Various signals used for device navigation in BCI production

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Abstract. With computer hardware development in recent years it has become easier than in earlier centuries to resolve problems in machine learning and computer vision. This has led to a widespread interest in EEG-based brain computer (EEG-BCI) interfaces, which can be used to support a number of support technologies which benefit from the hands-free and personal thought translation in this area. However, most analysis is more practical than evidence-of-concept. Therefore, some technological advances are being developed to allow seriously weakened engine systems to be used temporally in a 2D or 3D virtual environment, such as multiple sclerosis, amyotrophic lateral sclerosis. New technologies and rising developments in automation technologies. In bringing new technology to a continuously diverse population, we are confronted with new challenges. However, in recent years no one has studied general patterns for web applications with different aspects of the BCI interface architecture. In this study, we examined how EEG-BCI research has developed over the past decade to explore the latest trends in EEG applications. In this article, we have researched the review of articles BCI articles for each signals and functionality.

Keywords: EEG-BCI; Interface design, signals, multiple sclerosis, amyotrophic.

1. Introduction

Brain-computer interfaces (BCI) make science fiction of remotely controlling external objects with thought alone a reality. Decades of research have developed systems that can make our mental commands legible without explicit linguistic command or muscle movement. Generally, these systems are developed in order to assist individuals suffering from reduced motor movements [Bashashati et al., 2007][1]. Electroencephalography (EEG) offers the perfect setup for such a system. In fact, the EEG-based BCI models receive several uses by event-related synchronization (ERD / ERS), p300 (using speller) and SSVEP [Muller-Putz and Pfurtscheller, 2008][2]. ERD / ERS are primarily known to the person after the rest period or after the intended or actual movement. SPVEP has been shown to be influenced by a vibrating motion that was recently contralateral or Ipsilateral. The P300 is a waveform that arises when someone in the EEG time series introduces to stimulate something around 300 ms after the stimulus signal. P300 is one of the largest components that can be identified and isolated (Mak et al., 2012)[3]. There are several interesting paradigms in literature that study p300 based BCI. Most notably Berlin speller and Hex-o-spell paradigms rely on an alphabet grid presented visually where participants have to wait for a particular pre-assigned letter or character to be highlighted in the grid [4].
In recent years special attention has been paid to developing BCI controlled web-browser [5]. The importance of this application towards populations who lack finer motor control can hardly be overstated. To that end, there have been very important developments by several groups that use p300 based or SSVEP-based BCI paradigms[6]. There are several reasons why the p300 paradigm is preferred by BCI researchers [7]. However, in recent years several hybrid EOG-EEG or Eye-tracking based applications are steadily gaining ground [8]. In spite of all these advances the challenges to a real-time BCI web-browser are becoming more apparent in recent years. In the current work we intend to review the BCI web-browser applications developed over the last decade or so in terms of three different emerging criteria

2. Advances in BCI signals and classification

BCI in general combines recent advances in signal processing technology along with cutting-edge machine learning algorithms to deliver practical applications. Although most of the early BCI technologies focused on decoding EEG signals, over the last decade we have seen more and hybrid applications of BCI that combine EEG signals with eye-tracking or EOG signals [9]. Moreover some researchers take advantage of asynchronous combination of signals to achieve higher information transfer rate(ITR). In general Hybrid systems have been known to outperform simple EEG based BCI systems in terms of accuracy as well as ITR. However, very few studies have checked for usability of the system like [10-11]. In fact combining multiple signal sources although beneficial from purely technical stand point (accuracy and ITR), it can be said that the cognitive load on a naive user from purely practical usability perspective needs to be researched more. Table 1. Present different signals used in BCI development

| Author | Type of signals |
|--------|-----------------|
| 1,21,23 | EOG+EEG signal |
| 2,3,13  | Hybrid EEG      |
| 4,5,8,9,10,11,12,14,15,17,18,19,24 | EEG                |
| 6       | EOG             |
| 7,20    | EEG+ Eye tracker |
| 16,22   | Eyetracker      |

3. Summary of signals and classification

The hybrid BCI system does not allow segregation among command and non-control sites through blind prediction as the EOG signal is more reliable and can be detected more easily with excellent precision, and obtained good ITR[12].The EEG monitors the warning monitor and defines the specified request to be sent to the web section which specifies the series and displays the solution requested[13]. The result showed that it is a viable system in terms of accuracy and ITR [14].This program allows the user to access the computer and manage files stored efficiently by EEG signals[15].This system applied for Internet advertising and Robot arm control [16].This system allows the user to navigate the Internet and increase transmission speed [17].The highest Information
Transfer Rates (ITRs) are obtained by transparent tracking [18]. In this system, user can control the web navigation by using the virtual mouse and keyboard [19]. In this method, full examination of the EEG data demonstrated P300 power to all the respondents in relation to the experimental task [20]. An Linear Discrimination Analysis was used for designing and comparing three BCI systems with features selected by main component analysis [21] from the EEG targets.

Hybrid BCI-focused mail categorising multimodal functions based on EEG [22], which enable hybrid home management, web browsing, and residential support tools to make independent use of homes to cares [22]. EEG data from eight BCI stations and the participants using this BCI can select the target at a rate of precision of 93.6 percent ± 1.6 percent (mean housekeeping). In this method EEG caps, the system efficiency and speed have to be substantially improved [28]. P300 EEG is a brain powered browser to strengthen access to motor functionality of web services to those with the greatest mobility disability [29]. Eye-tracker signals display better results in terms of ITR score and system usability scales. The EEG-BCI is an online browser designed and tackled by individuals with amyotrophic lateral sclerosis (amyotrophic lateral sclerosis) who use the browser to find something to do on the web [30]. The Eye Tracker Command improves BCI web browsers during acquisition and data transfer rates [31-33]. With HybridBCI, users can enter text, access the Web, communicate by e-mail and use EEG and EOG alone to manage Essence [34]. This approach does not specify user status as the frequency-domain properties of EEG signals [35].

4. Conclusion

In the current paper we have discussed quite a few attempts to use these brain signals to use for web surfing. We have also seen recent works that have tried to use hybrid BCI systems using EOG data from eye trackers with EEG-BCI systems, such approaches remain in their infancy.

In this paper published articles in the reputed journals for the last decade have been investigated in terms of different signals. We have made comparisons among the various systems paying special attention to signals. There is a lag in the current system for a completely free interface with accuracy, so the following suggestions for future hands-free interface navigation are given for Patients with severe motor neuropathy (similar to patients with MS or ALS) currently have relatively few hands-free telecommunication and interface navigation systems. Some existing EEG-BCI systems for web navigation require little temporary delay or cumbersome tagging procedures to work properly.

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