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REVIEW

Brain computer interfacing: Applications and challenges

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Abstract Brain computer interface technology represents a highly growing field of research with application systems. Its contributions in medical fields range from prevention to neuronal rehabilitation for serious injuries. Mind reading and remote communication have their unique fingerprint in numerous fields such as educational, self-regulation, production, marketing, security as well as games and entertainment. It creates a mutual understanding between users and the surrounding systems. This paper shows the application areas that could benefit from brain waves in facilitating or achieving their goals. We also discuss major usability and technical challenges that face brain signals utilization in various components of BCI system. Different solutions that aim to limit and decrease their effects have also been reviewed.

Contents

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1. Introduction

Brain Computer Interface (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 [1]. The research community has initially developed BCIs with biomedical applications in mind, leading to the generation of assistive devices [2]. They have facilitated restoring the movement ability for physically challenged or locked-in users and replacing lost motor functionality [3]. The promising future predicted for BCI has encouraged research community to study the involvement of BCI in the life of non-paralyzed humans through medical applications.

However, the scope of research has been further widened to include non-medical applications. More recent studies have targeted normal individuals by exploring the use of BCIs as a novel input device and investigating the generation of hands-free applications [1,2]. The use of BCI interfaces for healthy users has been subject to some doubts as discussed in [4]. The problem of poor information transfer rate (ITR) of BCIs and its effect on reducing the commands user can give has been addressed as one of those issues. It has been claimed that this problem restricts BCI utilization for locked-in persons as it will not be able to keep up with ordinary communication ways or even existing human computer interfaces.

On the other hand, some of BCI advantages for able-bodied users have been enlightened in [5]. BCI could be helpful especially for safety applications or applications where it is instantaneously difficult to move and the response time is crucial. Besides they can also be used to increase the accuracy of the HCI systems, resulting in BCI contribution in various fields such as industry, educational, advertising, entertainment, and smart transportation. Despite its expected success, Brain computer interfacing needs to overcome technical difficulties as well as challenges posed by user acceptance to deal with such newly discovered technology.

The next sections will provide more information about BCI functions and associated applications. Various methods for acquiring brain signals are then explored along with the electrical changes reflected in the recorded brain waves. This paper will also discuss the issues facing BCI systems and some found solutions to their consequences in details.

2. BCI functions

Applications of Brain Computer Interface base its functionality on either observing the user state or allowing the user to deliver his\her ideas. BCI system records the brain waves and sends them to the computer system to complete the intended task. The transmitted waves are therefor used to express an idea or control an object.