Introduction

TOBI will develop practical technology for brain-computer interaction; i.e., non-invasive BCI prototypes combined with other assistive technologies (AT) that will have a real impact in improving the quality of life of disabled people. These non-invasive BCI are based on electroencephalogram (EEG) signals. TOBI seeks to develop BCI assistive technology endowed with adaptive capabilities that augment those other AT they are combined with. In such a hybrid approach users can fuse brain interaction and muscle-based interaction or can switch between different channels naturally (based on monitoring of physiological parameters or mental states).

TOBI Forseen Applications

In TOBI we have identified 4 application areas where BCI assistive technology can effectively support people with motor disabilities, namely:
- Communication & Control,
- Motor Substitution,
- Entertainment, and
- Motor Recovery.

TOBI Overall Objectives

TOBI will deliver short-term BCI assistive prototypes for each of the application areas by the first year that will be tested and evaluated by the second year. Then, we will build upon the work done for the achievement of these short-term milestones to create more advanced technology based on novel hybrid architectures, adaptive principles, as well as EEG hardware and common implementation platforms. This final BCI assistive technology will be tested and evaluated in real life situations by a large number of end-users.

Finally, TOBI will devote substantial efforts to create awareness of TOBI results among the key players. For this we will organize a serie of annual workshops.

1st Year Prototypes

The short-term BCI prototypes include:
- a zoomable document browser and a text entry (Communication & Control),
- a FES orthosis for maintaining elbow posture (Motor Substitution),
- an assistive mobility robot (Motor Substitution),
- a photo browser (Entertainment),
- and a BCI tool endowed with rehabilitative principles (Motor Recovery).

The objective for this first year was to demonstrate these prototypes, either completely (zoomable document browser and a text entry, FES orthosis, and photo browser) or partially (assistive mobility, and rehabilitation BCI).

It is worth mentioning that, as part of the demonstration, we already ran a first set of life demos during the 6-month review. Additional ones were presented at the first year public workshop and co-located review.

Figures 1 and 2 show demonstrations of the text entry prototype, where a subject delivers mental commands to QualiWORLD AT software in order to write sentences, and of the FES neuroprosthesis, where a BCI drives the FES system to allow a subject execute grasping patterns and opening the hand.
Project Progress Y1

In the early part of the year, the objectives spun around setting up the necessary infrastructure, both technical and human, to undertake the work in TOBI as a whole and in each of its workpackages. In this respect, a critical element to undertake work with patients in order to validate our BCI tools was the early definition of user requirements, inclusion and exclusion criteria, and evaluation metrics.

From the technical standpoint, apart from developing the initial prototypes and achieving the different milestones specific to each workpackage, there were three main objectives.

The first one was defining our approach to the hybrid BCI architecture and multimodal fusion.

The second one was establishing our roadmap for a common implementation architecture (standardization). This standardization effort also comprised our approach to IPR. In this respect, our strategy - which is supported by the TOBI Advisory Board - is to leave IPR holders decide whether to disclose their source code, while keeping the overall architecture an open standard.

The third objective was setting up the common EEG system - which required developing the necessary software and additional hardware to operate the EEG system.

In summary, all the objectives put forward for the first year of TOBI have been fulfilled and the project is now facing the challenges of its second year.

Project Objectives Y2

The main objective for the second year is to test the initial BCI assistive prototypes for each of the application areas. This evaluation is being carried out in clinics and also in assistive technologies centers. The outcomes of these tests will help improve the prototypes.

Another major objective is the selection of a second industrial partner to reinforce one of the application areas. This new partner will join TOBI at the beginning of the third year and will actively participate in the development of TOBI industrial strategy to bring our results in the field of BCI technology to the market.

Finally, the third objective is the proposal to the BCI community of a common implementation architecture. This architecture is intended to serve as a reference for the standardization of BCI implementations. Importantly, this is achieved by defining the communication between the BCI and its controlled device, and between the internal modules of a BCI; thus it can be incorporated into new and existing implementations without a major redesign.

TOBI at ICT 2010 Exhibition

TOBI will give six life demos at the ICT 2010 Exhibition. In demos 1, 2 and 3 people can control with software and physical devices for communication (text entry and web browser) and motor substitution (FES neuroprosthesis and assistive telepresence robot) by using their spontaneous brain activity. Prototypes 4 and 5 exploit natural brain responses to items appearing in the computer for entertainment (photo browser and brain painting). Demo 6 is a new commercial wireless helmet made of dry electrodes that visitors can wear to visualise immediately their brain state.

Figure 2: Life demonstration of the FES neuroprosthesis prototype developed in the “Motor Substitution” application area. A first subject uses another motor imagery BCI to drive a FES system that allows a second subject execute grasping patterns and opening the hand.

Next Event:
TOBI Workshop 2
Where: Fondazione Santa Lucia Roma, Italy
When: December 2-3 2010
Duration: 2 days.
Additional info: www.tobi-project.org/TOBI-workshop-2