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COGAIN

Communication by Gaze Interaction

Network of Excellence

Information Society Technologies

D2.8 A Summary of draft standards, recommendations and safety for gaze based communication, environmental, and mobility control

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PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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…and to all the contributors to WP2 activities

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Executive Summary

Workpackage "WP2 – Standardization" aimed 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.

Standardization is a constant process, with long-term results. For remaining within the constraint and budget of the COGAIN project, we developed a lean management process, allowing *priority-driven* shared choices among possible topics, *cost-effective* follow-up of the selected topics and involvement of all interested actors, and a *sustainable* structure designed to survive after the end of the COGAIN project

During the project several important areas for standardization have been identified: Recommendations and standards for interfacing with eye tracking systems; Recommendations and standards for safe infrared exposure levels when using eye tracking systems; Recommendations and standards for eye tracking driven environmental control; and Recommendations and standards for 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.

The Standardization Roadmap developed in COGAIN to handle this variability is quite simple and direct, providing the level of sustainability required after the end of the project, but at the same time leaving open the possibility for implementing complex processes, if and when they are needed for a specific type of 'standard'.

The Roadmap defines four types of standards-related results: COGAIN Draft Recommendation, COGAIN Recommendation, Reference Implementation, enforceable formal Standard. Depending on the nature of the technical topic, one or more of these type(s) of results is selected as the best available option.

The process is managed by appointing Working Groups for each topic of interest, including individuals and institutions from the within and from outside COGAIN. The mandate of Working Groups is defined by the Steering Board and may use COGAIN resources allocated by the Steering Board.

This whole standardization structure (the Roadmap, the types of standards, the existing Working Groups, the attained results, the current activities still ongoing) are currently in a transitioning phase towards the COGAIN Association. The simpler and easily manageable structure of the Roadmap has been designed to help transitioning this activity towards the COGAIN Association, that will probably have more limited funds than the COGAIN NoE, at least in the short term

This deliverable also outlines the main Technical Results that have been reached in WP2 along the four main priority topics, that are duly reported in the relevant Deliverables.

1 Introduction

The COGAIN Network of Excellence in its Joint Program of Activities is committed to serving the communities of researchers, of end users and of industries involved in eye control. This includes supporting actions and measures to increase the innovation, take-up and dissemination of new technologies, products, solutions and best practices that contribute to the development of the sector and that benefit one or more of the mentioned actors.

Workpackage "WP2 – Standardization" aimed at fulfilling these goals by identifying those research results that required some form of standardization. In general 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.

'Standards'[1] may have extremely different natures, ranging from more technical issues (protocols, programming interfaces, …), to user-interaction issues (interfaces, feature sets, …), to safety issues (safe behavior, user control, health effects in the short and long terms, …). All these different kinds of topics require **different forms of 'standards'**, and during the COGAIN project we identified the best option for each specific topic.

During the lifetime of the COGAIN project, it was soon realized that standardization is a constant process, with long-term results. It is **a constant process**, since the available technologies, the market, and user requirements are constantly evolving: all 'standards' need to be continuously reviewed to adapt to their changing environment, but at the same time consistency and compatibility should be ensured. It aims at **long-term results**, since the issued 'standards' may be applied several years after their first publication, and at the same time some standardization processes take several years to be completed.

COGAIN, as a Network of Excellence, has a limited time-span (5 years) and pre-defined resources to address the complexity of the standardization activities. Therefore, we had to develop a **lean management** process, allowing *priority-driven* shared choices among possible topics, *cost-effective* follow-up of the selected topics and involvement of all interested actors, and a *sustainable* structure designed to survive after the end of the COGAIN project.

The present Deliverable D2.8, without repeating what is already stated in the other Deliverables issued in WP2, aims at outlining the main results, from the points of view of the technical topics that have been considered, of the management structure that has been devised, and of the specific technical results attained by the partners of the project.

As a final word in this introductory paragraph, the authors wish to thank for their collaboration all the COGAIN partners, especially those involved in WP2 and WP5, and the excellent support from the COGAIN Office, who were a constant source of encouragement and problem-solving in these complex issues. Sincere acknowledgements are also due to the Project Reviewers and the Project Officer, who stimulated us to find the best shape and structure for the standardization processes and activities.

[1] There is some ambiguity involved with the word "standard": it may be used to refer to any explicit formalization of shared requirements (in the wider sense), or to a formally published document issued by a recognized standardization institution (in the stricter sense). In this document, we will use quotes ('standard') when we refer to the wider interpretation, and we will use capital letters (Standard) when referring to the stricter instance.

2 Technical priorities

During the lifetime of the project, several important areas have been identified, that deserved investing towards finding and adopting *standardized* solutions. Such areas, of different nature and with different objectives, are:

- **Recommendations and standards for interfacing with eye tracking systems**: programming interfaces between eye tracking hardware and eye-based applications. A standard interface would be beneficial for enabling a more horizontal, rather than vertical, structuring of the hardware and software market, and ultimately benefits end users with more choices and opportunities for selecting the right combination of technical aids
- **Recommendations and standards for safe infrared exposure levels when using eye tracking systems**: measurement methodologies and safety limits for protecting patients health when using for long periods of time eye trackers that emit infrared light.
- **Recommendations and standards for eye tracking driven environmental control**: with the advent of new automation and intelligent technologies in users' houses, the potential for autonomy may significantly increase. However, specific interoperation standards are needed to interact with the increasing variety of domotic solutions, and special user interface guidelines for eye-tracking based interaction and control of intelligent environments.
- **Recommendations and standards for eye tracking driven personal mobility**: the next step in enabling user autonomy is mobility (e.g., motorized wheelchairs) to be driven by gaze in the indoor or outdoor environments, while guaranteeing user safety. These kinds of solutions, especially due to the strict regulations for existing wheelchairs, are still an active subject of research.

The definition of such technical priorities has been reached by exploiting the width and breadth of the COGAIN network. In fact, while some of the priorities were already stated in the Technical Annex for the project, their relative importance shifted significantly according to interactions with the partners, the user communities (BUC), and the involved industries (BIA). Just to mention a couple of examples, personal mobility was often regarded as a "futuristic" theme, but in the last 1½ years it received a significant boost, since some prototype products started to be showcased. As a second example, the upcoming CIE Standard on safe infrared exposure was not initially foreseen, but was requested by the User Communities, and COGAIN adapted its workplan to follow their priorities.

The four abovementioned types of standardization activities are prototypical for different kinds of needed standards, as summarized by the table below:

Topic	Requirements	Kind of needed solution
Software interface with eye tracking systems	Set of standardized APIs. Easy to implement on the eye tracking side, and easy to adopt on the application side. Possibility of extending or updating it as technology evolves (new languages, libraries, operating system versions, …). Free reference implementations are a must.	*Software Library-level standard.*
Safe Infrared Exposure levels	Detailed physical measurements and assessment of biological effects. Definition of suitable safety thresholds and levels. Enforceable definitions, under a competent official standardization organization.	*Official enforceable standard.*
Eye based environmental control	Integration and interoperation of existing standards in the domotic environment. Definition and of programming interfaces. Implementation of components for creating integrated systems among control interfaces and automation systems. Guidelines for user interfaces and application builders.	*Network-level architecture standard.* *User-interface guidelines.*
Eye based mobility control	Study of existing standards, to match the requirements of existing safety regulation (mainly based on joystick control) with the current capabilities of eye tracking systems.	*Analysis and review of standards to drive research and innovation.*

The above analysis clearly shows that **different levels of 'standards'** are important, some require enforceability, some require easy updating, some require reference implementations, some require review and evaluation of existing standards, etc.

COGAIN is no standardization body, but the consortium has the technical expertise to cover most of the required aspects. The strategy selected by the COGAIN project is to publish relevant technical documents, whenever enforcement is not needed, and to seek partnership with existing standardization bodies, whenever necessary. During the final years of the project, extensive discussion with enterprises (eye tracking producers and application developers), who are collaborative in setting out health standards, but need to keep and protect their technical specificity and innovation, helped us to determine the right level of requirements for efficiently enabling the publication and adoption of standards-based solutions defined by the COGAIN consortium. Among this, the word "standard" was sometimes interpreted in different ways, and we need to be clearer about the scope and possible uptake of COGAIN results, as better explained in the next Section of this Deliverable.

3 Management and methods

The management of standardization activities within COGAIN WP2 has been formalized and steered through a Standardization Roadmap. During the course of development of the project, such Roadmap has been subject to several revisions, basically to find the best trade-off between supporting a comprehensive process, and enabling a sustainable day-to-day implementation.

The final version of the Standardization Roadmap is available in document [COGAIN-SR30], called «COGAIN Standardization Roadmap (Revised version 3.0)» and was released on March 31, 2009.

The final Standardization Roadmap is quite simple and direct, providing the level of sustainability required after the end of the project, but at the same time leaves open the possibility for implementing complex processes, if and when they are needed for a specific type of 'standard'.

The spirit of the v. 3.0 update is *clarity* and *simplification*. Clarity implies clarifying the real validity scope of various standards-related documents, by choosing a better suited terminology, and at the same time better matching the actual procedures that are being followed by the work groups. Simplification aims at reducing the management complexity and burden, especially for non-enforceable standards, and taking into account the decreasing budget resources that will be available in the first period of the COGAIN Association's lifetime.

In particular, we define:

- A new, clearer nomenclature for COGAIN proposed or endorsed standards, giving more importance also to "lighter" forms of standards
- A new, simpler management process, compatible with more limited resources, and more suited for lighter forms of standards.

The Standardization Roadmap 3.0 is centered upon some basic principles:

a. COGAIN, as a network of researchers and research institutions, will not issue *Standards*.
    1. COGAIN will issue *Recommendations* (and will manage the lifecycle for publishing such Recommendations),

    -- or --

    2. COGAIN will collaborate, by offering available technical competence, with established standardization institutions, and will contribute to formal Standards.

b. The feedback from user communities and industrial communities, formerly managed thanks to the BUC and BIA boards, respectively, has been opened up to the community at large, by establishing suitable *thematic Working Groups.*

c. In addition to "textual" Recommendation, COGAIN will publish *Reference Implementations* of suitable Recommendations, that in many cases are extremely important to help adoption of the relevant solutions.

For further details about the process please refer to [COGAIN-SR30].

3.1 Types of standards

The COGAIN Standardization Roadmap (Revised version 3.0) defines the following levels of standardization within COGAIN:

- **COGAIN Draft Recommendation**: a published report stating proposed standards. Such drafts may be subject to revision, comments, corrections, etc, governed by a clear versioning system. In particular, Recommendations may have different natures:
  - Recommendations for **new** interfaces, data formats, algorithms, etc., proposed by COGAIN members.
    Example: the Eye Tracking Universal Driver (ETU) interface. In such cases, COGAIN commits to providing reference implementations (see below).
  - Recommendations for **existing** interfaces, data formats, algorithms, etc., developed outside COGAIN, but that have been evaluated and "adopted" by COGAIN, that therefore recommends them.
    Example: the adoption of the OSGi platform for controlling home automation systems
- **COGAIN Recommendation**: a Draft Recommendation gains the status of "approved" Recommendation after its publication, at least 6 months after its first publication, and only if no substantial objections arise.
- **Reference Implementation**: a specific software or hardware component or set of components complying with a COGAIN Recommendation, either in the Draft or approved state.
- For enforceable formal Standards, standardization is pursued in collaboration with existing standardization bodies, therefore the final standard will not bear the "COGAIN" mark. It will be an ISO standard, or CIE standard, etc.

3.2 Management process

An important aspect of standards management is an open, effective, democratic and technically sound process for driving and validating the proposed COGAIN Recommendations.

After the experience gained during the project, and by analogy with other standardization initiatives, we simplified the management structure, by appointing Working Groups for each topic of interest. The Working Group collates the necessary competences (technical, ergonomic, medical, assistive, academic, technical, etc) to form a team able to produce a Draft Recommendation, and publish it for dissemination and for open commenting.

Working Groups are formally approved by the Steering Board, since they imply dedicating some resources to activities within WP2. Any COGAIN member may propose creating a Working Group, and also non-COGAIN persons are allowed, on an individual basis, provided they contribute with their scientific and technical knowledge. Working Groups, within the limits set by the Steering Board, may use COGAIN resources for their operation. The mission of a Working Group is to produce one (or a set or related) standardization results (COGAIN Draft Recommendation, COGAIN Recommendation, Reference Implementation, or Official Formal Standard). If no progress is reported in 6 months, then the Working Group decays at the next Steering Board meeting.

The Steering Board will ensure that the Working Group sets up the necessary links to the relevant stakeholders (user communities through the BUC, industries through the BIA), unless they are already part of the Group.

Proposals, suggestions, and the publication of relevant information from the partners and from external collaborators, reach all interested partners through the e-mail address standards@cogain.org, active since the beginning of the project.

3.3 Transitioning to the COGAIN Association

The simpler and easily manageable structure of the new Roadmap has also been designed to help transitioning this activity towards the COGAIN Association, that will probably have more limited funds than the COGAIN NoE, at least in the short term.

The WP2 of the COGAIN NoE project therefore started interacting[2] with the COGAIN Association's Management Board (A-MB) to transfer the experience gained in the COGAIN project to the new Association activities.

The following table summarizes the main steps taken to (a) design the standardization activities that the COGAIN Association will implement by devising a suitable Roadmap to be adopted in that context, and (b) formally transfer the attained results and the future responsibilities to the COGAIN Association.

The role of the Standardization Roadmap 3.0 has been crucial in handling this process, as it has been designed with the necessary flexibility and lightness to be compatible, from the start, with the Association activities.

Date/Period	**WP2 of COGAIN NoE**	**Management Board of COGAIN Association**
September 2008		COGAIN Association founded.
31/01/2009	Standardization Roadmap version 3.0 published	
April-May 2009		Works on an updated version of the Research Programme that includes standardization among the main activities.
May 2009	Formally Asks to A-MB to integrate Standardization activities into the Research Programme	
25/05/2009		*Meeting of the Management Board in Copenhagen.* New Research Programme approved. Standardization Roadmap v 3.0 (of the COGAIN NoE, not directly applicable to the Association) examined. Decision to ask to COGAIN NoE to prepare a proposal suitable for the Association.

[2] Please notice that this interaction is not a formal exercise of some persons switching hats: the WP2 leader and most active members are not part of the Association Management Board. We wanted to ensure that the Association management is really aware and willing to take up standardization activities, thus we followed a more formal and less personal process.

Date/Period	WP2 of COGAIN NoE	Management Board of COGAIN Association
25/05/2009	*Meeting of the COGAIN Steering Board in Copenhagen.* The Steering Board, and in particular WP2, has been asked to write a proposal on how standardization can be prosecuted in the COGAIN Association.	
July 2009	Proposal for the "COGAIN Association Standardization Roadmap", heavily based on the 3.0 version, has been submitted to the Association Management Board for their consideration.	
Next meeting		Proposal to be considered (and possibly approved) by the Association.

4 Outline of Technical Results

1. Recommendations and standards for interfacing with eye tracking systems

- A COGAIN Recommendation (ETU Driver) is already available since Month 18 (Deliverable 2.3), that comprises both the definition and the reference implementation
  i. COGAIN Recommendation on the common format of eye movement data [COGAIN-D2.2]
  ii. COGAIN Recommendation on the programming interface between Eye trackers and applications (ETU Driver – Eye Tracking Universal Driver) [COGAIN-D2.2]
  iii. Reference Implementation for [COGAIN-D2.2] available at http://www.cs.uta.fi/~oleg/etud.html
- The ETU Driver is *supported by all* major eye tracking manufacturers, and is being used in several research institutions
- The COGAIN Recommendation on the common format of eye movement data (Deliverable D2.2) has been adopted by another European Project (PINVIEW - http://www.pinview.eu/) as the internal format of their tools
- Recently (March 2009), a new Working Group has been formed (called "ETAPIS – Eye-Tracking Application Programming Interface Standardization" Group and coordinated by Oleg Spakov, see Appendix) 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 thanks to the on-line forums at http://www.cogain.org/forums/et-api-standardisation/.
- The new ETAPIS Working Group (Eye-Tracking Application Programming Interface Standardization) is working to develop a next-generation eye tracking software interface. Discussions took place during the COGAIN2009 conference in Copenhagen, but mostly continue on-line on the COGAIN forums. Please notice that about 40% of the forum participants are not COGAIN members.
- The first version of the new driver software is expected by the end of the project.

2. Recommendations and standards for safe infrared exposure levels when using eye tracking systems

- Working group formed, with and international expert appointed.
- Draft available, based on the content of [COGAIN-D5.4].
- Agreement with CIE for later standardization of the measurement methods.
- Industrial endorsement of the future CIE standard is confirmed.
- Activity is carried on by an Official CIE working group that is going to publish a CIE working draft.
- 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.
- CIE is still evaluating whether to publish a brand new standard, or to integrate it in other existing standards.
- More information about this activity can be found in the WP5 documentation.

3. Recommendations and standards for eye tracking driven environmental control

- A COGAIN Recommendation is available (D2.5). This deliverable both contains Recommendations for existing standards (OSGi, XML-RPC, OWL/RDF) to be deployed for creating environmental control systems, and novel Recommendations for user interface design specifically developed for eye control.
- A Working Group has been established, is led by Emiliano Castellina (POLITO) and includes members from POLITO, CTU, DMU, UTA. External industrial members (e.g., bTicino manufacturers, the MyOpen community of domotic developers, the private company Zirak active in the domotic sector) and possible adopters (e.g., the Don Gnocchi Foundation) have been involved in the discussion.
- A Reference Implementation is available and has been presented at the COGAIN Conference 2009 and in the just-released Deliverable [COGAIN-D4.11].

4. Recommendations and standards for eye tracking driven personal mobility

- This area is the less mature, and complete solutions are not yet available in the literature or in the market.
- The recently released Deliverable [COGAIN-D2.7] reviews existing solutions and outlines the relevant standards applicable to the field (or that have been applied by some manufacturer with their prototypes).
- No Working Group has been set up, yet, and the imminent end of the COGAIN project will prevent completion of this activity within the Network of Excellence. It will be a matter of discussion for the COGAIN Association whether to support this activity, in addition to the other (more mature) three ones.
- The market analysis conducted in Deliverable D2.7 helped COGAIN to understand the current status of commercial systems and research prototypes. D2.7 already includes some usability and safety guidelines.
- Further details and Recommendations will be included in the forthcoming COGAIN book, where a chapter is devoted to mobility and environmental control.

5 References

[COGAIN-D2.1] D2.1 Survey of De-Facto Standards in Eye Tracking, http://www.cogain.org/results/reports/COGAIN-D2.1.pdf

[COGAIN-D2.2] D2.2 Requirements for the common format of eye movement data, http://www.cogain.org/results/reports/COGAIN-D2.2.pdf

[COGAIN-D2.3] D2.3 Implementation of COGAIN Gaze Tracking Standards, http://www.cogain.org/results/reports/COGAIN-D2.3.pdf

[COGAIN-D2.4] D2.4 A survey of existing 'de-facto' standards and systems of environmental control, http://www.cogain.org/results/reports/COGAIN-D2.4.pdf

[COGAIN-D2.5] D2.5 Draft standards for gaze based environmental control, http://www.cogain.org/results/reports/COGAIN-D2.5.pdf

[COGAIN-D2.6] D2.6 A survey of existing 'de-facto' standards and systems of gaze based mobility control, http://www.cogain.org/results/reports/COGAIN-D2.6.pdf

[COGAIN-D2.7] D2.7 Recommendations on safety issues involved in gaze based mobility control, http://www.cogain.org/internal/deliverables/upload/COGAIN-D2.7.pdf

[COGAIN-D4.11] D4.11 Report on experiments with environmental control software operated by gaze

[COGAIN-D5.4] D5.4 Exploration of safety issues in eye tracking, http://www.cogain.org/results/reports/COGAIN-D5.4.pdf

[COGAIN-SR30] F. Corno, H. Istance, R. Bates, COGAIN Standardization Roadmap (Revised version 3.0)