Severe cognitive or physical disabilities from any origin have a dramatic effect on autonomy, intimacy or dignity, and, by extension, on quality of life. A person with a severe brain injury resulting from a car collision or those suffered a brain stroke are examples of disabilities of neurologic nature. For years, the severely disabled have learned to cope with their restricted autonomy, restricting their daily activities like moving around or turning on the lights and limiting their social interaction.

The ***BrainAble project*** is about empowering them to mitigate this barriers of the everyday life to which those individuals are confronted. BrainAble has researched, designed and validated an *ICT-based HCI (Human Computer Interface) based on BNCI (Brain Neural Computer Interface) sensors combined with affective computing to control smarthome services and virtual environments.*

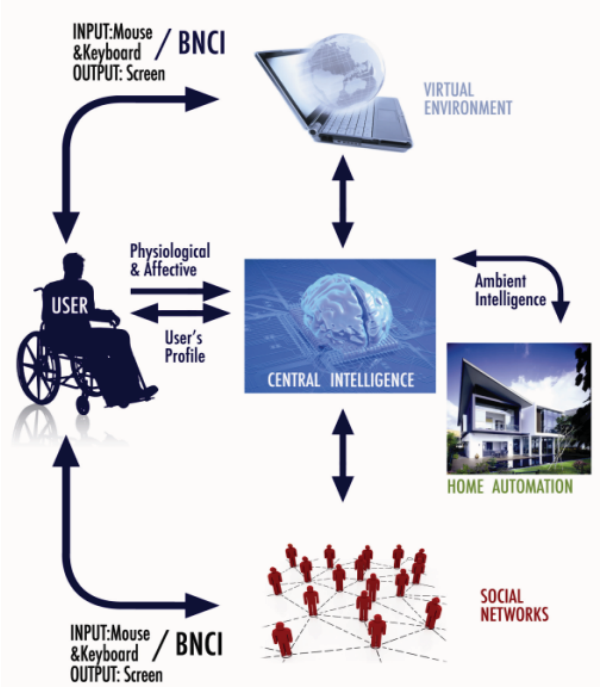
This combination is expected to *improve their quality of life of the severe disabled by overcoming the two main shortcomings they suffer* (1) at home by providing inner functional independence for daily life activities and autonomy withaccessible and interoperable smarthome services; and (2) enabling the participation in social activities with adapted social networks services.

BrainAble improves both direct and indirect interaction between the user and ICT services. Interaction is upgraded by creating tools that allow controlling inner and outer environments using a "hybrid" Brain Computer Interface (BNCI) system, combining diferent BCI techniques and BCIs with other inputs such as EOG or EMG signals. BrainAble also proposes a novel BCI training paradigm with the auto-calibration Adaptive ERD BCI paradigm, which allows for a very quick and highly effective setup of an ERD based BCI requiring only a minimal amount of sensors and no expert knowledge. Finally, BrainAble's BNCI also takes into account other input coming from the physiological and affective sensors increasing the BNCI performance to measure levels of alertness and fatigue, and detect and handle spasms.

BNCI first-time users are often confused and overwhelmed. While this BNCI familiarization takes place, BrainAble proposes an intelligent Virtual Reality-based user interface with avatars and scenarios that will help the disabled move around freely, and interact with any sort of devices as their first contact with BNCI. VR also enables the users to play serious games to counteract cognitive decline, and get trained in new functionalities and tasks.

To enhance the BNCI performance of the users, BrainAble incorporates machine learning techniques, Ambient Intelligence (AmI), so that the system provides an adapted assistance to the user. The role of AmI is mainly to carry out the interaction with the real environment by performing the user's commands (e.g., to turn on a light) in an intelligent manner. For this purpose, AmI counts on the Context-Awareness feature which is able to recognise the specific happening taking place.

The three-year project reached its termination in 2012. During this period, BrainAble has completed three cycles of prototype testing aligning the project with the User-centre design. Pilot testing sessions were participated by 8 disabled people and 10 non-disabled people in two separated locations in Spain and UK. By applying UCD, that is, working with end-user's organisations throughout the whole project life cycle, BrainAble has gained valuable insights into the processes by which emergent technologies are introduced, together with the drivers and barriers to uptake and adoption of the system.



Main scientific achievements accomplished are the development of a novel interface of BNCI, the Hex-O-Spell; the auto-calibration Adaptive ERD paradigm to facilitate the BNCI training presented in international congresses; Ambient Intelligent techniques such as the Context-dependent UI for BCI interfaces; and incorporation of the URC/UCH that facilitates the integration of new services or devices.

As an outcome, BrainAble has produced a pre-commercial product and a set of technologies intended to assist people with severe physical disabilities. The technology has the potential to assist those with special needs such as individuals living with Brain Damage or ALS. The modular architecture and middleware utilized by BrainAble to connect user-centered bio-interfaces and interactive immersive environments to networks of devices and people, provide attractive assets for the markets of intelligent and assistive *Smart Homes* and adaptive *Assistive Technologies*.

Project title: **Autonomy and social inclusion through mixed reality Brain-Computer Interfaces: Connecting the disabled to their physical and social world**
Project coordinator: Fundació Privada Barcelona Digital Centre Tecnològic
Scientific coordinator: **Felip Miralles** (**fmiralles@bdigital.org** or **PMO@BrainAble.org)** Tel: +34 93 553 45 40 41
For more information, please visit us at ***http://www.BrainAble.org***