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D6.2 BRAIN - Dissemination, use, and exploitation plan (DUEP)

BCIs with Rapid Automated Interfaces for Nonexperts

Public document

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BCIs with Rapid Automated Interfaces for Nonexperts

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List of abbreviations

BCI	Brain Computer Interface
EEG	Electroencephalogram
ERD/ERS	Event related desynchronization / synchronization. In this context, ERD/ERS refers to EEG dynamics during limb movement and motor imagery
ERD/ERS based BCI	BCI based on motor imagery
SSVEP	Steady State Visual Evoked Potential

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1. Executive Summary

This dissemination, use and exploitation plan (DUEP) is a dynamic document, which will be continuously updated throughout BRAIN's duration. It serves the following purposes:

- To document the overall strategy for the dissemination and exploitation of the knowledge gained in BRAIN
- To document the exploitation plans of each partner
- To be a repository of the history of presentations and publications that result from BRAIN work
- To generally disseminate information on BRAIN and its progress, in such a way that other projects in the area can utilize BRAIN's results

This document comprises three sections, namely exploitable knowledge, knowledge dissemination, and publishable results. The section on exploitable knowledge lists the project results that are classified as knowledge and have a potential for product or service development. The section on knowledge dissemination summarizes the major activities (workshops, conferences, etc.) in which BRAIN's results have been presented. The last section provides a summary of each exploitable result that BRAIN has generated.

2. Exploitable knowledge

This section presents the project results that are classified as knowledge and have a potential for product or service development.

2.1. Overview table

Table 1. Exploitable knowledge

Exploitable knowledge	Exploitable products or services	Application domains	Timetable for commercial use	Patents or other IPR protection	Owner and other partners involved
Rapid SSVEP calibration procedure	SSVEP based BCIs for assistance to the physically challenged	Restoration of communication	First prototype for evaluation March 2009 Second prototype September 2009	Published work	PHILIPS
Detection of SSVEP evoked by high frequencies	Safe SSVEP based BCIs	Restoration of communication	First prototype for evaluation March 2009 Second prototype September 2009	Published work	PHILIPS
Combination of SSVEP with easily recordable signals for interaction	HCI devices incorporating SSVEPs for healthy users	Restoration of communication General interaction solution Attention monitoring	Prototype for healthy users incorporating convenient electrodes by March 2010	Patents pending	PHILIPS

2.2. SSVEP advanced tools

To be viable as consumer interaction devices, Steady-State Visual Evoked Potential (SSVEP) based BCIs need to increase their usability along three main criteria, namely

SSVEP are described in (Pastor, et al. 2003)

shorter setup and calibration procedures, safety, and higher information throughput. The first two criteria have been initially addressed in this project because of their higher importance in achieving a usable BCI that does not require expert assistance. Increasing the communication throughput constitutes our underlying objective that can be achieved by leveraging on the results of the research aiming at shortening the calibration and increasing the safety.

In this document, only a brief summary of the underlying techniques is provided. A complete description can be found in (Garcia Molina, et al. 2009).

Rapid calibration to detect the SSVEP at a given frequency is achieved through a training phase which consists in presenting the subject with a short sequence of oscillatory visual stimuli at the trained frequency interspersed with break periods. A set of coefficients is then obtained to linearly combine the signals recorded from several electrodes into a single signal that has maximum power at the trained frequency. The topographical representation of these coefficients on the scalp confirms the fact that the relevant activity originates in the region that is closer to the primary visual cortex. In the actual demonstrator, the calibration lasts for 30 second per stimulation frequency.

To ensure the safety of the current SSVEP based BCI, stimulation frequencies above 30 Hz are used. This approach is beneficial for two reasons. First, the risk for photo-induced epileptic seizure diminishes for high stimulation frequencies (Pastor, et al. 2003) (Fisher, Harding and Erba 2005) and second, the procedure for finding the optimal linear combination coefficients is simplified because the higher harmonics do not need to be considered given the limited bandwidth of the scalp recorded EEG.

2.2.1. Possibilities of exploitation

SSVEP based BCIs in their current form are well suited as communication restoration devices. Within the BRAIN framework the current prototype will undergo tests with patients at CEDAR. The feedback from these early tests will serve as a basis for improvement of the twelve month deliverable. On completion of the project, it is envisioned to deploy a simple two-frequency stimulation system for physically challenged people.

Combination of SSVEP with other signals that are more readily generated by the user opens the possibility of deploying SSVEP based BCIs for the general consumer in the area of advanced HCI. This requires however a longer evaluation procedure that if promising should be conducted according to Philips standards.

3. Knowledge dissemination

Table 2 reports the past and future dissemination activities in BRAIN.

Table 2. Knowledge dissemination

Planned/actual dates	Nature	Type of audience	Countries addressed	Size of audience	Involved partner
Press release					
12-March-09	Update on project at Belfast meeting 12/3/09	Public	Northern Ireland	unknown	Ulster
Conference					
20-23 November 2008	Tutorial on EEG processing for ERD/ERS BCIs IEEE/BiOCAS 08 conference	Research, Industry & Higher education	International	200	PHILIPS
26th November 2008	European Society for Engineering & Medicine Workshop at EMBEC 2008	Research, Industry & Higher education	International	50	ULSTER
12-13 March 2009	Paper presentation NEUROMATH 2009	Research, Industry & Higher education	International	100	PHILIPS
August 2009	Proposed Tutorial on EEG processing for BCIs EUSIPCO 09	Research, Industry & Higher education	International	500	PHILIPS

SSVEP are described in (Pastor, et al. 2003)

Planned/actual dates	Nature	Type of audience	Countries addressed	Size of audience	Involved partner
Publications					
November 2008	Dissemination article in Focus on 7 (Invest NI)	Research, Industry & Higher education	Northern Ireland	500	ULSTER
August 2009	Paper submitted EUSIPCO 09	Research, Industry & Higher education	International	500	PHILIPS
December 2009	Journal Paper submitted Biomedizinische Technik / Biomedical Engineering,	Research, Industry & Higher education	International		PHILIPS
Project website					
October 2008	First project website online	General public	International		PHILIPS
February 2009	Final project website online	General public	International		Uni. Bremen, PHILIPS
Posters					

3.1. Description of major activities

3.1.1. Press release

A press release to reflect upon the BRAIN project was prepared by University of Ulster after the consortium meeting in Jordanstown on 10th March. Photographs were also taken for web site.

Dr McCullagh subsequently provided a radio interview to Radio Ulster on 16th-March-09.

3.1.2. Conferences

BRAIN's results and research in ERD/ERS based BCIs were presented in a tutorial session at the IEEE/BiOCAS 2008 conference in Baltimore-US.

The SSVEP research resulted in two papers. The first paper was submitted for presentation at the EURASIP/EUSIPCO 09 conference while an extended version was submitted to the Journal of Biomedizinesche Technik (special issue NEUROMATH).

A presentation on BCI was presented at EMBEC 2008 (Antwerp, Belgium) as part of a workshop on Brain discovery techniques. The presentation indicated the technical challenges that successful uptake of BCI and hence inclusion for disadvantaged citizens would need to address.

The work on SSVEP will also be presented at NEUROMATH 2009 on March 13. The NEUROMATH workshop focuses on algorithmic methods for describing brain activity and connectivity. In this year's edition, NEUROMATH emphasizes BCI technology; in particular the selection of the BCI modality.

In addition a tutorial session on EEG processing for BCIs was proposed for presentation at EUSIPCO 09.

3.1.3. Publications

The Focus on 7 newsletter article provided local Northern Ireland dissemination on the project to the R&D community.

3.1.4. Project Website

www.brain-project.org

Knowledge generated within the project will be made available to the general public through the public part of the BRAIN website.

• The first version of the project website is online since October 2008.

• The final version of the project website was published on February 2009.

SSVEP are described in (Pastor, et al. 2003)

4. Publishable results

Table 3 lists the published material in BRAIN including conference/journal papers, patents, and book chapters.

Table 3. Publishable results

Title	Conference proceedings/Journal/Book/Patent	Partner involved
Spatial filters for detecting Steady State Visual Evoked Potentials: BCI application	Neuromath Workshop Leuven 2009: Advanced Methods for the Estimation of Human Brain Activity and Connectivity	PHILIPS

5. References

Fisher, R., H. Harding, and G. Erba. "Photic - and Pattern - induced Seizures: A Review for the Epilepsy Foundation of America Working Group." *Epilepsia*, 2005: 1426-1441.

Garcia Molina, G., David Ibañez, Vojkan Mihajlovic, and Dmitri Chestakov. "Spatial filters for Detecting Steady State Visual Evoked Potentials" *Journal Biomedizinische Technik / Biomedical Engineering*, 2009: Submitted.

Pastor, Maria, Julio Artieda, Javier Arbizu, Miguel Valencia, and Jose Masdeu. "Human Cerebral Activation during Steady-State Visual-Evoked Responses." *Behavioral/Systems/Cognitive*, 2003: 11621-11627.

SSVEP are described in (Pastor, et al. 2003)