The Potential of Brain Computer Interfacing for Sustainable Development

S. R. Liyanage

Faculty of Computing and Technology, University of Kelaniya, Kelaniya, Sri Lanka.; sidath@kln.ac.lk

Abstract

A Brain-Computer Interface (BCI) is a communication system which enables its users to send commands to a computer using only brain activities. These brain activities are generally measured by ElectroEncephaloGraphy (EEG), and processed by a system using machine learning algorithms to recognize patterns in EEG data. In the next few years, BCIs will be more flexible and powerful, and much easier to use with little or no support. BCIs will be the more practical tools for severely disabled users, and will gain increasing adoption, catalyzing a synergistic feedback effect. As BCIs become cheaper, easier to use, and better publicized, more people may wish to purchase BCIs, leading to further advances.

BCIs may be invasive or non-invasive. Invasive BCIs require surgery to implant the necessary sensors, whereas non-invasive BCIs do not. More than 80 percent of BCIs are non-invasive systems, like the EEG that measures electrical activity associated with mental tasks. All BCIs require four components: methods to acquire, process, implement, and manage relevant brain and/or other signals. Rapid progress is being made in all four components. New sensors are being developed that do not require electrode gel, which reduces preparation time and hassle and makes BCIs more accessible to new users. Dry sensors over the forehead can acquire not only brain signals, but also other relevant signals such as electrooculogram (EOG) and facial electromyography (EMG). Improved sensors for invasive BCIs could provide a better picture of brain activity while reducing the cost, time, and surgery.

Invasive BCIs have shown they can provide reliable control years after implantation, helping to address concerns about long term reliability. "Hybrid" BCIs combine a BCI with another means of sending information, such as another BCI or assistive technology, or a conventional interface like a keyboard or mouse. The additional communication system could improve bandwidth, confirm selections, turn the primary channel on or off, provide a backup if the user is fatigued, or yield other benefits. A whole new category of BCI applications is being explored—devices for disorder rehabilitation, rather than simple communication and control.

The aim of this paper is to explore the potential of BCI research, some of which is carried out in Sri Lanka from different perspectives. As an emerging market South Asian region has a huge potential to develop effective and sustainable BCI systems in the future. Collaborative integrated research in medicine and engineering in neuroscience, signal processing and pattern recognition are required to make any significant advancement at this stage.

Introduction

A Brain-Computer Interface (BCI) is a communication system which enables its users to send commands to a computer using only brain activities. These brain activities are generally measured by ElectroEncephaloGraphy (EEG), and processed by a system using machine learning algorithms to recognize patterns in the EEG data. The brain-computer interface (BCI) field is one such technology which shows great promise. The World Economic forum has identified BCI as one of the top emerging technologies.

BCI research is gaining attention from various groups, including commercial companies, academics, funding agencies, and potential new users. This new found interest has facilitated considerable progress in each of the four component areas defining BCIs. In thenext few years, BCIs will become more flexible and powerful, and much easier to use with little or no support. BCIs will be more practical tools for the severely disabled, and will gain increasing adoption among other groups. Increasing adoption could catalyze asynergistic feedback effect. As BCIs become cheaper, easier to use, and better publicized, more people may wish to purchase BCIs, leading to further advances.

BCIs may be invasive or non-invasive. Invasive BCIs require surgery to implant the necessary sensors, whereasnon-invasive BCIs do not. More than 80 percent of BCIs are non-invasive systems, such as the electroencephalogram (EEG) that