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Title(English)	Real-Time Brain Computer Interface Based on Eye Movements Using Electroencephalographic Signals
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種別(和文)	要約
Type(English)	Outline

Thesis Outline

This thesis presents the fundamental knowledge behind developing communication systems based on EEG and eye movement, presents a state-of-the-art review of BCI research and then describes real-time application implemented by the author. The thesis concludes by looking to the future of hybrid EOG-EEG based BCI technology. The author highlights the challenging areas in BCIs field that must be addressed to facilitate further progression of this line of research.

The first Chapter performs a thorough review of brain-computer interface based on the electrophysiological activity within the brain. The chapter describes in detail the origin, acquisition, characterization and applications of EEG recorded signals. The purpose of this chapter is to familiarize the reader with BCI applications, eye-movement-based communication systems and some EEG characteristics that will be exploited and referred to in second chapter. A large portion of this chapter is devoted to performing a state-of-the-art review of BCI technology and describing the approaches of various different BCI research groups around the globe.

The second chapter begins by introducing the idea and purpose of using biomedical signals recording from the scalp. The essential components of EEG signals are described and some of the signal-processing methodologies behind them are reviewed in detail. The chapter concludes by reviewing necessary standardized performance metrics and discusses the challenges for future progression of using both of brain activity and eye movements.

The third chapter discusses the possibility to use EEG recording instead of EOG as an alternative technique to measure eye movements. We present a simple algorithm for offline recognition of four directions of eye movements from electroencephalographic signals.

The fourth chapter describes online detection and classification of six classes of eye movements using two temporal EEG sensors. We explain in details all steps of the proposed algorithm from electrodes position to classification results. The biggest challenges would be reducing the number of sensors used and extracting appropriate features of eye movements from EEG signal.

The fifth chapter presents a real-time BCI controlled video game with eye movements using our proposed algorithm. The chapter describes the EEG signals associated with eye movements and the methodologies that are exploited in this study to offer real-time control. The real-time deployment of this system and the associated performance results are reviewed. Finally, a discussion reviews the success and future work of this type of communication-system implementation.

Conclusion provides a conclusion on the issues addressed by this research and on the future of non-invasive, asynchronous, and hybrid BCIs based on brain EEG and EOG signals.