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

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.

sec:workplan sec:implementation

1 Implementation

1.1 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.

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 Data[1]*, 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.

[1] Certain 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.

"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.

spccdapa

Work package description

Work package number	**WP1**		**Starting month**	1
Work package title	**Virtual HID, Data Collection, and ML Code**			
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 a Virtual Human Interface Device;
2. To develop an API that gathers raw data from the Cyton board and feeds it to a CSV file;
3. To write code needed to efficiently store and manage datasets;
4. To write code needed to start training Model 1 on Command A.

task:wp2task3 task:wp1task1

Description of work

Task T1.1: Task1 (M1-M12) *Leader: **UoC**. Contributors: UoC*
Here we will test the WP Task code.

Task T1.2: Task2 (M6-M9) *Leader: **UoC**. Contributors: UoC*
In this task UZH will integrate the work done in **??**.

Task T1.3: Task3 (M9-M12) *Leader: **UoP3**. Contributors: All other*
Here all the WP participants will apply the results to...

dev:wp1

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)**

wp:m1cA

Work package number	WP2		Starting month	2
Work package title	Model 1 Command A			
Participant number	1	**2**	3	
Short name	UoC	**UoP2**	UoP3	
Person-months	3	**12**	6	

Objectives

1. To collect training, validation, and test datasets for Model 1 Command A;
2. Training Model 1 using aforementioned data;
3. Testing/Patching Model 1.

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:wp2task1 task:wp2task2 task:wp2task3

Task T2.1: Task1 (M1-M12) *Leader: **UoC**. Contributors: UoC*
Here we will test the WP Task code.

Task T2.2: Task2 (M6-M9) *Leader: **UoC**. Contributors: UoC*
In this task UZH will integrate the work done in **??**.

Task T2.3: Task 3 (M9-M12) *Leader: **UoP2**. Contributors: All other*
Here all the WP participants will apply the results to...

dev:wp2dev1 dev:wp2dev2 dev:wp2dev3

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)**

wp:test

Work package number	WP3		Starting month	1
Work package title	TEST WORK PACKAGE			
Participant number	1	2	**3**	
Short name	UoC	UoP2	**UoP3**	
Person-months	3	8	**12**	

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:wp3integratetest

Task T3.1: Test (M1-M12) *Leader: **UoC**. Contributors: UoC*
Here we will test the WP Task code.

Task T3.2: Integrate (M6-M9) *Leader: **UoC**. Contributors: UoC*
In this task UZH will integrate the work done in T3.1.

Task T3.3: 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 T3.2.
UoC will..

dev:wpdocumentation

Deliverables

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)**

sec:wplist

List of work packages

Table 1.1b: List of work packages

Work package number	Work package title	Lead partic-ipant no.	Lead partici-pant name	Person-months	Start month	End month
WP1	Virtual HID, Data Collection, and ML Code	1	UoC	17	1	36
WP2	Model 1 Command A	2	UoP2	21	2	36
WP3	TEST WORK PACKAGE	3	UoP3	23	1	36
	TOTAL			61		

sec:deliverables

List of deliverables

[2] **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 1.1c: Deliverable list

Delive-rable num-ber	Deliverable name	WP no.	Lead par-ticipant name	Na-tu-re	Disse-mina-tion 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

[2] If 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).

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

sec:management

1.2 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)

sec:milestones

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 1.2a: 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

sec:risks

Critical risks for implementation

table:risks

Table 1.2b: 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

sec:consortium

1.3 Consortium as a whole

table:soe

Table 1.4a: 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.

sec:resources

1.4 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

2 Ethics and Security

cha:ethics

sec:ethics

This section is not covered by the page limit.

2.1 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.

sec:security

2.2 Security

[3] Please indicate if your project will involve:

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

[3] Article 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).