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Abstract (for dissemination)	This document reports the project-wide dissemination undertaken by the project partners.
Keywords	Dissemination actions

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1 Introduction

BrainAble project's main objective is to help to improve the quality of life of people with disabilities by overcoming the two main shortcomings they suffer - exclusion from home and social activities. This will be achieved using an ICT-based human computer interface (HCI) composed of BNCI sensors combined with affective computing and virtual environments, developed in the duration of BrainAble.

In order to achieve project-wide success, BrainAble project dissemination activities must enable the efficient transfer of ICT technologies developed in the project and subsequently generated knowledge to researchers and therapists, among others, within and outside of the BrainAble network. However, the successful adoption of these technologies will not only strongly depend on the intrinsic quality of the tools developed and knowledge generated, it will also depend on the accessibility of these tools and knowledge to the group of potential users. Therefore, from the early stages of the project, we target specific for end user groups for promoting project activities through our dissemination strategy.

The BrainAble consortium includes partners with significant expertise in effective dissemination of scientific information to both IT and users communities. The project dissemination activities are taking advantage of this expertise in order to ensure the effective dissemination of scientific results from all areas of the project.

Dissemination activities in the first reporting period (reported in D7.1 by January 2011) included the release of the project web site and corporate materials in addition to a large number of overview and specialised researched-based presentations and publications. During 2011, we aimed to deeper extend the project-wide dissemination by presenting full-functional components but also the BrainAble project itself as a stand-alone solution.

This deliverable is aimed **to report on the information disseminated through activities** of individual partners, or groups of partners, focusing on specific technical developments **carried out within the second year of the project** (January to December 2011).

2 Dissemination support material

2.1 Project video

To provide a better and simpler understanding of the project's goals, expected results and undergoing activities, a simple, yet complete, description of BrainAble's Year 1 Prototype was made in a form of a short video. This media material was shown for the first time at the occasion of the project Review in Brussels to the attention of the Project Officer and the reviewers.

The video, available for viewing on YouTube and embedded in the project's website since March of 2011, is nine minutes long, with English audio and subtitles.

YouTube provides a view counter for videos. In the 28th of December of 2011, the video already **had reached more than 1.525 views**, what corresponds to more than 150 views per month, since its publication.

Video link: <http://www.youtube.com/watch?v=dLIYmgvuWnU>.

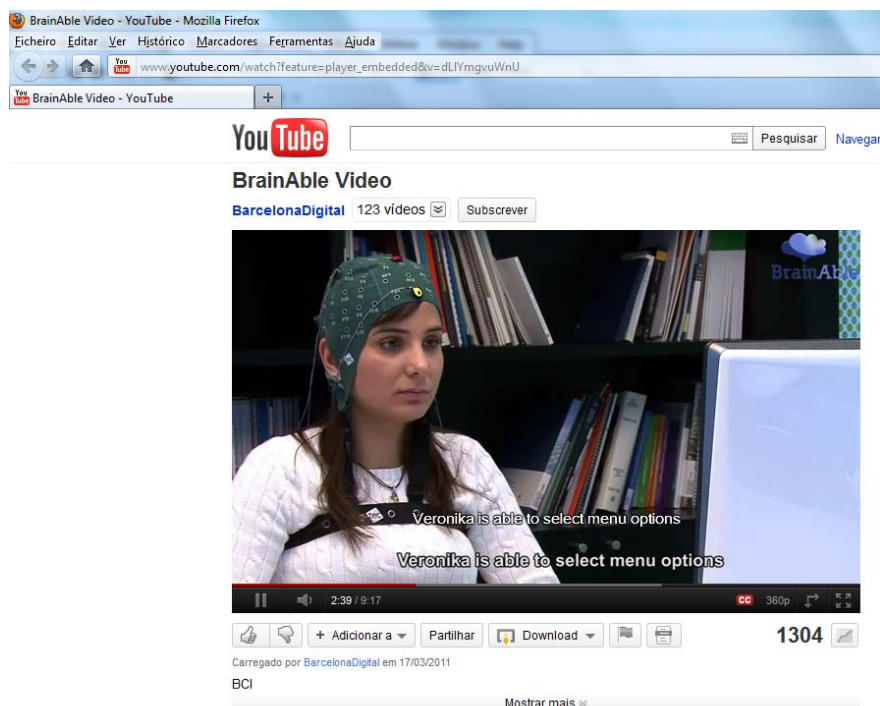


Figure 1: BrainAble's YouTube video snapshot

CDs were recorded with the video so that, in project presentations, the project partners can distribute them if suitable.



Figure 2: BrainAble's video CDs

2.2 Web page

A website is one of the best dissemination channels available. The project website was set up in February 2010, as reported in deliverable D7.1 Dissemination Report Year 1, and has been continuously updated with latest news, dissemination activities, events, and other relevant information. For instance, the Home page was updated with accurate information on developments issued during the first year of the project implementation as well as the information regarding the beneficiaries of the project.

Website statistics are being retrieved since May 2011. These statistics show, until 20th of December of 2011, that www.BrainAble.org has achieved almost **2.970 visits**, around 360 visits per month, since the service subscription.



Figure 3: BrainAble's webpage snapshot

These statistics also show that the website has been visited from people from 92 different countries. A list with the top 10 countries with most visits to the BrainAble's website is available:

- Spain, with 814 visits; United States, with 330 visits; United Kingdom, with 290 visits; Austria, with 157 visits; Portugal, with 155 visits; Germany, with 97 visits; India, with 83 visits; Turkey, with 81 visits; Belgium, with 66 visits; Italy, with 66 visits, etc.

One other important data collected from the statistics is the source of the traffic. The biggest share comes from search engines (41%), traffic from referring sites has 32% and direct traffic has 27% of the total traffic.

3 Second year dissemination actions

3.1 Past activities – Overview table

Project participations in major events are also outlined in the website.



Figure 4: BrainAble's webpage News section snapshot

The following table summarizes the events where the BrainAble project was present.

A complete list of associated publications and presentations is included in the sections that follow this table.

Date	Title / Type	Audience	Countries Addressed	Partners Involved
03/2011	Automatic Face & Gesture Recognition and Workshops (FG 2011), FG 2011 : IEEE International Conference on Automatic Face & Gesture Recognition (California, USA) http://www.fg2011.org	Neuroscientists Community	World	UPF
03/2011	Mada Qatar Assistive Technology Center Seminar (Doha, QATAR)	End users organizations, Assistive Tech	World	BDCT
04/2011	5th International IEEE EMBS Conference on Neural Engineering (Cancun, MEXICO) http://ne2011.embs.org/	Neuroscientists Community	World	TU-GRAZ
05/2011	8th BCI2000 Workshop (Utrecht, THE NETHERLANDS) http://www.bci2011.eu/	BCI Community	Europe	BDCT, G.TEC
06/2011	IWANN-2011, International Work Conference on Artificial Neural Networks (Torremolinos, SPAIN) http://iwann.ugr.es/2011/iwann11.php	Machine Learning	Europe	TU-GRAZ
06/2011	IWAAL 2011, International workshop on Ambient Assisted Living (Málaga, SPAIN) http://mami.uclm.es/iwaal2011/	AAL Community	Europe	BDCT, TU-GRAZ
06/2011	UPF Industry Day (Barcelona, SPAIN) http://www.upf.edu/industryday/en/	Academic, SMEs	Spain	BDCT, UPF
06/2011	Future BNCI Workshop (Barcelona, SPAIN) http://future-bnci.org	BCI Community	Europe	BDCT, TU-GRAZ, G.TEC

06/2011	amb-11 Workshop (Brussels, BELGIUM) http://aaloa.org/workshops/amb11	AAL Community	World	METI
07/2011	22nd IJCAI, International Joint Conference on Artificial Intelligence (Barcelona, SPAIN) http://ijcai-11.iiia.csic.es/	Artificial Intelligence Community	Spain	TU-GRAZ
09/2011	5th International Brain-Computer Interface Conference (Graz, AUSTRIA) http://bci.tugraz.at/BCI2011/	BCI Community	Europe	BDCT, TU-GRAZ, G.TEC
09/2011	AAL Forum (Lecce, ITALY) http://www.aalforum.eu/page/welcome-to-lecce	End users organizations, Assistive Tech	Europe	BDCT
10/2011	III International Meeting of Technology for persons with Disabilities (São Paulo, BRAZIL) http://www.unaeventos.com.br/encontro/2011/en/index.php	End users organizations, Assistive Tech	World	BDCT
11/2011	Neuroscience 2011 (Washington, USA) http://www.sfn.org/am2011/	Neuroscientists Community	USA	TU-GRAZ
12/2011	Innovation Convention 2011 (Brussels, BELGIUM) http://ec.europa.eu/research/innovation-union/ic2011/index_en.cfm	General	Europe	BDCT, G.TEC

In addition to the listed events, the BrainAble consortium gave more than 30 project presentations, by talks, presentation slides or leaflets, announcing the project to various groups and entities, such as: FH Linz (Austria), Brain-Science Institute Riken (Japan), LifeTool (Austria), Salutis (Spain), Star Healthcare Management (Germany), Visabeira Digital (Portugal), WindRiver (Germany), among others.

3.2 Published Results

Author	C. Guger, G. Edlinger
Title	The First Commercial Brain-Computer Interface Environment
Format	Book Chapter
Book	Brain-Computer Interfaces, 1st Edition, pp. 281 – 305. Editors: Graimann, B. Allison, G. Pfurtscheller Publisher: Springer
Date	February 2011

Author	C. Guger, G. Bin, X. Gao, J. Guo, B. Hong, T. Liu, S. Gao, C. Guan, K. Keng Ang, K. Soon Phua, C. Wang, Z. Yang Chin, H. Zhang, R. Lin, K. Sui Geok Chua, C. Kuah, B. Ti Ang, H. George, A. Kübler, S. Halder, A. Höfle, J. Münßinger, M. Palatucci, D. Pomerleau, G. Hinton, T. Mitchell, D. B. Ryan, E. W. Sellers, G. Townsend, S. M. Chase, A. S. Whitford, A.B. Schwartz, K. Kawashima, K. Shindo, J. Ushiba, M. Liu, G. Schalk
Title	State-of-the-Art in BCI Research: BCI Award 2010.
Format	Book Chapter
Book	" Recent Advances in Brain-Computer Interface Systems ". pp. 193 – 222. ISBN 978-953-307-175-6. Edited by: Reza Fazel. Publisher: InTech
Date	February 2011

Author	C. Guger, G. Edlinger, G. Krausz
Title	Hardware/Software Components and Applications of BCIs
Format	Book Chapter
Book	" Recent Advances in Brain-Computer Interface Systems ". pp. 1 – 24. ISBN 978-953-307-175-6. Edited by: Reza Fazel. Publisher: InTech
Date	February 2011

Author	Inderbitzin, M., Väljamäe A., Calvo J. M. B., Verschure P. F. M. J., & Bernardet U.
Title	Expression of Emotional States during Locomotion based on Canonical Parameters
Format	Conference paper
Abstract	Humans have the ability to use a complex code of non-verbal behavior to communicate their internal states to others. Conversely, the understanding of intentions and emotions of others is a fundamental aspect of human social interaction. In the study presented here we investigate how people perceive the expression of emotional states based on the observation of different styles of locomotion. Our goal is to find a small set of canonical parameters that allow to control a wide range of emotional expressions. We generated different classes of walking behaviour by varying the head/torso inclination, the walking speed, and the viewing angle of an animation of a virtual character. 18 subjects rated the observed walking person using the two-dimensional circumplex model of arousal and valence. The results show that, independent of the viewing angle, participants perceived distinct states of arousal and valence. Moreover, we could show that parametrized body posture codes emotional states, irrespective of the contextual influence or facial expressions. These findings suggest that human locomotion transmits basic emotional cues that can be directly related to canonical parameters of a different dimension of the expressive behaviour. These findings are important as they allow us to build virtual characters whose emotional expression is recognizable at large distance and during extended periods of time.
Event / Publication	1st International Workshop on Emotion Synthesis, rePresentation, and Analysis in Continuous space (EmoSPACE) in conjunction with the 9th IEEE FG 2011 (Automatic Face & Gesture Recognition Conference), Santa Barbara, USA, http://emotion-research.net/sigs/speech-sig/emospace
Date	March 21-25, 2011

Author	Chung M, Cheung W, Scherer R and Rao R P.N.
Title	Towards Hierarchical BCIs for Robotic Control.
Format	Conference paper
Abstract	There has been growing interest in brain- computer interfaces (BCIs) for controlling robotic devices and prosthetics directly using brain signals. Non-invasive BCIs, such as those based on electroencephalographic (EEG) signals, suffer from low signal-to-noise ratio, limiting the bandwidth of control. Invasive BCIs, on the other hand, allow fine-grained control but can leave users exhausted over long periods of time because of the amount of attention required for control on a moment-by- moment basis. In this paper, we address these problems using a new adaptive and hierarchical approach to brain-computer interfacing. The approach allows a user to teach the BCI system new skills on-the-fly; these learned skills are later invoked directly as high-level commands, relieving the user of tedious lower-level control. We demonstrate the approach using a hierarchical EEG-based BCI for controlling a humanoid robot. In a study involving four human subjects controlling the robot in a simulated home environment, each subject successfully used the BCI to teach the robot a new navigational task. They later were able to execute the same task by selecting the newly learned command from the BCI's adaptive menu, avoiding the need for low-level control. A comparison of the performance of the system under low-level and hierarchical control revealed that hierarchical control is both faster and more accurate. Our results suggest that hierarchical BCIs can provide a flexible and robust way of controlling complex robotic devices, satisfying the dual goals of decreasing the cognitive load on the user while maintaining the ability to adapt to the user's needs.
Event / Publication	5th International IEEE EMBS Conference on Neural Engineering, Cancun, Mexico, http://ne2011.embs.org/
Date	April 27 - May 1, 2011

Author	Navarro A A, Ceccaroni L, Velickovski F, Torrellas S, Miralles F, Allison B Z, Scherer R and Faller J
Title	Context-Awareness as an Enhancement of Brain-Computer Interfaces
Format	Workshop paper
Abstract	<p>Ambient intelligence has acquired a relevant presence in assistive technologies. Context-awareness, the ability to perceive situations and to act providing suitable responses, plays a key role in such presence. BrainAble, an ongoing European project, aims at raising the autonomy of people with functional diversity, facilitating and enhancing the interaction with their environment. Brain-computer interfaces are applied as communication means to allow users to perform actions by using their electroencephalogram signals. Multiple approaches are studied and combined in order to provide the best set of brain signals which specifies a concrete event or action. In this setting, we propose the application of context-awareness to extend the traditional proactive and pervasive nature of ambient intelligence in a way which enhances the brain-computer interface. One practical example is the dynamic personalization of available options in the user interface, based on user's current context.</p>
Event / Publication	III International Workshop on Ambient Assisted Living (IWAAL 2011), Malaga, Spain, http://mami.uclm.es/iwaal2011/
Date	8-10th June 2011

Author	Scherer R, Friedrich E C.V., Allison B, Pröll M, Chung M, Cheung W, Rao R P.N. and Neuper C
Title	Non-invasive brain-computer interfaces: Enhanced gaming and robotic control
Format	Conference paper
Abstract	<p>The performance of non-invasive electroencephalogram-based (EEG) brain-computer interfacing (BCI) has improved significantly in recent years. However, remaining challenges include the non-stationary and the low signal-to-noise ratio (SNR) of the EEG, which limit the bandwidth and hence the available applications. In this paper, we review ongoing research in our labs and introduce novel concepts and applications. First, we present an enhancement of the 3-class self-paced Graz-BCI that allows interaction with the massive multiplayer online role playing game World of Warcraft. Second, we report on the long-term stability and robustness of detection of oscillatory components modulated by distinct mental tasks. Third, we describe a scalable, adaptive learning framework, which allows users to teach the BCI new skills on-the-fly. Using this hierarchical BCI, we successfully train and control a humanoid robot in a virtual home environment.</p>
Event / Publication	International Work Conference on Artificial Neural Networks (IWANN 2011), Torremolinos, Spain, http://iwann.ugr.es/2011/iwann11
Expected Date	8-10th June 2011

Author	Jin, J., Allison, B.Z., Sellers, E.W., Brunner, C., Horki, P., Wang, X. and Neuper, C.
Title	An adaptive P300 based control system.
Format	Journal Paper
Abstract	An adaptive P300 brain-computer interface (BCI) using a 12 × 7 matrix explored new paradigms to improve bit rate and accuracy. During online use, the system adaptively selects the number of flashes to average. Five different flash patterns were tested. The 19-flash paradigm represents the typical row/column presentation (i.e. 12 columns and 7 rows). The 9- and 14-flash A and B paradigms present all items of the 12 × 7 matrix three times using either 9 or 14 flashes (instead of 19), decreasing the amount of time to present stimuli. Compared to 9-flash A, 9-flash B decreased the likelihood that neighboring items would flash when the target was not flashing, thereby reducing the interference from items adjacent to targets. 14-flash A also reduced the adjacent item interference and 14-flash B additionally eliminated successive (double) flashes of the same item. Results showed that the accuracy and bit rate of the adaptive system were higher than those of the non-adaptive system. In addition, 9- and 14-flash B produced significantly higher performance than their respective A conditions. The results also show the trend that the 14-flash B paradigm was better than the 19-flash pattern for naive users.
Event Publication /	Journal of Neural Engineering, 8; 8(3):036006.
Date	June 2011

Author	Chung M, Cheung W, Scherer R and Rao R P.N.
Title	A Hierarchical Architecture for Adaptive Brain-Computer Interfacing
Format	Conference paper
Abstract	Brain-computer interfaces (BCIs) allow a user to directly control devices such as cursors and robots using brain signals. Non-invasive BCIs, e.g., those based on electroencephalographic (EEG) signals recorded from the scalp, suffer from low signal-to-noise ratio which limits the bandwidth of control. Invasive BCIs allow fine-grained control but can leave users exhausted since control is typically exerted on a moment-by-moment basis. In this paper, we address these problems by proposing a new adaptive hierarchical architecture for brain-computer interfacing. The approach allows a user to teach the BCI new skills on-the-fly; these learned skills are later invoked directly as high-level commands, relieving the user of tedious low-level control. We report results from four subjects who used a hierarchical EEG-based BCI to successfully train and control a humanoid robot in a virtual home environment. Gaussian processes were used for learning high-level commands, allowing a BCI to switch between autonomous and user-guided modes based on the current estimate of uncertainty. We also report the first instance of multi-tasking in a BCI, involving simultaneous control of two different devices by a single user. Our results suggest that hierarchical BCIs can provide a flexible and robust way of controlling complex robotic devices in real-world environments.
Event Publication /	22nd Joint Conference on Artificial Intelligence, Barcelona, Spain http://ijcai-11.iia.csic.es/
Date	July 16-22, 2011

Author	Allison, B.Z., Brunner, C., Altstätter, C., Wagner, I., Grissmann, S., and Neuper, C
Title	Predicting performance in a hybrid SSVEP/ERD BCI for continuous simultaneous cursor control
Format	Conference paper
Event / Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Date	22-25 September, 2011

Author	Jin, J., Allison, B.Z., Wang, X., and Neuper, C
Title	A hybrid brain-computer interface based on P300 and M-VEP
Format	Conference paper
Event / Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Date	22-25 September, 2011

Author	D. Balderas, T. Zander, F. Bachl, J. Faller, C. Neuper, and R. Scherer
Title	Restricted Boltzmann Machines as useful tool for detecting oscillatory EEG components
Format	Conference paper
Abstract	Brain Computer Interfaces(BCIs) are in need of different classification techniques, capable of having feature extraction and pattern classification. In this work we introduce Restricted Boltzmann Machines(RBMs) as a generative classification technique for BCI. It is demonstrated that RBMs are capable of inducing a powerful internal representation of spatio- temporal EEG patterns. Our results show that the emerging joint distribution of features and class labels yields expressive conditional distributions in both directions. We report initial results of the capabilities of RBMs used as classifiers.
Event / Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Expected Date	22-25 September, 2011

Author	M. Chung, M. Bryan, W. Cheung, R. Scherer and R.P.N. Rao
Title	Interactive Hierarchical Brain-Computer Interfacing: Uncertainty-Based Interaction between Humans and Robots
Format	Conference paper
Abstract	<p>Current non-invasive brain-computer interfaces such as those based on electroencephalography (EEG) suffer from the problem of low signal-to-noise ratio, making fine-grained moment-by-moment control tedious and exhausting for users. To address this problem, we have previously proposed an adaptive hierarchical approach to brain-computer interfacing: users teach the BCI system new skills on-the-fly and these skills are later invoked directly as high-level commands, relieving the user of tedious lower-level control. However, the high-level commands learned from user demonstrations are often not reliable due to incomplete or insufficient data. In this paper, we address the unreliability of such learned high-level commands by proposing an interactive hierarchical BCI. The proposed approach utilizes an uncertainty metric in the learning algorithm to determine whether the learned high-level command is reliable enough to be performed in the present context. The BCI system interacts with the user to make the best decision at each stage. We illustrate the approach using an interactive hierarchical BCI for controlling a simulated wheeled robot. In a study involving two human subjects controlling the robot in a simulated home environment, each subject successfully used the system to complete a sequence of five different navigational tasks. Our results suggest that interactive hierarchical BCIs can provide a scalable and robust way of controlling complex robotic devices in real-world environments.</p>
Event Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Date	22-25 September, 2011

Author	T. O. Zander, D. M. Klippel, R. Scherer
Title	Introducing the Detection of Auditory Error Responses Based on BCI Technology for Passive Interaction
Format	Conference paper
Abstract	<p>In this article we will introduce a passive BCI system for detecting responses of the human brain on the perception of errors in music. We played cadences, sequences of chords, to subjects who are experts in music theory and actively play an classical instrument. As the expectancy is highest at the ending chord, we randomly introduced cadences with erroneous ending. In consistence with previous studies from the neurosciences we evoked an event- related potential, mainly consisting of an early right anterior negativity reflecting syntactic error processing followed by a stronger negativity in erroneous trials at 500ms, induced by semantic processing. We could identify single trials of these processes with a standardized, cross validated offline classification scheme, resulting in an accuracy of 75.7 %.</p>
Event Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Date	22-25 September, 2011

Author	E. V. C. Friedrich, R. Scherer, J. Faller, C. Neuper
Title	Do user-related factors of motor impaired and able-bodied participants correlate with classification accuracy?
Format	Conference paper
Abstract	<p>This study investigated (1) if able-bodied and motor impaired participants differ in the evaluation of BCI tasks with respect to the quality of imagery, ease and enjoyment and (2) if prior experience and task evaluation correlate with classification accuracy. This article includes data from three studies that included word association, mental subtraction, spatial navigation and motor imagery as control strategies for a mental-imagery based brain-computer interface (BCI).</p> <p>Task evaluation and prior experience were surveyed with self-reports.</p> <p>Classification was based on common spatial patterns and Fisher's linear discriminant functions. The results showed that motor impaired participants enjoyed performing the mental tasks generally less than able-bodied participants. Task evaluation and classification accuracy was especially low in the motor imagery task for the motor impaired users in contrast to the able-bodied participants. Although prior experience and task evaluation showed some correlations with classification accuracy, it was not possible to explain the classification results with these two factors. To conclude, motor imagery tasks might not be the best choice for motor impaired users for BCI control and therefore, more efforts should be made to find user-appropriate tasks for individuals with motor disabilities.</p>
Event / Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Date	22-25 September, 2011

Author	V. Putz, C. Guger, C. Holzner, S. Torrellas, F. Miralles
Title	A Unified XML based Description of the Contents of Brain Computer Interfaces
Format	Proceedings paper
Abstract	<p>In the past decades, a variety of applications and devices were interfaced with EEG based Brain Computer Interfaces (BCIs) with the aim to offer assistive technology to severely handicapped users. Nevertheless, up to now no standardized description of the possible interaction options (i.e. the tasks a user can perform with the aid of the BCI) was available. Each function provided by an application or device connected to the BCI had to be hard-coded. In this contribution, we propose a new platform-independent XML based description of the interaction options. The scheme is interpreted by a middleware layer which connects applications and devices to the BCI. In its current version, scheme and middleware layer are designed for a BCI which provides graphical feedback to the user.</p>
Event / Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Date	22-25 September, 2011

Author	R. Ortner, R. Prückl, V. Putz, J. Scharinger, M. Bruckner, A. Schnürer, C. Guger
Title	Accuracy of a P300 Speller for different conditions: A comparison
Format	Proceedings paper
Abstract	<p>When using a Brain-Computer Interface (BCI) as a spelling device, the P300-based BCI is mostly common, because of its high speed and accuracy, compared to other BCI paradigms. During the last years many studies have been performed to optimize the single spelling parameters, the stimulation frequency and stimulation intensity. Also different options for the electrode position and classification algorithm were analyzed intensively. But most of these studies were tested on healthy, young participants, subjects who may achieve better results than the people BCIs are mainly thought for: people with motor impairments. The tests were performed in a quiet laboratory environment where all possible outer distractions were altered out. The aim of this publication is to take the results of a previous study, performed on healthy people within a laboratory (Group A) and to compare them to measurements on two other groups. Group B were healthy people that tested the device in a noisy environment, group C in contrast consisted of people with motor impairments. The conclusions deliver valuable results towards bringing BCIs to the end-user.</p>
Event / Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Date	22-25 September, 2011

Author	R. Ortner, F. Aloise, R. Prueckl, F. Schettini, V. Putz, J. Scharinger, E. Opisso, U. Costa, C. Guger
Title	Accuracy of a P300 Speller for People with Motor Impairments: A Comparison.
Format	Journal paper
Abstract	<p>A Brain-Computer Interface (BCI) provides a completely new output pathway that can provide an additional option for a person to express himself/herself if he/she suffers a disorder like amyotrophic lateral sclerosis (ALS), brainstem stroke, brain or spinal cord injury or other diseases which impair the function of the common output pathways which are responsible for the control of muscles. For a P300 based BCI a matrix of randomly flashing characters is presented to the participant. To spell a character the person has to attend to it and to count how many times the character flashes. Although most BCIs are designed to help people with disabilities, they are mainly tested on healthy, young subjects who may achieve better results than people with impairments. In this study we compare measurements, performed on people suffering motor impairments, such as stroke or ALS, to measurements performed on healthy people. The overall accuracy of the persons with motor impairments reached 70.1% in comparison to 91% obtained for the group of healthy subjects. When looking at single subjects, one interesting example shows that under certain circumstances, when it is difficult for a patient to concentrate on one character for a longer period of time, the accuracy is higher when fewer flashes (i.e., stimuli) are presented. Furthermore, the influence of several tuning parameters is discussed as it shows that for some participants adaptations for achieving valuable spelling results are required. Finally, exclusion criteria for people who are not able to use the device are defined.</p>
Journal	In the official Journal of the EEG and Clinical Neuroscience Society (ECNS), Vol. 42 No. 4, p. 214 ff.

3.3 Presentations

Author	Not specified (BDigital)
Title	BrainAble project
Format	Poster
Event / Publication	8th BCI2000 Workshop, Utrecht, The Netherlands http://www.fmri.nl/bci2011/
Expected Date	18-19 May, 2011

Author	Felip M. (BDigital)
Title	Lessons learned in BrainAble: barriers for the real implementation of BCI, context awareness as a facilitator, and perspectives of bringing BCI back home for active independent living
Format	Talk/slides
Event / Publication	Future BNCI Workshop Barcelona, Barcelona, Spain
Date	15 June, 2011

Author	D. Balderas, T. Zander, F. Bachl, J. Faller, C. Neuper, and R. Scherer
Title	Restricted Boltzmann Machines as useful tool for detecting oscillatory EEG components
Format	Poster
Abstract	Brain Computer Interfaces (BCIs) are in need of different classification techniques, capable of having feature extraction and pattern classification. In this work we introduce Restricted Boltzmann Machines (RBMs) as a generative classification technique for BCI. It is demonstrated that RBMs are capable of inducing a powerful internal representation of spatio-temporal EEG patterns. Our results show that the emerging joint distribution of features and class labels yields expressive conditional distributions in both directions. We report initial results of the capabilities of RBMs used as classifiers.
Event / Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Date	22-25 September, 2011

Author	M. Chung, M. Bryan, W. Cheung, R. Scherer and R.P.N. Rao
Title	Interactive Hierarchical Brain-Computer Interfacing: Uncertainty-Based Interaction between Humans and Robots
Format	Poster
Abstract	<p>Current non-invasive brain-computer interfaces such as those based on electroencephalography (EEG) suffer from the problem of low signal-to-noise ratio, making fine-grained moment-by-moment control tedious and exhausting for users. To address this problem, we have previously proposed an adaptive hierarchical approach to brain-computer interfacing: users teach the BCI system new skills on-the-fly and these skills are later invoked directly as high-level commands, relieving the user of tedious lower-level control. However, the high-level commands learned from user demonstrations are often not reliable due to incomplete or insufficient data. In this paper, we address the unreliability of such learned high-level commands by proposing an interactive hierarchical BCI. The proposed approach utilizes an uncertainty metric in the learning algorithm to determine whether the learned high-level command is reliable enough to be performed in the present context. The BCI system interacts with the user to make the best decision at each stage. We illustrate the approach using an interactive hierarchical BCI for controlling a simulated wheeled robot. In a study involving two human subjects controlling the robot in a simulated home environment, each subject successfully used the system to complete a sequence of five different navigational tasks. Our results suggest that interactive hierarchical BCIs can provide a scalable and robust way of controlling complex robotic devices in real-world environments.</p>
Event / Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Expected Date	22-25 September, 2011

Author	T. O. Zander, D. M. Klippel, R. Scherer
Title	Introducing the Detection of Auditory Error Responses Based on BCI Technology for Passive Interaction
Format	Poster
Abstract	<p>In this article we will introduce a passive BCI system for detecting responses of the human brain on the perception of errors in music. We played cadences, sequences of chords, to subjects who are experts in music theory and actively play an classical instrument. As the expectancy is highest at the ending chord, we randomly introduced cadences with erroneous ending. In consistence with previous studies from the neurosciences we evoked an event- related potential, mainly consisting of an early right anterior negativity reflecting syntactic error processing followed by a stronger negativity in erroneous trials at 500ms, induced by semantic processing. We could identify single trials of these processes with a standardized, crossvalidated offline classification scheme, resulting in an accuracy of 75.7 %.</p>
Event / Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Date	22-25 September, 2011

Author	E. V. C. Friedrich, R. Scherer, J. Faller, C. Neuper
Title	Do user-related factors of motor impaired and able-bodied participants correlate with classification accuracy?
Format	Poster
Abstract	<p>This study investigated (1) if able-bodied and motor impaired participants differ in the evaluation of BCI tasks with respect to the quality of imagery, ease and enjoyment and (2) if prior experience and task evaluation correlate with classification accuracy. This article includes data from three studies that included word association, mental subtraction, spatial navigation and motor imagery as control strategies for a mental-imagery based brain-computer interface (BCI).</p> <p>Task evaluation and prior experience were surveyed with self-reports.</p> <p>Classification was based on common spatial patterns and Fisher's linear discriminant functions. The results showed that motor impaired participants enjoyed performing the mental tasks generally less than able-bodied participants. Task evaluation and classification accuracy was especially low in the motor imagery task for the motor impaired users in contrast to the able-bodied participants. Although prior experience and task evaluation showed some cor-relations with classification accuracy, it was not possible to explain the classification results with these two factors. To conclude, motor imagery tasks might not be the best choice for motor impaired users for BCI control and therefore, more efforts should be made to find user-appropriate tasks for individuals with motor disabilities.</p>
Event / Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Date	22-25 September, 2011

Author	V. Putz, C. Guger, C. Holzner, S. Torrellas, F. Miralles
Title	A Unified XML based Description of the Contents of Brain Computer Interfaces
Format	Poster
Abstract	<p>In the past decades, a variety of applications and devices were interfaced with EEG based Brain Computer Interfaces (BCIs) with the aim to offer assistive technology to severely handicapped users. Nevertheless, up to now no standardized description of the possible interaction options (i.e. the tasks a user can perform with the aid of the BCI) was available. Each function provided by an application or device connected to the BCI had to be hard-coded. In this contribution, we propose a new platform-independent XML based description of the interaction options. The scheme is interpreted by a middleware layer which connects applications and devices to the BCI. In its current version, scheme and middleware layer are designed for a BCI which provides graphical feedback to the user.</p>
Event / Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Date	22-25 September, 2011

Author	R. Ortner, R. Prückl, V. Putz, J. Scharinger, M. Bruckner, A. Schnürer, C. Guger
Title	Accuracy of a P300 Speller for different conditions: A comparison
Format	Talk
Abstract	<p>When using a Brain-Computer Interface (BCI) as a spelling device, the P300-based BCI is mostly common, because of its high speed and accuracy, compared to other BCI paradigms. During the last years many studies have been performed to optimize the single spelling parameters, the stimulation frequency and stimulation intensity. Also different options for the electrode position and classification algorithm were analyzed intensively. But most of these studies were tested on healthy, young participants, subjects who may achieve better results than the people BCIs are mainly thought for: people with motor impairments. The tests were performed in a quiet laboratory environment where all possible outer distractions were altered out. The aim of this publication is to take the results of a previous study, performed on healthy people within a laboratory (Group A) and to compare them to measurements on two other groups. Group B were healthy people that tested the device in a noisy environment, group C in contrast consisted of people with motor impairments. The conclusions deliver valuable results towards bringing BCIs to the end-user.</p>
Event / Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Date	22-25 September, 2011

Author	Allison, B.Z., Brunner, C., Altstätter, C., Wagner, I., Grissmann, S., and Neuper, C
Title	Predicting performance in a hybrid SSVEP/ERD BCI for continuous simultaneous cursor control
Format	Talk
Event / Publication	5th International Brain-Computer Interface Conference 2011, Graz, Austria http://bci.tugraz.at/BCI2011/
Date	22-25 September, 2011

Author	Allison, B.Z., Brunner, C., Grissmann, S., Altstätter, C., Wagner, I., and Neuper, C.
Title	A Hybrid ERD/SSVEP BCI for Continuous Simultaneous Two Dimensional Cursor Control.
Format	Poster
Abstract	<p>We introduce a new type of BCI for continuous simultaneous cursor control. Users tried to control the vertical position of a virtual ball via ERD activity associated with imagined movement while simultaneously controlling horizontal position with SSVEP activity resulting from visual attention. 25 subjects participated in an offline screening session. Ten of these subjects returned for six online control sessions based on these offline data, though later results showed that this screening procedure did not effectively predict performance. The online sessions assessed subjective measures via questionnaires as well as normative objective measures. Subjects generally reported that this task combination was not especially difficult or annoying. Two subjects attained very good performance, while the remaining subjects did not. Training did not affect subjective or objective measures. Overall, results show that this new hybrid approach is viable for some users, and that substantial further research is needed to identify and optimize the best BCIs for each user.</p>
Event / Publication	Neuroscience 2011, Washington, USA http://www.sfn.org/am2011/
Date	15 November, 2011

Author	V. Putz (G.TEC), S. Torrellas (BDigital)
Title	BrainAble: Autonomy and social inclusion through communication without movement
Format	Presentation
Abstract	<p>Visitors of our stand will be able to test the current prototype and experience features such as navigation through the virtual representation of a home, interaction and control of smart home devices as well as the use of social networks and communication tools.</p>
Event / Publication	Innovation Convention 2011, Brussels, Belgium http://ec.europa.eu/research/innovation-union/ic2011/
Date	5-6 December, 2011

3.4 Special events

The **Innovation Convention exhibition** organised by the EC in Brussels (5-6 December 2011) showcased exciting research and innovation results being developed under European funding programmes.

Following a call for exhibitors opened to projects supported by the EU's Framework Programme for Research and the EU's Competitiveness and Innovation Framework Programme around, BrainAble project was selected to form part of the Convention Exhibition, among 450 applications.

Located in stand number 10 of the Research and Innovation area of the exhibition, our demonstration introduced visitors to the usage of the current prototype of BrainAble. BCI measures the activity of EEG (Electroencephalography) signals carried out by means of a cap with electrodes worn by the visitor. In order to obtain the best performance, multiple approaches were explored which finally lead to use of the P300 technique, which is based on the detection of the P300 wave (i.e. event-related potential). To generate such response, the visitors taking part in the demonstration were asked to fix their gaze at a specific point in a matrix-displayed selection, which sequentially flashes every cell. Each time one of the matrix cell flashes and the visitor's gaze looks at it, his/her brain produces a P300 wave. Such wave is detected by the BCI and the system reacted launching the associated action: for instance if the cell matches with the letter 'a', the system wrote 'a' in the message box.



Figure 5: BrainAble stand

The general public is not used to BCI systems and therefore the demonstration started with a short training stage (5-15 minutes depending on visitor concentration) that fine-tuned some system parameters for each visitor. Then, the booth visitors were entitled to experience, by means of the BCI-controlled interface, the services available in the prototype:

- ✓ In-home Virtual Reality: Virtual-Reality representation of a predefined home allowing the visitor to navigate and interact with smart home elements.
- ✓ Social Network applications: BrainAble aims at providing new ways of communication to the disabled to give them additional chances of sharing experiences with others. A micro-blogging fulfils this, which is integrated into one of the most popular social networks. Twitter. For this service, an account was predefined for the purpose of the demonstration but the visitor was also able to use his/her own private account if he/she wished for using such service.
- ✓ Smart Home appliances: The severely impaired often need assistance to carry out most of their daily life activities. BrainAble will improve their independence by

providing control over different smart home devices. For this prototype, a lighting system and the control of a standard TV set were the selected examples.

- ✓ Telepresence service: Unobtrusive and miniaturised mobile robot which allows the visitor to feel as if he was present at other place than his/her true location. It brought the visitor the possibility to “virtually” walk around and ‘see’ images from a remote location.



Figure 6: BrainAble prototype testing by the team and 10 year old kid

3.5 Ph.D. and Master Theses

Not Applicable 2011

3.6 Press events, press releases, press articles and related items

This section lists events and publication not funded by BrainAble, but contributing to information dissemination for the project.

- ✓ Two articles about the BrainAble project were published in the e-Inclusion Newsletter (http://ec.europa.eu/information_society/activities/einclusion/). The first in September 28th and the second in November 17th.

- The first article, issued in the e-Inclusion Newsletter of 8th of September, reported:

The FP7 funded BrainAble Project empowers disabled people to feel more independent and in control – In March 2011 the project consortium, led by the eHealth R&D Group of Barcelona Digital Centre Tecnològic, launched a video to present to the European Commission the first year’s prototype of BrainAble that demonstrates an ICT-based solution controlled via a BNCI interface to create an assistive environment. The prototype is considered a proof-of-concept of the full BrainAble system and at this stage includes a BNCI interacting with: (1) home appliances such as a commercial television and a lamp (2) a virtual avatar acting in a virtual representation of user’s home; and (3) social environment facilitating the participation in today’s modern web 2.0 networks with the access to micro-blogging services such as Twitter. BrainAble has been funded with Euros 2,3 M by the European Commission under the programme ICT FP7 and is expected to terminate in December 2012. BrainAble aims to improve personal independence and social constraints of people with physical disabilities, giving them the possibility to interact with their environment through novel Human-

Computer interfaces consisting of sensors measuring the individual physical and emotional state (by means of Brain-Computer interfaces -BCI-combined with affective computing) and integrating their outcomes with virtual environments, smart homes and social networks. BrainAble's main goal is to improve the quality of life of people suffering from functional diversity by addressing their two major limitations: exclusion from home and social activities.

- In the 21st of November, the following article about BrainAble text was presented in the e-Inclusion Newsletter:

See the demonstration of the BrainAble project at the Innovation Convention 5-6 December 2011 – The BrainAble project (<http://www.BrainAble.org>) seeks to improve the autonomy and quality of life of the physically disabled, based on BNCI (Brain/ Neuronal Computer Interface). By combining affective computing, ambient intelligence and virtual environments, a Brain-Computer Interface enables people to communicate without moving. Visitors of the stand will be able to test the current prototype and experience features such as navigation through the virtual representation of a home, interaction and control of smart home devices as well as the use of social networks and communication tools.

- ✓ BrainAble project was highlighted in Neelie Kroes' blog on ICT and disability – **“ICT and disability: achieving a better world for all”** (Vice President of the European Commission and European Digital Agenda Commissioner) – <http://blogs.ec.europa.eu/neelie-kroes/ict-disability-achieving-a-better-world-for-all/>.
- ✓ Newspaper article: “g.tec entwickelt Hilfe“ (g.tec develops help), OÖNachrichten (10.6.2011).
- ✓ Newspaper article: “g.tec in Schiedlberg wächst mit der Kraft der Gedanken. “ (g.tec in Schiedlberg grows with the force of thoughts), OÖNachrichten (15.06.2011).
- ✓ Newspaper article: The Economist (Sept 03, 2011): Put your thinking cap on.
- ✓ Article about brainpainting, posted on the webpage of the national TV of Austria (www.ORF.at): Bilder, direkt aus dem Gehirn (Images directly from the brain) – <http://science.orf.at/stories/1690188>.
- ✓ g.tec distributes a Newsletter (4 to 5 times/year) to more than 7000 project partners, customers and BCI researchers all over the world. The newsletter includes topics related to BCI and alternative input methods like the Wii, which are components of the Y2-Prototpye of the BrainAble project.
- ✓ g.tec won the 2011 Pegasus Award, an Austrian Award for economy.
- ✓ g.tec has several videos available on YouTube:
 - 28.03.2011: Dry Electrodes
<http://www.youtube.com/watch?v=zqagSQmJL18>
 - 28.03.2011: Second Life with BCI
<http://www.youtube.com/watch?v=S4xIdPYRoJY>
 - 28.03.2011: ORF Workshop in Graz
http://www.youtube.com/watch?v=b73zSG77D_s
 - 28.03.2011: Microsoft Innovation Award
<http://www.youtube.com/watch?v=OWzbOYXivOA>
 - 24.03.2011: Position Tracking with Wifi
http://www.youtube.com/watch?v=YuQsGNq_6as

3.7 Project Sponsoring

The aforementioned dissemination activities, undertaken by the entire consortium, played an important role in what concerns to the Sponsoring Programme of the project.

In the scope of the Sponsoring Programme, selected stakeholders (capable of satisfying the project's needs) were contacted.

One of those contacts resulted in the provision of three free of charge USB dongles, needed to interact with the ZigBee home devices, by Telegesis Ltd (<http://www.telegesis.com>), manufacturer of Original Equipment Manufacturer (OEM) ZigBee modules, and so becoming a BrainAble Sponsor.

3.8 Project Clustering

In the scope of the Project Clustering, a conference call was held in the 31st of March with several entities participating in projects where synergies with BrainAble could arise.

The following projects were represented:

- ✓ Asterics (<http://www.asterics.eu/>);
- ✓ BrainAble (<http://www.BrainAble.org/>);
- ✓ BrainGain (<http://www.braingain.nl/>);
- ✓ Better (<http://www.iai.csic.es/better/>);
- ✓ Brain (<http://brain-project.org/>);
- ✓ Decoder (<http://www.decoder.i1.psychologie.uni-wuerzburg.de/>);
- ✓ Future BNCI (<http://www.future-bnci.org/>);
- ✓ Mundus (<http://www.mundus-project.eu/>);
- ✓ TOBI (<http://www.tobi-project.org/>).

Possible synergies and workaround of common problems were discussed. Several contributions were made to the Future BNCI roadmap.

4 List of Key Words/Abbreviations

AAL	Ambient Assisted Living
AmI	Ambient Intelligence
BCI	Brain Computer Interface
BNCI	Brain/Neuronal Computer Interface
HCI	Human Computer Interface
ICT	Information and Communication Technology
IL	Independent Living
OEM	Original Equipment Manufacturer
VR	Virtual Reality