

cogniLink: A Non-Invasive Brain-Computer Interface That Enables Seamless Execution of Commands Through Thoughts

Project cogniLink

Abstract

Great strides have been achieved in making computers more accessible; however, it is a fact that we can do so much better. When technology is designed for everyone, it lets everyone do what they want, including, but not being limited to, individuals with motor, dexterity, and/or speech impairments. In this document we propose cogniLink, a tool to help developers make computers more accessible for persons with afflictions. cogniLink works as a brain-computer interface that allows the user to trigger the execution of a command by simply thinking of a trigger. A training data set is to be collected from n-users in order to train n-models using an ElectroEncephaloGram (EEG). Each model is trained to recognize one or more trigger thoughts. The same model interacts with a stack of software which maps positive outputs from the model to a command and executes it. In this case, for the purpose of demonstration, the model will be trained to recognize commands from one user which will be mapped to a virtualHID in such a way that the user can play Super Mario Bros. After an extensive process of training n-models, a universal model (UM) will be trained using data from the aforementioned n-models in order to have a simpler training process for new users. cogniLink will allow disabled people to execute commands in a very seamless and orderly fashion, thus making computers more accessible to persons with digital input impairments. Two of cogniLink's long term goals are to allow an amputee to be able to effortlessly be able to control a wheelchair in realtime, and for someone suffering from Locked-In Syndrome to be able to interact with the world around them at more ease.

1 S&T Excellence

Your proposal must address a work programme topic for this call for proposals.

This section of your proposal will be assessed only to the extent that it is relevant to that topic.

1.1 Targeted breakthrough, Long term vision and Objectives

- Describe the targeted scientific breakthrough of the project.
- Describe how the targeted breakthrough of the project contributes to a long-term vision for new technologies.
- Describe the specific objectives for the project, which should be clear, measurable, realistic and achievable within the duration of the project.

1.2 Relation to the work programme

- Indicate the work programme topic to which your proposal relates, and explain how your proposal addresses the specific challenge and scope of that topic, as set out in the work programme.

1.3 Novelty, level of ambition and foundational character

- Describe the advance your proposal would provide beyond the state-of-the-art, and to what extent the proposed work is ambitious, novel and of a foundational nature. Your answer could refer to the ground-breaking nature of the objectives, concepts involved, issues and problems to be addressed, and approaches and methods to be used.

1.4 Research methods

- Describe the overall research approach, the methodology and explain its relevance to the objectives.
- Where relevant, describe how sex and/or gender analysis is taken into account in the projects content.

Sex and gender refer to biological characteristics and social/cultural factors respectively. For guidance on methods of sex/gender analysis and the issues to be taken into account, please refer to <http://ec.europa.eu/research/science-society/gendered-innovations/index-en.cfm>

1.5 Interdisciplinary nature

- Describe the research disciplines involved and the added value of the inter-disciplinarity.

2 Impact

2.1 Expected impact

Please be specific, and provide only information that applies to the proposal and its objectives. Wherever possible, use quantified indicators and targets.

- Describe how your project will contribute to the expected impacts set out in the work programme under the relevant topic.
- Describe the importance of the technological outcome with regards to its transformational impact on science, technology and/or society.
- Describe the empowerment of new and high-potential actors towards future technological leadership.

2.2 Measures to maximize impact

Dissemination and exploitation of results

- Provide a plan for disseminating and exploiting the project results. The plan, which should be proportionate to the scale of the project, should contain measures to be implemented both during and after the project.
- Explain how the proposed measures will help to achieve the expected impact of the project.
- Where relevant, include information on how the participants will manage the research data generated and/or collected during the project, in particular addressing the following issues:¹
 - What types of data will the project generate/collect?
 - What standards will be used?
 - How will this data be exploited and/or shared/made accessible for verification and re-use? If data cannot be made available, explain why.
 - How will this data be curated and preserved?

You will need an appropriate consortium agreement to manage (amongst other things) the ownership and access to key knowledge (IPR, data etc.). Where relevant, these will allow you, collectively and individually, to pursue market opportunities arising from the project's results.

The appropriate structure of the consortium to support exploitation is addressed in section 3.3.

¹For further guidance on research data management, please refer to the H2020 Online Manual on the Participant Portal.

- Outline the strategy for knowledge management and protection. Include measures to provide open access (free on-line access, such as the “green” or “gold” model) to peer-reviewed scientific publications which might result from the project.²

Open access publishing (also called ‘gold’ open access) means that an article is immediately provided in open access mode by the scientific publisher. The associated costs are usually shifted away from readers, and instead (for example) to the university or research institute to which the researcher is affiliated, or to the funding agency supporting the research.

Self-archiving (also called ‘green’ open access) means that the published article or the final peer-reviewed manuscript is archived by the researcher - or a representative - in an online repository before, after or alongside its publication. Access to this article is often - but not necessarily - delayed (“embargo period”), as some scientific publishers may wish to recoup their investment by selling subscriptions and charging pay-per-download/view fees during an exclusivity period.

Communication activities

- Describe the proposed communication measures for promoting the project and its findings during the period of the grant. Measures should be proportionate to the scale of the project, with clear objectives. They should be tailored to the needs of various audiences, including groups beyond the project’s own community. Where relevant, include measures for public/societal engagement on issues related to the project.

3 Implementation

3.1 Project work plan

Please provide the following:

- brief presentation of the overall structure of the work plan;
- timing of the different work packages and their components (Gantt chart or similar);
- detailed work description, i.e.:
 - a description of each work package (table 3.1a);
 - a list of work packages (table 3.1b);
 - a list of major deliverables (table 3.1c);
- graphical presentation of the components showing how they inter-relate (Pert chart or similar).

Give full details. Base your account on the logical structure of the project and the stages in which it is to be carried out. Include details of the resources to be allocated to each work package. The number of work packages should be proportionate to the scale and complexity of the project.

²Open access must be granted to all scientific publications resulting from Horizon 2020 actions. Further guidance on open access is available in the H2020 Online Manual on the Participant Portal.

You should give enough detail in each work package to justify the proposed resources to be allocated and also quantified information so that progress can be monitored, including by the Commission.

You are advised to include a distinct work package on “management” (see section 3.2) and to give due visibility in the work plan to “dissemination and exploitation” and “communication activities”, either with distinct tasks or distinct work packages.

You will be required to include an updated (or confirmed) “plan for the dissemination and exploitation of results” in both the periodic and final reports. (This does not apply to topics where a draft plan was not required.) This should include a record of activities related to dissemination and exploitation that have been undertaken and those still planned. A report of completed and planned communication activities will also be required.

If your project is taking part in the Pilot on Open Research Data³, you must include a ‘data management plan’ as a distinct deliverable within the first 6 months of the project. A template for such a plan is given in the guidelines on data management in the H2020 Online Manual. This deliverable will evolve during the lifetime of the project in order to present the status of the project’s reflections on data management.

Definitions:

“Work package” means a major sub-division of the proposed project.

“Deliverable” means a distinct output of the project, meaningful in terms of the project’s overall objectives and constituted by a report, a document, a technical diagram, a software etc.

“Milestones” means control points in the project that help to chart progress. Milestones may correspond to the completion of a key deliverable, allowing the next phase of the work to begin. They may also be needed at intermediary points so that, if problems have arisen, corrective measures can be taken. A milestone may be a critical decision point in the project where, for example, the consortium must decide which of several technologies to adopt for further development.

Report on work progress is done primarily through the periodic and final reports. Deliverables should complement these reports and should be kept to the minimum necessary.

Work package description

Work package number	WP1	Starting month			1
Work package title	MANAGEMENT WORK PACKAGE				
Participant number	1	2	3		
Short name	UoC	UoP2	UoP3		
Person-months	12	3	2		

Objectives

This work package has the following objectives:

1. To develop
2. To apply this
3. etc.

³Certain actions under Horizon 2020 participate in the Pilot on Open Research Data in Horizon 2020. All other actions can participate on a voluntary basis to this pilot. Further guidance is available in the H2020 Online Manual on the Participant Portal.

Description of work

Description of work carried out in WP, broken down into tasks, and with role of partners list. Use the \wptask command.

Task T1.1: Test (M1-M12)

Leader: UoC. Contributors: UoC

Here we will test the WP Task code.

Task T1.2: Integrate (M6-M9)

Leader: UoC. Contributors: UoC

In this task UZH will integrate the work done in T1.1.

Task T1.3: Apply (M9-M12)

Leader: UoP3. Contributors: All other

Here all the WP participants will apply the results to...

Role of partners

Participant short name will lead Task T1.2.

UoC will..

Deliverables

D1.1 Report on the definition of the model specifications. **(M36)**

D1.2 Report on Feasibility study for the model implementation. **(M12)**

D1.3 Prototype of model implementation. **(M24)**

Work package number	WP2	Starting month			1
Work package title	DEVELOPMENT WORK PACKAGE				
Participant number	1	2	3		
Short name	UoC	UoP2	UoP3		
Person-months	3	12	6		

Objectives

This work package has the following objectives:

1. To develop ...
2. To apply this
3. etc.

Description of work

Description of work carried out in WP, broken down into tasks, and with role of partners list.
Use the \wptask command.

Task T2.1: Test (M1-M12)

Here we will test the WP Task code.

Leader: UoC. Contributors: UoC

Task T2.2: Integrate (M6-M9)

In this task UZH will integrate the work done in T2.1.

Leader: **UoC**. Contributors: UoC

Task T2.3: Apply (M9-M12)

Here all the WP participants will apply the results to...

Leader: UoP2. Contributors: All other

Role of partners

Participant short name will lead Task T2.2.

UoC will..

Deliverables

D2.1 Report on the definition of the model specifications. (M36)

D2.2 Report on Feasibility study for the model implementation. **(M12)**

D2.3 Prototype of model implementation. (M24)

task:wp3integwp3test	
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dev : wpsv arqbyy pafjagseptcat ion

1. To develop
2. To apply this
3. etc.

Description of work carried out in WP, broken down into tasks, and with role of partners list.
Use the \wptask command.

Leader: UoC. Contributors: UoC

Task T3.2: Integrate (M6-M9)

Leader: UoC. Contributors: UoC

Task T3.3: Apply (M9-M12)

Leader: UoP3. Contributors: All other

Here all the WP participants will apply the results to...

Participant short name will lead Task T3.2.
UoC will..

D3.1 Report on the definition of the model specifications. (M36)

D3.2 Report on Feasibility study for the model implementation. **(M12)**

D3.3 Prototype of model implementation. (M24)

List of work packages

Table 3.1b: List of work packages

Work package number	Work package title	Lead participant no.	Lead participant name	Person-months	Start month	End month
WP1	MANAGEMENT WORK PACKAGE	1	UoC	17	1	36
WP2	DEVELOPMENT WORK PACKAGE	2	UoP2	21	1	36
WP3	TEST WORK PACKAGE	3	UoP3	23	1	36
TOTAL				61		

List of deliverables

4 KEY

Deliverable numbers in order of delivery dates. Please use the numbering convention <WP number> . <number of deliverable within that WP>.

For example, deliverable 4.2 would be the second deliverable from work package 4.

Type:

Use one of the following codes:

R: Document, report (excluding the periodic and final reports)

DEM: Demonstrator, pilot, prototype, plan designs

DEC: Websites, patents filing, press & media actions, videos, etc.

OTHER: Software, technical diagram, etc.

Dissemination level:

Use one of the following codes:

PU = Public, fully open, e.g. web

CO = Confidential, restricted under conditions set out in Model Grant Agreement

CI = Classified, information as referred to in Commission Decision 2001/844/EC.

Delivery date:

Measured in months from the project start date (month 1).

Table 3.1c: Deliverable list

Deliverable number	Deliverable name	WP no.	Lead participant name	Nature	Dissemination Level	Delivery date (proj. month)
D1.2	Report on Feasibility study for the model implementation.	WP1	UoP3	R	PU	12
D2.2	Report on Feasibility study for the model implementation.	WP2	UoP3	R	PU	12
Continued on next page						

⁴If your action taking part in the Pilot on Open Research Data, you must include a data management plan as a distinct deliverable within the first 6 months of the project. This deliverable will evolve during the lifetime of the project in order to present the status of the project's reflections on data management. A template for such a plan is available on the Participant Portal (Guide on Data Management).

3. Implementation

D3.2	Report on Feasibility study for the model implementation.	WP3	UoP3	R	PU	12
D1.3	Prototype of model implementation.	WP1	UoP2	R	PU	24
D2.3	Prototype of model implementation.	WP2	UoP2	R	PU	24
D3.3	Prototype of model implementation.	WP3	UoP2	R	PU	24
D1.1	Report on the definition of the model specifications.	WP1	UoC	R	PU	36
D2.1	Report on the definition of the model specifications.	WP2	UoC	R	PU	36
D3.1	Report on the definition of the model specifications.	WP3	UoC	R	PU	36

3.2 Management and risk assessment

- Describe the organisational structure and the decision-making (including a list of milestones (table 3.2a))
- Describe any critical risks, relating to project implementation, that the stated project's objectives may not be achieved. Detail any risk mitigation measures. Please provide a table with critical risks identified and mitigating actions (table 3.2b)

List of milestones

KEY

Estimated date

Measured in months from the project start date (month 1)

Means of verification

Show how you will confirm that the milestone has been attained. Refer to indicators if appropriate. For example: a laboratory prototype that is up and running; software released and validated by a user group; field survey complete and data quality validated.

Table 3.2a: List of milestones

Milestone number	Milestone name	Related WPs	Estimated date	Means of verification
M1	Completed simulator development	1	24	Software released and validated
M2	Final demonstration	WP 3	36	Application of results

Critical risks for implementation

Table 3.2b: Critical risks for implementation

Description of Risk	WPs involved	Proposed risk-mitigation measures
The dedicated chip sent to fabrication is not functional.	WP 3	Resort to Software simulations

3.3 Consortium as a whole

Table 3.4a: Summary of staff effort

Partic. no.	Partic. short name	WP1	WP2	WP3	Total person months
1	UoC	12	3	3	18
2	UoP2	3	12	8	23
3	UoP3	2	6	12	20
Total		17	21	23	61

The individual members of the consortium are described in a separate section 4. There is no need to repeat that information here.

- Describe the consortium. How will it match the projects objectives? How do the members complement one another (and cover the value chain, where appropriate)? In what way does each of them contribute to the project? How will they be able to work effectively together?
- If applicable, describe how the project benefits from any industrial/SME involvement.
- **Other countries:** If one or more of the participants requesting EU funding is based in a country that is not automatically eligible for such funding (entities from Member States of the EU, from Associated Countries and from one of the countries in the exhaustive list included in General Annex A of the work programme are automatically eligible for EU funding), explain why the participation of the entity in question is essential to carrying out the project.

3.4 Resources to be committed

Please make sure the information in this section matches the costs as stated in the budget table in section 3 of the administrative proposal forms, and the number of person/months, shown in the detailed work package descriptions.

Please provide the following:

- a table showing number of person/months required (table 3.4a)
- a table showing “other direct costs” (table 3.4b) for participants where those costs exceed 15% of the personnel costs (according to the budget table in section 3 of the administrative proposal forms)

Summary of staff efforts

Table 3.4a: Please indicate the number of person/months over the whole duration of the planned work, for each work package, for each participant. Identify the work-package leader for each WP by showing the relevant person-month figure in bold.

Other direct cost items (travel, equipment, other goods and services, large research infrastructure)

Please provide a table of summary of costs for each participant, if the sum of the costs for “travel”, “equipment”, and “goods and services” exceeds 15% of the personnel costs for that participant (according to the budget table in section 3 of the proposal administrative forms).

Participant no. 1 (UoC)	Cost (EUR)	Justification
Travel	2500	3 pairwise meetings for 2 people, 2 conferences for 3 people, 3 internal project meetings for 3 people
Equipment	3000	CAD workstation for chip design
Other goods and services	60000	Fabrication of 2 VLSI chips
Total	65500	
Participant no. 2 (UoP2)	Cost (EUR)	Justification
Other goods and services	40000	Fabrication of prototype PCBs
Total	40000	

Please complete the table below for all participants that would like to declare costs of large research infrastructure under Article 6.2 of the General Model Agreement, irrespective of the percentage of personnel costs. Please indicate (in the justification) if the beneficiary's methodology for declaring the costs for large research infrastructure has already been positively assessed by the Commission.

Note: Large research infrastructure means research infrastructure of a total value of at least EUR 20 million, for a beneficiary. More information and further guidance on the direct costing for the large research infrastructure is available in the H2020 Online Manual on the Participant Portal.

Participant no. 1 (UoC)	Cost (EUR)	Justification
Large research infrastructure	400000	Synchrotron
Participant no. 3 (UoP3)	Cost (EUR)	Justification
Large research infrastructure	400000	Synchrotron

References

Computer accessibility - wikipedia. (n.d.). Retrieved from https://en.wikipedia.org/wiki/Computer_accessibility

4 Members of the consortium

This section is not covered by the page limit.

The information provided here will be used to judge the operational capacity.

4.1 Participants (applicants)

Please provide, for each participant, the following (if available):

- a description of the legal entity and its main tasks, with an explanation of how its profile matches the tasks in the proposal;
- a curriculum vitae or description of the profile of the persons, including their gender, who will be primarily responsible for carrying out the proposed research and/or innovation activities;
- a list of up to 5 relevant publications, and/or products, services (including widely-used datasets or software), or other achievements relevant to the call content;
- a list of up to 5 relevant previous projects or activities, connected to the subject of this proposal;
- a description of any significant infrastructure and/or any major items of technical equipment, relevant to the proposed work;
- any other supporting documents specified in the work programme for this call.

4.2 Third parties involved in the project (third party resources)

Please complete, for each participant, the following table (or simply state "No third parties involved", if applicable).

If yes in first row, please describe and justify the tasks to be subcontracted. If yes in second row, please describe the third party, the link of the participant to the third party, and describe and justify the foreseen tasks to be performed by the third party⁵. If yes in third row, please describe the third party and their contributions.

UoC	
Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	Y/N
Does the participant envisage that part of its work is performed by linked third parties	Y/N
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	Y/N

⁵A third party that is an affiliated entity or has a legal link to a participant implying a collaboration not limited to the action. (Article 14 of the Model Grant Agreement).

UoP1	
Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	Y/N
Does the participant envisage that part of its work is performed by linked third parties	Y/N
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	Y/N
UoP2	
Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	Y/N
Does the participant envisage that part of its work is performed by linked third parties	Y/N
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	Y/N

5 Ethics and Security

This section is not covered by the page limit.

5.1 Ethics

If you have entered any ethics issues in the ethical issue table in the administrative proposal forms, you must:

- submit an ethics self-assessment, which:
 - describes how the proposal meets the national legal and ethical requirements of the country or countries where the tasks raising ethical issues are to be carried out;
 - explains in detail how you intend to address the issues in the ethical issues table, in particular as regard:
 - * research objectives (e.g. study of vulnerable populations, dual use, etc.)
 - * research methodology (e.g. clinical trials, involvement of children and related consent procedures, protection of any data collected, etc.)
 - * the potential impact of the research (e.g. dual use issues, environmental damage, stigmatisation of particular social groups, political or financial retaliation, benefit-sharing, malevolent use, etc.).
- provide the documents that you need under national law(if you already have them), e.g.:
 - an ethics committee opinion;
 - the document notifying activities raising ethical issues or authorising such activities;

If these documents are not in English, you must also submit an English summary of them (containing, if available, the conclusions of the committee or authority concerned).

If you plan to request these documents specifically for the project you are proposing, your request must contain an explicit reference to the project title.

5.2 Security

⁶ Please indicate if your project will involve:

- activities or results raising security issues: (YES/NO)
- “EU-classified information” as background or results: (YES/NO)

⁶Article 37.1 of the Model Grant Agreement: Before disclosing results of activities raising security issues to a third party (including affiliated entities), a beneficiary must inform the coordinator – which must request written approval from the Commission/Agency. Article 37.2: Activities related to “classified deliverables” must comply with the “security requirements” until they are declassified. Action tasks related to classified deliverables may not be subcontracted without prior explicit written approval from the Commission/Agency. The beneficiaries must inform the coordinator – which must immediately inform the Commission/Agency – of any changes in the security context and –if necessary – request for Annex 1 to be amended (see Article 55).

