

# Brain Computer Interface

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**Abstract**— A Brain Computer Interface basically provides an interface between a human and a computer or peripheral devices with human thinking. Due to advancement in sector of computer science and biological study, well it will be a great achievement to convert imagination into reality. This technology works with the help of electrodes to catch the electric signals detected by electrodes which comes from the brain, this signals are then transferred to computer system or peripheral devices. The translations of detected patterns by the system are then converted into useful commands for desired operation. The main reason for which BCI should implemented for helping out the disabled or paralyzed persons. Our paper includes a proper overlook of BCI, its types, real time system working.

**Key words:** Brain Computer Interface, Invasive, Semi-Invasive, Non-Invasive, Electro Encephalography (EEG), Magneto Encephalography (MEG)

## I. INTRODUCTION

In 1924, Hans Berger, a German neurologist was the first to record human brain signals by means of EEG. Research on BCIs started at University of California, Los Angeles in 1970. The first neuro prosthetic device was implemented in humans appeared in mid 1990s. Duke University scientists successfully connected brain of two rats with EEG that allowed them to transfer the information, at very first brain to brain interface. By the help of EEG and MEG the BCI technology will provide a new experience to computer system users and disabled persons. So that they will not sense that they are lacking behind.

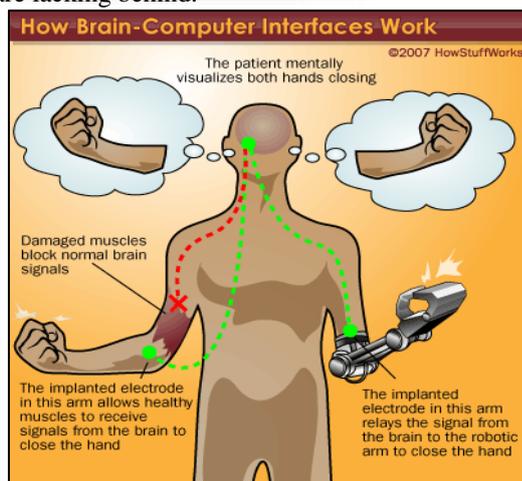


Fig. 1: Interaction of human-brain

A human computer communication will entirely change the prospect of human-system and human-human. For initiate the Control of person's thinking which relates to the ongoing brain activity is in the form of specific patterns which is detected by Brain Computer Interface system. As we know the human activities are fully controlled by neurons. Each nerve cell is attached to each other by axons and dendrites each time we move, remember anything, imagine,

in these all activities our neuron are at work. This operation is taken out by tiny electric signals that get transferred from neuron- neuron at speed of 250 mph. Each neuron has ions on the membrane whenever the electric potential slightly changes at that moment these signals are generated.

These electric signals are then catch by the electrodes. Wires from particular electrode transfer the values to the computer. Electrode compares the fine fluctuations in the voltage between the neurons. This signal is then filtered and amplified. In this way, BCI detects the signal and translates this signal in form of command which is use to operate a computer system. The basic operation of this we will discuss in the entire paper. BCI is all about gathering signal, processing on it by sake of which we will operate the system.

## II. WORKING

At initial state electrodes are attached to human brain by three method invasive method, partially invasive method, and Non-invasive method. These electrodes are just place in the Instrument which is to be fitted on the particular person for purpose of using it Which works as detecting signal from neuron and to process on it for getting exactly what- type and on what feature of it is related to As next somewhere the captured signal has to go so they are sent to the amp (known as amplifier) which basically accepts the signal make it stronger to be sent forward for further processing to implement manipulation. Now concept of artifact is introduced in BCI systems that are annoying potentials that harm the brain signals and are likely of non-cerebral origin.

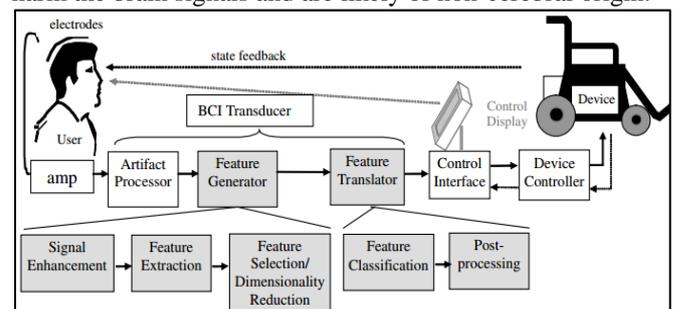


Fig. 2: Model Of functional BCI System

So therefore, there is use to neglect, remove or reject such artifacts from the signals which are received, this process of removing the artifacts is done by artifact processor for neglecting noise and unwanted signals. The identified and collected feature identify the feature and the operation of translation is to worked on which is carried out by feature translation so that it becomes easy to read the signal (what type is it, strength, data within in).After getting what is the signal about its important to properly extract the feature acquired by signals of neurons. When we have got the extraction so we are able to distinguish what feature is it mainly? So, exactly we have to know which type of features we have collected; Feature classification lock does the work

of classifying the features. All this records and measurements are transferred to the next block in which post processing is carried out.

As now we have gathered the information we know what type of signal it is, we have also gathered the classification and working of the related feature so now we have to perform controlling commands from the collected signal through control interface which will properly distinguish which control we have to execute. The execution of the command will be displayed on the control display. Device controller is always connected to device to control interface to continue the two way communication for proper execution or output. This will supervise the device as per the commands or signals generated by human for execution purpose.

#### A. Types of brain computer interface

There are basically three types of BCI, that are usually known. The basic function of the devices is to catch the electric signals that are caught by the electrodes from the neuron in the brain that is detected by external devices.

##### 1) Non-Invasive Brain Computer Interface

It is the most useful neuron signal detecting method which is adjusted to the outer side of skull and hold on the scalp. This is a very safest technique as compared to other techniques. Non-invasive method is known to be out in which meditative scanning devices are fixed on caps or electrode instruments to read brain signals. This technique is least interfering and also read signal less adequately because electrodes are not implanted directly inside the brain. In these five temporal resolutions is provided by EEG. Non-Invasive BCI is portable, less expensive and easy to use.

##### 2) Semi-Invasive Brain Computer Interface

It is other type of Brain signal reading technique which is adjusted inside the skull but outside the grey matter. This type of BCI provides lower signal strength as compared to invasive BCI. Semi-Invasive BCI have less risk of damaging the brain tissues as to invasive BCI. This technique involves embedding laser inside the skull. The laser will capture each signal and the changes in signals of neuron detected by individual sensor. Whenever neuron fires the laser light design and graph it shows will be slightly changed. Although this technique will let on the scientists to invigilate single neuron and require less contact with tissue and reduce the risk.

##### 3) Invasive Brain Computer Interface

This technique of invasive brain computer interface is directly implemented inside the brain and provides the strongest and best quality signals. Invasive BCI are implemented directly into the grey matter of the brain by help of neuron surgery but the invasive BCIs are harmful for the brain tissue buildup. Meanly these devices are implemented to provide services to the disabled persons. Even though it provides strong signal but it is also harmful technique to implement.

### III. INTERACTION OF HUMAN BRAIN WITH THE COMPUTER SYSTEM

The technique used for interaction of human brain with computer system is Electro encephalography (EEG) and Magneto encephalography (MEG).

#### A. Electro Encephalography (EEG)

Electro encephalography comes under a non-invasive which is having a high potential because of its portability, less costs, fine temporal resolution and ease of use. EEG records activity on the scalp generated by firing of neuron in the brain. The recording of electrical activity is done at a short period of time usually 20-35 minutes as captured by multiple electrodes placed on the device. In scalp EEG, the measurement is obtained by adjusting electrodes in the scalp with a conductive gel, normally after preparing the scalp area by low abrasion to scalp down the impedance due to dead skin cells. These electrodes are connected by individual wire to transmit the signal.

##### 1) Algorithm for Electro-Encephalography

- Step 1: The entire signal which is passed from neuron is firstly cached by electrode itself.
- Step2: The signal goes to EEG signal acquisition (which basically stores all the signals).
- Step 3: Process that signal begins by the process wavelet analysis.
- Step4: Now feature identifying is began, that about which feature exactly the signal relates to. i.e. Simply feature is extracted.
- Step 5: Hereafter identifying the feature, selection of feature is done by principal component analysis. (PCA).
- Step 6: Atlas, exactly we have to know which type of signal we have gathered, for that purpose signal classification is done by Support Vector Machine (SVM).

This then analyses the signal and provides further output

#### B. Magneto Encephalography (MEG)

Magneto encephalography is another technique of non-invasive interface; both are used successfully as non-invasive BCI. MEG catches the minute magnetic fields generated by individual neurons inside the brain. It can spot the active region in millimeter and can result the motility of brain action as it travels from sector to sector within the brain.

### IV. APPLICATION

- Provides advanced control of devices such as assistance robot, wheel chair or vehicle for people with disabilities.
- To serve entire new expression in computer games.
- To build intelligent relaxation devices.
- To operate the robots that works in the inhospitable or dangerous situations.
- Considering therapeutic method, helpful to establish a feedback loop to intensify the benefits.
- To establish passive devices for capturing function such as monitoring long time drug effects, evaluating psychological state etc.
- Identifying stages of sleep, memory upload/download, dream capture.
- To implement brain as a computer.
- To offer the paralyzed patient to improve their quality of life. BCI is well suited for patients who are paralyzed.

## V. CONCLUSION

Brain Computer Interface is basically a potential therapeutic tool. It is an enhanced technology, promising paradigm shift in sectors like human enhancement, virtual reality and machine control so it's potentially high impact technology. This technology is new emerging area which is mainly for the patient who had lost their speech due to accident or with any other reason. Also it will empower us to achieve singularity very soon. This can help humans to dive into a virtual world by attaching their brains directly to a computer. As BCI technology has achieved further advances, brain tissue one day may give way to embedded silicon chips thereby establishing a completely computerized simulation of human brain intensified at will.

Futurists believed that from that point super human AI would not be far behind. Future work in this sector would be discovering different approaches which can boost the reliability of scalp EEG technique. Discovering some more algorithms which will help to reduce the size of EEG in future. We can say that as experimental design and identifying technique will improve the BCI. The BCI will be upgraded as well and could contribute wealth alternative for particular person to interact with external environment.

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