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COGAIN

Communication by Gaze Interaction

Network of Excellence

Information Society Technologies

Final Report
The publishable final activity report

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Project Execution

COGAIN is a Network of Excellence on Communication by Gaze Interaction, supported by the European Commission's IST 6th framework program. COGAIN integrates cutting-edge expertise on interface technologies for the benefit of users with disabilities. The network gathers Europe's leading expertise in eye gaze interaction with computers in a research project on assistive technologies for citizens with motor impairments.

Objectives

Bringing together small, scattered research teams. The aim of COGAIN is to gather Europe's leading expertise in eye gaze interaction with computers in a research project on assistive technologies for citizens with motor impairments. COGAIN focuses on improving the quality of life for those whose life is impaired by motor-control disorders, such as ALS or CP. COGAIN assistive technologies will empower the target group to communicate by using the capabilities they have and by offering compensation for capabilities that are deteriorating.

Fostering durable community building. Some of the objectives (such as removing current obstacles, e.g. the unnecessary diversity in data formats that are in use) can well be achieved during the period that COGAIN is funded by the Commission. This will by itself have a structuring effect in the research, and it will not require funding after the five-year period. Many objectives, on the other hand, are such that they need continued attention and activity. The goal of COGAIN is to become a permanent knowledge centre through various activities. In general, COGAIN aims at establishing itself through the funding period, so that it becomes self-evident to all parties involved that continued participation in the activities is worthwhile.

Promoting integration and standardisation. COGAIN aims at overcoming the tight coupling of hardware and software in current research and development work. Due to the fragmentation of the research activities, a given software system often works only with a particular eye tracking device. The same applies for tools of analysing the efficiency and the usability that are tailored only for a particular set-up. COGAIN will work for the modularisation and standardisation that will integrate the existing pieces into a portfolio of compatible and usable tools and devices. COGAIN will also contribute to bringing down the price of eye tracking technology of existing devices and by developing alternatives for everyday use at home and on the move.

Making the development work user-driven and known to the user community. The usability, comfort and take-up of the results are ensured by the strong involvement of user communities in the project. Special activities are planned both for involving users in design and for spreading the results to those in need of the technology. Spreading the excellence via dissemination activities is thus an important task of COGAIN.

Providing the right kind of tools for each user. The users will be able to use applications that help them to be in control of the environment, or achieve a completely new level of convenience and speed in gaze-based communication. Using the technology developed in the network, text can be created quickly by eye typing, and it can be rendered with the user's own voice. In addition to this, the network will provide entertainment applications for making the life of the users more enjoyable and more equal. COGAIN believes that assistive technologies serve best by providing applications that are both empowering and fun to use.

User needs are fundamental to the work of COGAIN. Sarah helped demonstrating the potentials of gaze interaction at IST 2004.

Contractors Involved

The members of the COGAIN consortium are listed below in Table 1.

Participant name	Country
University of Tampere	Finland
IT University of Copenhagen	Denmark
Bispebjerg Hospital	Denmark
Danish Centre for Assistive Technology	Denmark
Danmarks Tekniske Universitet	Denmark
Technische Universitaet Dresden	Germany
Universitaet Koblenz-Landau	Germany
Universität zu Lübeck	Germany
Hewlett Packard Italiana SRL	Italy
Politecnico di Torino	Italy
Siauliu Universitetas	Lithuania
Tobii Technology	Sweden
ACE Centre Advisory Trust Ltd	United Kingdom
The Chancellor, Masters and Scholars of the University of Cambridge	United Kingdom
De Montfort University	United Kingdom
Tokyo Institute of Technology	Japan
Universitaet Zuerich	Switzerland
Universidad Publica de Navarra	Spain
Czech Technical University	Czech
Västra Götalands Läns Landsting	Sweden
Loughborough University	United Kingdom
Metrovision	France
LC Technologies	USA
EyeTech Digital Systems	USA

Table 1. List of COGAIN partners during the fifth project year.

In addition to the core members, COGAIN involves two external boards to consult in the future planning and decision-making activities: the Board of User Communities (BUC) and the Board of Industrial Advisors (BIA). Both boards function as advisory entities whose input will be sought regarding the practical usefulness, dissemination and possible commercialisation of the research findings. BUC and BIA members also participate in the decisions of the COGAIN Supervisory Body on Standardization, providing their input and feedback over the various standards developed within COGAIN or relevant to COGAIN. For more information on the work of the advisory boards, see http://www.cogain.org/boards.

COGAIN continues after the funded part ends in the form of an association. Several institutions and private citizens who are not members in the COGAIN project have already joined the COGAIN Association. For more information, see http://www.cogain.org/association.

Work Performed and End Results

Bringing together small, scattered research teams

The work in COGAIN has been done within 8 workpackages: (WP1) *Durable community building*, (WP2) *Standardisation*, (WP3) *User involvement*, (WP4) *Tool development*, (WP5) *Eye tracker development*, (WP7) *Community outreach*, (WP8) *Academic impact*, and (WP9) *Management*. (WP6 "Analysis and evaluation" was merged into WP3 or practical reasons as the evaluation is closely linked with user trials.)

Instead of reporting the work performed on the workpackage level, we draw a summary of the work and end results following the main goals and aims set in the Objectives of the Network. In general, it can be said that all of the joint research conducted within the last five years have contributed to integration and close collaboration between partners. However, WP1 has mostly worked towards tightening the integration between collaborators and building of a durable community. WP7 and WP8 have contributed to the dissemination of knowledge to the user community, industry, policy makers, and academic community, as well as to the general public. Most of the joint research and development work has been conducted in workpackages WP3, WP4 and WP5. WP2 is a special workpackage that has concentrated on standardization and guidelines for eye tracking and gaze interaction, and it has been working in close collaboration with the other workpackages.

COGAIN Camps and Conferences

As one of the main activities of WP1, the yearly COGAIN Camps have been in a big role in bringing together the small, scattered research teams. The COGAIN camp is a major event where all the COGAIN's researchers and students meet each other and the end-users, their representatives, and industry. The camp contains both external and internal events.

Internal events have included management meetings, workpackage research retreats and workshops, and a possibility for the members of the network to discuss burning issues and work in progress in detail, face to face. In the early days of COGAIN, we assumed today's electronic means such as online discussion areas would be the main tools for communication. However, it soon became evident that nothing can replace actual face to face meetings that have become an essential part of the COGAIN collaboration.

The external part of the camp consists of an academic conference and an end-user and industry day that are open to anybody. The academic conference has grown to be a major, widely acknowledged event in its field, attracting a substantial number of submissions and visitors from outside the network. Similarly, the open house day, with thematic tutorials and gaze control demonstrations in the exhibition, has been found to be an effective tool in informing local AT professionals and user communities. For more information about past and future COGAIN conferences, see http://www.cogain.org/conference.

The tutorial on Gaze Controlled Technology (on the left) and the exhibition (on the right) at COGAIN 2008 in Prague were well attended and received positive feedback from the participants. For more COGAIN photos, see http://www.cogain.org/photos

Fostering durable community building

COGAIN has put extensive effort into integration and durable community building. In order to boost close collaboration and true integration of both individual members and institutions of the network, COGAIN has actively searched for possibilities and promoted opportunities for joint research. For example, special integration sessions have been organized at the COGAIN camps, to allow members to present their current work, share project ideas and search for new partners.

The COGAIN Association

Several possibilities to continue the work of COGAIN were investigated, to ensure the continuation of the work. As a result, the COGAIN Association was established in the beginning of the fifth project year. The founding meeting of the Association was held in connection with the COGAIN 2008 conference in Prague, on the 3rd of September 2008. During the COGAIN 2008 Camp, it was possible for anyone to join the Association on the spot. After that, it has been possible to join either as an individual or as an institutional member by filling in a web form and by paying the registration fee. The association also accepts donations.

The Association has already taken over some of COGAIN activities. For example, COGAIN 2009 was organized by the Association in May in Lyngby, Denmark. It was the first COGAIN conference that was self sustained and which collected participation fees and received sponsoring from local organizations. Other COGAIN activities continued by the association include organization of tutorials and courses, sharing of educational and training materials, providing consultation and expertise for research projects related to the field, maintaining the online information resources and shared repositories etc. In addition, a Research Roadmap has been drafted by the WP leaders of the COGAIN project. It outlines directions for future research for the consideration of the association.

For more information about the COGAIN Association, instructions for joining, and services offered by the association and its members, see http://www.cogain.org/association.

Joint Education Training

As part of its durable training activities, COGAIN has organized several PhD and summer schools. One example is the GaCIT summer school on Gaze, Communication, and Interaction Technology that has now been organized twice together with the UCIT graduate, see http://www.cs.uta.fi/ucit/gacit and http://www.cs.uta.fi/ucit/gacit2009/.

Another part of the durable training activities has been initiated in the form of a COGAIN Book. It summarizes the results and knowledge gained during the five years of the project. Once printed, it will be published and distributed by the COGAIN Association.

COGAIN has also produced a fair amount of video material recorded in connection of the COGAIN conferences and PhD schools. The Training section of the COGAIN web portal contains a rich source of information suitable for self training and educational use, see http://www.cogain.org/training/.

Hands-on exercises at the GaCIT summer school.

Promoting integration and standardisation

The work on technical and software integration of eye tracking systems, and the work for common standards and guidelines have been done within WP2. It aims at increasing the innovation, take-up and dissemination of new technologies, products, solutions and best practices, in particular for the benefit of end-users. Standardization helps final users, since it enables the creation of interoperable products, which comply with independently-assessed minimum requirements. It may also benefit industries, especially new and smaller ones, since it allows them easier entry points into new markets.

Areas for Standardization

During the project several important areas for standardization have been identified: Recommendations and standards for (1) interfacing with eye tracking systems, (2) safe infrared exposure levels when using eye tracking systems, (3) eye tracking driven environmental control, and (4) eye tracking driven personal mobility.

Such areas are of widely differing nature, and they require different types of standardization solutions: software library-level standards, official enforceable standards, network-level architecture standards, user-interface guidelines, analysis and review of standards to drive research and innovation, etc.

COGAIN Standards and Guidelines

Examples demonstrating the different levels of the COGAIN standardization work are given below:

- COGAIN WP2 and WP5 joined forces with the International Commission on Illumination (CIE) to work on the safety issues in eye tracking, especially considering the exposition to the IR illumination. The first report on "Exploration of safety issues in eye tracking" shows that the current standards do not cover the extended, daily use of eye control systems. A *Technical Committee* was formed under CIE Division 6, with members from COGAIN and expert members from CIE, to work on a official, binding standard that would fill this serious gap. The draft will be available before the end of the project, but the formal standards needs more time to be discussed and formalized – this will be managed by the COGAIN Association. The first report of the Technical Committee as well as other related deliverables and reports are available at http://www.cogain.org/results/reports.
- The *COGAIN ETU Driver* comprises both the definition and the reference implementation for a COGAIN recommendation for interfacing with eye tracking systems. It defines common format for eye movement data and implementation of the programming interface, with reference implementation. The ETU Driver is available for most of the major eye tracking manufacturers at http://www.cs.uta.fi/~oleg/etud.html.
- Recently (March 2009), a new Working Group has been formed (called "ETAPIS – Eye-Tracking Application Programming Interface Standardization" Group) to discuss a new updated version of the Recommendation, that should be easier to integrate and develop and more compatible with existing programming technology. We are currently in the requirement analysis phase, and the discussion is on-going at http://www.cogain.org/forums/et-api-standardisation/

The standardization work will be continued within the Technical Committee and within the COGAIN Association. A Standardization Roadmap that outlines directions for future research on this area has been drafted and distributed to the member of COGAIN.

Making the development work user-driven and known to the user community

User needs are fundamental to the work of COGAIN. The users have been involved in the work of COGAIN from the very beginning and their involvement has been enhanced further during the project. Questionnaires on user requirements and needs have been spread and several short and long term user trials and experiments have been conducted. The work has been reported in various COGAIN deliverables, especially within WP3. COGAIN reports and deliverables have been published and they are available online. COGAIN reports are available at http://www.cogain.org/results/reports.

User Involvement

COGAIN WP3 has prepared a special section on the COGAIN web portal for new users that provides an entry point and introduction to gaze interaction. It includes a multimedia training resource to make the initial assessment process and eye control take-up as successful as possible for as many people as possible, as well as an online resource of exemplar eye control activities for end-users with complex needs, with design suggestions and free downloads. For more information, see

COGAIN User Involvement entry point at http://www.cogain.org/user_involvement/

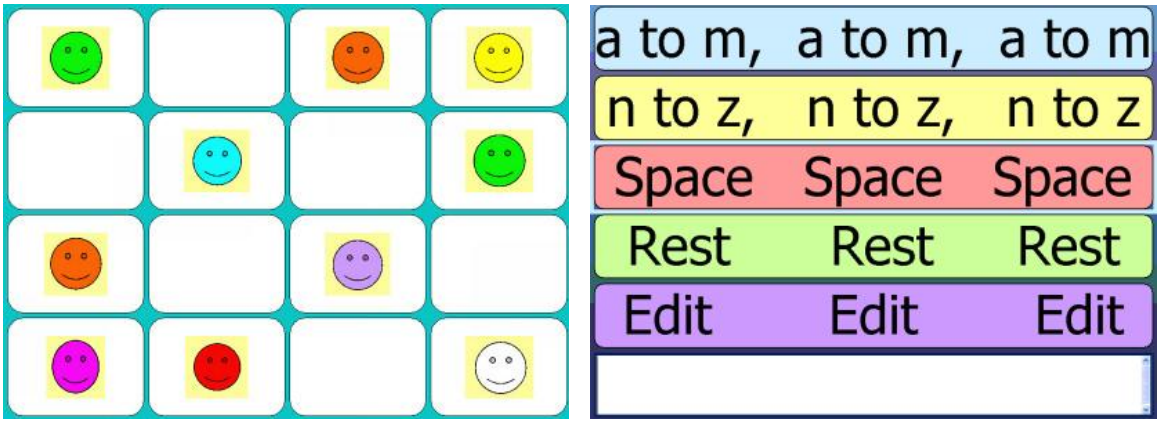
Eye Control Hints and Tips at http://www.cogain.org/user_involvement/eye-control-hints-and-tips

Exemplar Grids at http://www.cogain.org/user_involvement/exemplars

Dissemination and Academic Impact

COGAIN has put special effort on dissemination activities, including decision makers, the scientific community, assistive technology professionals, and the general public. Several press releases, brochures and marketing and dissemination material have been prepared. COGAIN has also attracted the interest the public press. A list of media appearances and dissemination material is available at http://www.cogain.org/media.

COGAIN has also been active in scientific conferences; for example, COGAIN is heavily involved in organizing the forthcoming ETRA 2010, and COGAIN related papers have been published in numerous related conference proceedings and journals. A bibliography of COGAIN publications (with a link to a more general, comprehensive Gaze Interaction Bibliography maintained by COGAIN) is available online at http://www.cogain.org/bibliography/.



Exemplar eye control activities and specially tailored gaze communication grids, with detailed instructions, are available via the COGAIN web portal.

Providing the right kind of tools for each user

As has been shown in the COGAIN report on user requirements, in the early days of COGAIN, eye control could only be used effectively to meet a limited range of user requirements, and it could only be used effectively by a limited number of people with disabilities who might benefit greatly from it. COGAIN has actively worked to make eye control as a genuine choice to as many users as possible. This has meant the work on both hardware and software, in order to make sure the available eye control technology could meet the needs of the full range of users who might benefit from it. This work has been conducted in collaboration with WP3, WP4 and WP5.

Eye Tracking Systems

There is no perfect eye control system. The best system depends on the abilities and needs of the user, and it is recommended that a careful assessment is conducted before any decision on the purchase of the system is made. The COGAIN Eye Control Hints and Tips multimedia training resource as well as the WP3 deliverables will provide invaluable guidance when considering the key features of an eye control system.

COGAIN maintains a catalogue of currently available eye trackers for interactive applications within AAC at http://www.cogain.org/eyetrackers/

The price of such systems is still high, and the COGAIN WP5 has worked actively to develop low cost and open source systems for gaze estimation. Information for developers, as well as links to freely downloadable systems are available at http://www.cogain.org/eyetrackers/low-cost-eye-trackers

Gaze Controlled Applications

COGAIN has developed several gaze communication tools that are freely available via the COGAIN web portal. These include for example GazeTalk that not only provides means of communication but also provides a web browser, email, PDF reader and speech output. It has also been linked with Dasher for situations where high speed text entry by gaze is needed. In addition, there are various leisure applications and games that can be used by eye movements alone, including applications for drawing by the eye and playing music by the eye.

For more information and to download the applications, see http://www.cogain.org/results/applications/.

Gaze communication systems, leisure applications as well as gaze-controlled games are freely available via the COGAIN web portal

Dissemination and Use

COGAIN activities and dissemination will be continued by the COGAIN Association. The dissemination activities are part of the services offered by the Association, see http://www.cogain.org/association#services

Examples of planned future dissemination activities include:

- Continuation of COGAIN conferences, either as separate events or jointly with other established conferences, such as COGAIN 2009 that was organized jointly with the Danish Visionday event, see http://www.visionday.dk/
- ETRA 2010, organized jointly with COGAIN, see http://www.e-t-r-a.org
- Publish and distribute the COGAIN book
- Offer consultation and expertise for research projects related to the field, as well as continue replying to queries related to eye tracking and gaze interaction (via email or web based queries) and update the FAQ in response, see http://www.cogain.org/faq/
- The COGAIN Association will continue maintaining and updating of the COGAIN web portal. In the future, it will be divided (but closely linked for easy navigation) to separate sections for static information for the Association (at www.cogain.org that will continue to be the main entry point), with special wiki pages for public information that can be updated by the community (wiki version developed but not yet released, data transfer under way).
- Offer tutorials and courses on gaze interaction
- Prepare and share educational and self training material, see http://www.cogain.org/training/
- Maintain list of resources for free and open source software, lists of eye trackers, related bibliographies, see

  http://www.cogain.org/results/applications/
  http://www.cogain.org/eyetrackers
  http://www.cogain.org/eyetrackers/low-cost-eye-trackers
  http://www.cogain.org/bibliography/

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