# A Systematic Approach of Brain Computer Interfaces

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*Abstract*— A brain computer interfaces (BCI) is a communication system that translates brain activity into commands for a computer or other devices. Brain computer interfaces (BCI) technology is a powerful communication tool between users and systems. It does not require any external devices or muscle intervention to issue commands and complete the interaction. In other words, a BCI allows users to act on their environment by using only brain activity, without using peripheral nerves and muscles. The major goal of BCI research is to develop systems that allow disable users to communicate with other persons, to control artificial or to control their environment. An alternative application area for brain computer interfaces (BCIs) lies in the field of multimedia communication. To develop systems for usage in the field of assistive technology or multimedia communication, many aspects of BCI systems are currently being investigated. Research area include evaluation of invasive and noninvasive technologies to measure brain activity, evaluation of control signals, development of algorithms for translation of brain signals into computer commands and the development of new BCI application. In this paper I give an introduction to some of the aspects of BCI research mentioned above, present a concrete example of a BCI system, and open problems.

***Keywords:*** Brain- Computer Interface, virtual keyboard, Accessibility, Communications

## I. INTRODUCTION

Brain-computer interfaces (BCI) are systems that allow communication between the brain and various machines. They work in three main steps: collecting brain signals, interpreting them and outputting commands to a connected machine according to the brain signal received. BCI can be applied to a variety of tasks, including but not limited to restoring motor function to paralyzed patients, allowing communication with locked in patients and improving sensory processing. BCI can be separated in three categories depending on the method used to collect brain signals 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), is a direct communication pathway between an enhanced or wired brain and an external device. BCI differs from neuromodulation in that it allows for bidirectional information flow. BCIs are often directed at researching, mapping, assisting, augmenting, or repairing human cognitive or sensory-motor functions. Brain-computer interface (BCI) is 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. In the case of cursor control, for example, the signal is transmitted directly from the brain to the mechanism directing the cursor, rather than taking the normal route through the body's neuromuscular system from the brain to the finger on a mouse. By reading signals from an array of neurons and using computer chips and programs to translate the signals into action, BCI can enable a person suffering from paralysis to write a book or control a motorized wheelchair or prosthetic limb through thought alone. Current brain-interface devices require deliberate conscious thought; some future applications, such as prosthetic control, are likely to work effortlessly. One of the biggest challenges in developing BCI technology has been the development of electrode devices and/or surgical methods that are minimally invasive. In the traditional BCI model, the brain accepts an implanted mechanical device and controls the device as a natural part of its representation of the body. Much current research is focused on the potential on non-invasive BCI. At the European Research and Innovation Exhibition in Paris in June 2006, American scientist Peter Brunner composed a message simply by concentrating on a display. Brunner wore a close-fitting (but completely external) cap fitted with a number of electrodes. Electroencephalographic (EEG) activity from Brunner's brain was picked up by the cap's electrodes and the information used, along with software, to identify specific letters or characters for the message. The BCI Brunner demonstrated is based on a method called the Wadsworth system. Like other EEG-based BCI technologies both user and software are expected to adapt and learn, making the process more efficient with practice. During the presentation, a message was displayed from an American neurobiologist who uses the system to continue working, despite suffering from amyotrophic lateral sclerosis. Although the scientist can no longer move even his eyes, he was able to send the following e-mail message: "I am a neuroscientist who (sic) couldn't work without BCI.

## II. LITERATURE REVIEW

| S.NO | Title | Author | Findings | Remark |
|---|---|---|---|---|
| 1 | Brain Computer Interface systems using non- invasive electroencephalographm signal | Sunil Kalagi & Jose Machado June 2017 | The human brain Controls all the body Functions & movements | The first Brain computer Interface (BCI) as an idea has described under upon brain surgery to press a bottom &record the Electrical activity of the cortex region. |
| 2 | Controlling a servo Motor using EEG signals from the Primary Motor cortex. | Somer Nancy, SadeenKbah & Hind A Jafer. Oct 2016 | BCI is beginning to move from the proof of concept & emulation stages into | One of popular applications of EEG based BCI is for spelling systems, which allow users to select or construct character from |

 

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| | | | maturity. | a user interface based on their EEG patterns. |
| 3 | Parallel man-machine training in development of EEG based cursor control. | Priyanka Devendra Girase 2013 | EEG data recorded using 28 electrodes arranged according to the international 10-20 electrode system. | Only two subjects are train to achieve 2-D Cursor control. They achieved the hit rates of 70% & 85% Respectively. Ones subjects are fully trained they can hit the target close to 100% |
| 4 | Experiment with an EEG based computer interface | Manish P.Deshmukh & Dennis j.MC Farland 2014 | EEG recorded from one bipolar channel with two electrodes located 3cm behind C3&C4 of The international 10-20 system | Hara & soft rejection Improves classification accuracy. In hard 21% of data blocks were entirely rejected. In soft rejection method an average of 34% of the samples was Rejected |
| 5 | Current trends in Graz brain-Computer Interface research | R.A.Calvo, D.J MC Farland & Stephen Roberts 2008 | The EEG was recorded with 29 gold electrodes of which ground electrode was placed on the forehead | It is based on the Classification of the EEG Patterns during five Different mental tasks Using detection of the ERD & the ERS patterns during the motor imagery |

## III. Objectives of BCI

The main objective of this paper is to 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 Brain- computer interface (BCI) is 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. Between the brain and the object to be controlled. Brain computer interfaces have contributed in various fields of research Brain computer interfaces have contributed in various fields of research, they are involved in medical, neuroergonomics and smart environment, neuromarketing and advertisement, educational and self-regulation, games and entertainment, and Security and authentication fields. They are involved in medical, neuroergonomics and smart environment, neuromarketing and advertisement, educational and self- regulation, games and entertainment, and Security and authentication fields.

## IV. Analysis

In this paper, Brain Computer Interface is presented as when a person suffers a disease that compromise the ability to perform motor activity, there is a chance to rectitude some control of the environment using biological signals like EOG, EMG or EEG. The first two signals offer a limited use because in the case of EOG the quality of the signal depends of environment characteristics, which are out of control. In the case of EMG, these signals can't be used when the disease is severe and the person can´t control the motor activity of his body. The aim of a brain computer interface is to translate EEG signals into instructions for controlling a computer, which mean a new communication channel. A general approach to Brain Computer Interface includes a signal acquisition system, pre- processing, selection and extraction of features, classification and feedback. The acquisition signal system must guarantee a good signal to noise ratio through implementation of filters and other techniques of digital signal processing in order to eliminate noise present on the EEG signal. For the selection and extraction of features of the signal, the knowledge of the biological signals characteristics is needed. In this area the ERP´s, the oscillatory brain activity, slow cortical potentials and neuronal ensemble activity are of interest and these signals are used as input for the BCI. Finally, the classifier selects between the classes represented by the EEG signals, here the neural networks, support vector machines, and Linear Discriminant have been used showing good performance.

## V. Conclusion and Future Scope

BCI has progressively achieved several monumental milestones. The future impact of BCI in terms of patient care is slowly starting to come into focus. It is important to remember that the generation of physicians that we belong to will be in charge of knowing and integrating new technology, to provide better care to our patients. Brain-computer interfaces (BCI) are increasingly becoming reliable pieces of technology, changing the lives of patients, particularly of patient's whosuffer from paralysis or similar conditions. In this paper we have attempted to give an introduction to BCI research and have reviewed neurophysiologic signal processing and machine learning methods, as well as applications for BCIs. Furthermore, we have described a state of the art BCI system based on the data from disabled subjects. One of the main features of this system is that it employs advanced Bayesian machine learning tools, which makes training of classifier simple, fast, and reliable. Finally, some open problems in BCI research were discussed. As we have seen, a large variety of proof of concept systems exists. However, none of the systems described in the scientific literature is suited for daily use by disabled persons for use in multimedia environments. This is because the technology underlying

BCIs is not yet mature enough for usage out of the laboratory. Many challenging and interesting questions in BCI research are thus still waiting to be explored.

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