

Survey on Brain Computer Interface for Paralyzed People

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ABSTRACT: This paper presents the results of a survey of Brain Computer Interface . the purpose of the Brain Computer Interface is to connect human .The purpose of the Brain Computer Interface(BCI) is to connect the human brain to computer in order to read the electric signals generated by the brain. These electric signals are directed to a signal processor which differentiate the various signals that are generated by the brain. The signals can be read by using a sensor named electroencephalogram(EEG). This sensor can be used to measure the various emotions or states of the brain. The main objectives of the Brain Computer Interface (BCI) are to translate the brain signals into control signals and use them to control the activities of a particular application domain. The first section of this paper specifies what is Brain Computer Interface (BCI), the various signals that are generated by the brain. The second section specifies about the sensor electroencephalogram(EEG), the various uses of electroencephalogram(EEG). The third section is the comparison of the existing systems in this field.

KEYWORDS: BCI , EEG ,Brain Computer Interface for Paralyzed People Stress measurement, Survey on BCI

I. INTRODUCTION

A brain computer interface (BCI) is a technical system that allows a person to control the external world without relying on muscle activity. Rather than depending on the body's normal output pathways of nerve cells and muscles, the input control signals are represented by electrophysiological impulses recorded directly from the brain. The majority of all existing brain computer interface systems, including the one developed in this project, use recordings of the electrical activity in the brain, using electroencephalogram (EEG), as the source of input. The central nervous system (CNS) consists of two main components, the spinal cord and the brain, where the latter is denied as the part that is located inside the skull. A brain computer interface, sometimes called a direct neural interface or a brain-machine interface.

Brain-computer interface [BCI] is a collaboration between a brain and a device that enables signals from the brain to direct some external activity, such as control of a cursor or a prosthetic limb. The interface enables a direct communications pathway between the brain and the object to be controlled.The Brain Computer Interfaces [BCI] can be categorized as invasive and non-invasive. In invasive Brain Computer Interfaces [BCI], the electrical activity of the brain is recorded from inside the head with one or more microelectrodes which can record the activity of a single neuron. The non-invasive Brain Computer Interfaces [BCI] are based on the EEG measured from scalp of the human brain. Brain Computer Interfaces [BCI] can be used for communication, computer access, or control of devices such as a wheelchair or prosthetic arm, among other applications. Virtually anything that can be controlled by a computer could, potentially, be controlled by a BCI. BCI is being examined as a rehabilitation device to help people re-gain motor skills that are lost from stroke, as well as a prosthetic device to replace or compensate for motor skills that will never return.

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BASIC STRUCTURE OF BRAIN COMPUTER INTERFACE [BCI]

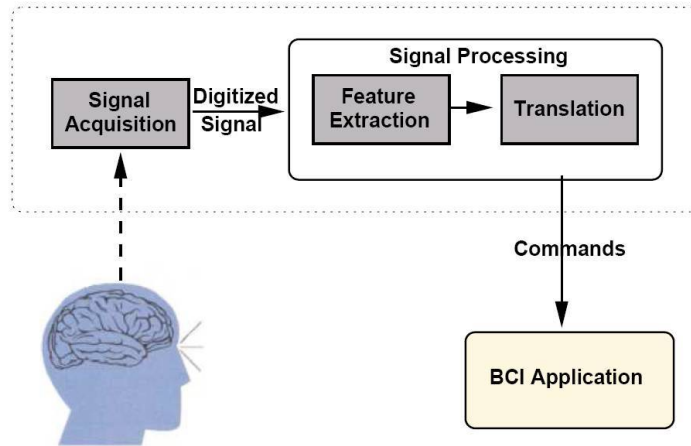


Figure 1: Block diagram of BCI

A brain-computer interface (BCI), sometimes called a mind-machine interface (MMI), direct neural interface (DNI), or brain-machine interface (BMI), is a direct communication pathway between an enhanced or wired brain and an external device. The basic implementation of the bci system includes signal acquisition, signal processing and issuing of commands to perform specific tasks. When a person is under stress the brain produces signals that can be captured by certain devices. These analog signals are acquired and digitized before processing. During the signal processing phase the features detecting stress are extracted. Once these features are extracted they are translated to commands that can make some external device like mobile or wheelchair work depending on the stress level.

BASIC STRUCTURE OF EEG

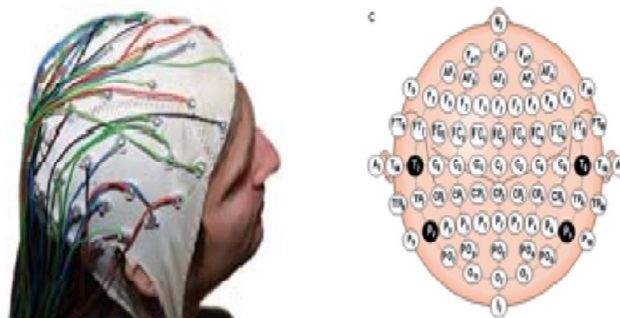


Fig 2 : - 64-Channel EEG cap (left), Electrode Positions (right)

Electroencephalogram (EEG) is a measure of brain waves. It is a readily available test that provides evidence of how the brain functions over time. The EEG is used in the evaluation of brain disorders.

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II. RELATED WORK

In the system named Emotional Control System using Brain computer Interface (BCI) uses Valence-Arousal model to analyze the captured brain EEG signals. The different emotions of human were recognized using Valence and Arousal values. The four emotions such as happy/pleasant, fear/tension, depressed/sad and normal /satisfied emotions were identified based on the trials and activities performed which yielded a satisfactory result with our filtered EEG data. Depending upon the mental state of the user the corresponding music will be played. The main disadvantage of this system is that the emotions that are measured may not be accurate and the music played will not be apt for the situation of the user. This system can be used only in those situations where the user's emotions are responding to music therapy. [1]

The Task Oriented Brain Computer Interface (BCI) Rehabilitation system for patients who suffer with hemiplegic. In this system they uses a closed loop which links continuous motor related brain activity measurement to stimulate the muscles which can modulate sensorimotor nervous system into a physiological state that enables volitional muscle control in severe chronic upper - extremity hemiplegia after stroke. It also contain a wearable dry typed electrode that can be used for recording EEG measurement as well as an exoskeleton robotic device for finger movement support. Here an electrode that can be used practically and can be installed easily. It is a brush like semi-dry electrode. It fills the gaps in the brush with hydro gel. The main advantage of the developed system is that the EEG recordings will become simpler and the preparation time is reduced. The main drawback of the system is that the system will not give accurate measurements and the EEG measurements can be used only to support finger movements. It is a time consuming process. The measurements that are taken will be effected by noise and need to be filtered. The readings will be affected by the hair movements on the scalp. Therefore it will not be useful in many cases.[2]

The paper Brain Computer interface: A Review intends to give an idea about the working of the BCI systems. There are four major phases in BCI systems; they are data acquisition, signal processing and classification, computer interfacing and application. The signal acquisition is usually done using three approaches they are invasive approach which gives quality signals since electrodes are placed inside the skull in a brain surgery, partial invasive approach where signals are read from the skull using BCI devices implanted outside the grey matter in the brain, non-invasive approach where the electrodes are mounted on the scalp for the acquisition of the signal. The input signals for signal processing and classification are always recorded with some unwanted data called noise. Some of the common preprocessing techniques for filtering noise are Basic Filtering, Adaptive Filtering, Blind Source Separation, Independent Computer Analysis (ICA), and Matching Pursuit Algorithm. Computer Interfacing requires proper feature extraction using appropriate method and these features are translated using translation algorithm. Application of BCI systems include robotics prosthetic, walk Again Project, wheelchair, alarm, the direct communication with mouse, monitor and keyboard etc. The paper concludes that BCI systems are really helpful for people suffering from various kindsofparalysis.[4]¹

The Classification of Mental Tasks Using Support Vector Machine Based on Linear Predictive Coding and New mother wavelet Transform. This system uses Linear Predictive Coding methods to compress channels of EEG one channel. Eight features are employed for each signal of EEG using LPC first order followed by 3 level Discrete Wavelet Transform (DWT). This system can be further extended to control wheel chairs, cars, to understand the emotions of the patient by their caretakers, etc. This system uses seven channels. In this seven channels six channels are used for measurements and the seventh channel is used as electroculogram (EOG). This system is mainly used for capturing the emotions using EEG. There is no other functionalities for this system. The major disadvantage of this system is that the reading will not be accurate.[5]

Sensorimotorrhythm is based BCIs offer a noninvasive method for conveying furthermore, cooperating with our surroundings specifically utilizing cerebrum signals in view of mental expectations started suddenly and continuously. With progressing propels in wearable sensors, signal handling calculations, and "Brain"- focused methodologies, SMR-based BCIs may soon turned out to be more normal in our everyday lives. Despite the fast advance in BCI improvement in the previous decade, challenges still exist with respect to SMR-based noninvasive BCIs. Long preparing is still required before most clients can utilize BCIs capably, and there remains a bit of clients who may not get to be capable not withstanding broadened preparing. The methodologies include incorporating noninvasive neuromodulation strategies to enhance the learning of BCI control what's more, personality body

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mindfulness preparing to improve early ability procurement, show extraordinary guarantee towards tending to these issues. Specifically focusing on a client's capacity to regulate cortical motions and consideration utilizing mind-body mindfulness preparing or focusing on a client's inspiration utilizing mechanical gadgets may permit more clients to figure out how to control BCIs speedier. The advantage is to consolidate a significant number of these strategies to advance the acknowledgment of highlevel BCI control. EEG source imaging is an intense apparatus that can distinguish the roots of BCI control signals and in addition distinguish mind areas in charge of engine learning. Inventive study outlines focusing on these districts with noninvasive neuromodulation advancements may open ways to overcoming inalienable client shortages concerning getting BCI control. [8]

The system for EEG Signal Classification using Principal Component Analysis with Neural Network in Brain Computer Interface Applications is mainly designed with the intention of helping paralyzed people for communicating with an external device. BCI use signals from brain to take actions, control, actuate and communicate with the world directly using brain integration with peripheral devices and systems. The brain waves should be free from noise before extraction of features. A technique called Artificial Neural Network (ANN) is used to accomplish this. The technique uses Back-Propagation algorithm. In order to classify the mental tasks, the brain signals are trained using neural network and also using Principal Component Analysis with Artificial Neural Network. Principal Component Analysis (PCA) is a tool for analyzing data and finding patterns in it. PCA projects high dimensional data to a lower dimension and it projects the data in the least square sense, it captures big inconsistency in the data and ignores small inconsistency. Observation from the analysis is that the correctly classified percentage of data is better in Principal Component Analysis with Neural Network compared to Neural Network alone. [10]

III. CONCLUSION

From this survey we can conclude that the Brain Computer Interface (BCI) is an upcoming technology that enables human to develop a system that is controlled by human brain. It enables human to record the electric signals that are generated by human brain, process it to detect the human emotions. There are several sensors that are used to detect the brain signals. The most common among them is the electroencephalogram (EEG). It is the simplest and the easiest way to record the signals that are generated by the brain. It is an area of technology that have several future usage and development.

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