by invasive techniques.

Filed Potential: They are measure of consolidated neuronal, synaptic and axonal movement of collection of neurons and might be estimated by electroencephalogram or embedded electrodes.

Some EEG signals are:

- Alpha
- Beta
- Gamma
- Delta signals
- Theta

## 3. Types of Brain Computer Interface (BCI)

There are different kinds of BCI. The central aim of these types is to intercept the electrical signals that pass through neurons in the brain and covert them to a signal which is sensed by external devices.

### 3.1 Invasive BCI

Here, Electrodes(sensors) are used. During neurosurgery, sensors are directly implanted, in the grey matter of the brain. So Signals with high quality are produce. This results in scar tissue buildup, which causes the signals to become weak and weaker. It can even make patient Blind and paralyzed.

<sup>3</sup>Defense Advanced Research Projects Agency

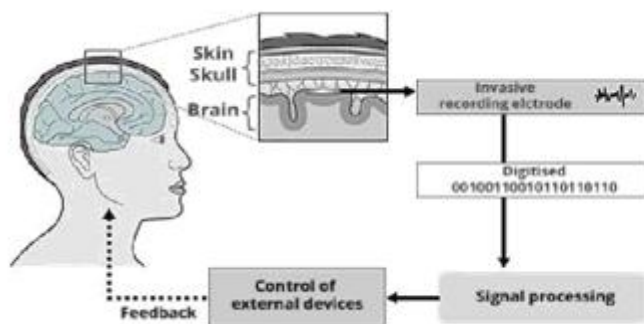


Fig. 1. Invasive BCI Block Diagram



Fig. 2. . Implanted electrodes on brain

To reestablish visual sight, working mind interface was created by William Doherty. Framework incorporates Cameras mounted on glasses through which signals are sent to embed. Roy Bakay Emory and Philip Kennedy University analysts in Atlanta were the first to actualize the brain implant in a human helped to produce high quality signals to help movement. Popular invasive BCI is Brain Gate Neural Interface System.

### 3.2 Partially Invasive BCI

In this compose, electrodes which are mostly embedded outside of the brain and the skull are used. Favorable position of this kind of BCI is that they deliver Better determination, great recurrence range and signals of high caliber. Here, the electrical action of the brain are taken from underneath skull and are estimated by ECoG (eastern cooperative oncology group) This BCI electrodes are installed in a thin plastic cushion that is put over the cortex, underneath the dura mater. These BCI gadgets for the most part include embedding a laser inside the skull. Some Researchers of Carleton University, Canada trusted that a similar interface of Light Reactive Imaging BCI could frame the premise of a mind controlled password systems



Fig. 3. Partially BCI

### 3.3 Non-Invasive BCI

This kind of BCI produces least signal clarity. It is most secure of a wide range of BCI. giving patient the capacity to move muscle implants which has been an extraordinary accomplishment of this sort of BCI. In the non-invasive system, medical scanning devices or a sensor are mounted on headbands or caps allows to access the brain signals. As electrodes are put on the skull and not on the required part of the brain specifically that is the reason these kinds of BCIs create Less signal clarity.

- MEG and fMRI Non-Invasive BCI: They are used today for recording brain's signal. The latter typically measures blood oxygenation level changes. Some current fMRI BCI tests are controlling robot arms and playing Pong. Magnetic fields inside the brain are distinguished by MEG
- EEG Based Non-Invasive BCI: EEG is an electrophysiological monitoring strategy to record electrical action of the brain. Current EEG BCI utilizes number of electrodes that range between a couple and 100 electrodes. because of probability of drying of electrode gel and furthermore the necessity of redundancy of setting up technique before every BCI use, these are not advantageous.

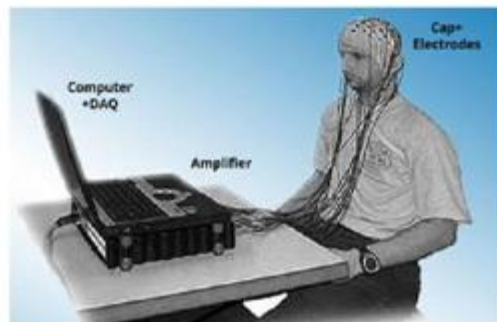
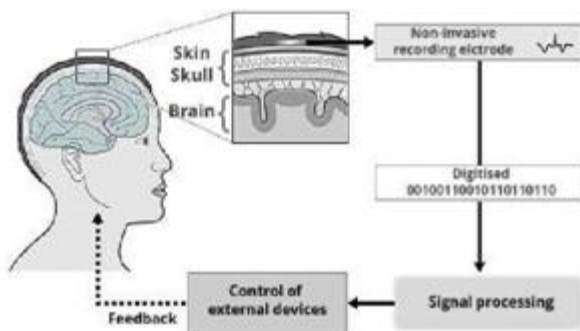


Fig. 4. Non Invasive BCI Block Diagram Fig. 5. EEG Based Non Invasive BCI

- Dry Electrode Array Based EEG Non-Invasive BCI: With a specific end goal to take care of issue of EEG based non-invasive BCI, dry electrodes are utilized by this BCI gadget. Electrolyte is not used, altogether compatibility and sensor size is reduced with EEG monitoring systems are the significant favourable circumstances of utilizing dry electrodes.
- Prosthesis Control Non-Invasive BCI: Today brain-control of prosthetic (an artificial body part) area in individuals with paralysis in upper or lower parts of body is possible. GertPfurtscheller of Graz University of Technology thought of this for the disabled.

#### 4. Advantages and Disadvantages of BCI

Advantages of BCI:

- prosthetic limbs can be controlled by paralyzed individuals with their mind
- visual pictures are transmitted to the brain of a visually impaired individual, enabling them to see
- sound-related information are transmitted to the brain of a deaf individual, enabling them to hear
- computer games can be controlled by the gamers with their minds
- mute person's thoughts are displayed and spoken by the computer

Disadvantages of BCI:

- Its development may be less due ethical issues
- Electrodes placed outside of the skull can recognize not many electric signals from the brain
- Scar tissues are created in the brain due to this process.

#### 5. Future scope of Brain Computer Interface (BCI)

With the innovative progression, a few scientists and research workers endeavor to release various sorts of

BCI apps helpful for everyone. Later on, we will have the capacity to make BCI restore and increment human functions in this manner upgrading the way of living. A few examples like flying an aircraft by thinking, a visually impaired driving a automobile and so forth will move toward becoming reality. Thinking procedures better approaches for controlling customer electronic goods with either gestures or basic voice are getting noticeable. It might even outcome in a condition where speech is considered pointless, and everyone can communicate wirelessly through translator chips. No additional whining because of loud music in clubs. The model TELESAR V lets a human administrator to 'bind' with it, see what it sees, and precise movements of a human hand inside a sensor-filled glove. Coming from Japan (Keio University and Tokyo University) the human client conjointly gets input on what the robot hand is encountering, each regarding touch and temperature. Perfect for taking care of venomous substances, explosives or investigating atomic mishaps like Fukushima, the use of this sort of innovation appears to be unending. Brain painting- Products of BCI are already out. Emotiv Systems4 offers its EPOC neuro-headset to users that reads electrical signals inside the wearer's brain to run games. In the interim, Austrian medical and engineering company, that offers the P300 speller, the intendiX, is operating on brain painting with disabled individuals. Internet of Things -"BCIs can match into the Internet of Things by including chips and implants in individuals and animals – everything will be connected by default," says Cochrane, who feels BCI and IOT go as an inseparable unit.

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4is an Australian electronics innovation company developing technologies to evolve human computer interaction incorporating non-conscious cues into the human-computer dialog to emulate human to human interaction.