

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.

1 Implementation

1.1 Project work plan

Work package description

Work package number	WP1	Starting week	1
Work package title	Virtual HID, Data Collection, and ML Code		
Participant number	1		
Short name	UoC		
Person-weeks	12		

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.

Description of work

Task T1.1: Task1 (W1-W12)

Here we will test the WP Task code.

Task T1.2: Task2 (W6-W9)

In this task UZH will integrate the work done in ??.

Task T1.3: Task3 (W9-W12)

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

Deliverables

D1.1 Report on the definition of the model specifications. (W36)

D1.2 Report on Feasibility study for the model implementation. (W12)

D1.3 Prototype of model implementation. (W24)

1. Implementation

Work package number	WP2	Starting week	2
Work package title	Model 1 Command A		
Participant number	1		
Short name	UoC		
Person-weeks	3		

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 T2.1: Task1 (W1-W12)

Here we will test the WP Task code.

Task T2.2: Task2 (W6-W9)

In this task UZH will integrate the work done in ??.

Task T2.3: Task 3 (W9-W12)

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

Deliverables

D2.1 Report on the definition of the model specifications. (W36)

D2.2 Report on Feasibility study for the model implementation. (W12)

D2.3 Prototype of model implementation. (W24)

description

Work package number	WP3	Starting week	1
Work package title	Model 1 n Commands		
Participant number	3		
Short name	UoP3		
Person-weeks	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 T3.1: Test (W1-W12)

Here we will test the WP Task code.

Task T3.2: Integrate (W6-W9)

In this task UZH will integrate the work done in [T3.1](#).

Task T3.3: Apply (W9-W12)

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

Role of partners

Participant short name will lead Task [T3.2](#).

UoC will..

Deliverables

D3.1 Report on the definition of the model specifications. **(W36)**

D3.2 Report on Feasibility study for the model implementation. **(W12)**

D3.3 Prototype of model implementation. **(W24)**

1. Implementation

description

Work package number	WP4	Starting week	1
Work package title	Model 2 n Commands		
Participant number	1		
Short name	UoC		
Person-weeks	12		

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.

Description of work

Task T4.1: Task1 (W1-W12)

Here we will test the WP Task code.

Task T4.2: Task2 (W6-W9)

In this task UZH will integrate the work done in ??.

Task T4.3: Task3 (W9-W12)

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

Deliverables

D4.1 Report on the definition of the model specifications. **(W36)**

D4.2 Report on Feasibility study for the model implementation. **(W12)**

D4.3 Prototype of model implementation. **(W24)**

description

Work package number	WP5	Starting week	1
Work package title	Optimizations		
Participant number	1		
Short name	UoC		
Person-weeks	12		

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.

Description of work

Task T5.1: Task1 (W1-W12)

Here we will test the WP Task code.

Task T5.2: Task2 (W6-W9)

In this task UZH will integrate the work done in ??.

Task T5.3: Task3 (W9-W12)

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

Deliverables

D5.1 Report on the definition of the model specifications. **(W36)**

D5.2 Report on Feasibility study for the model implementation. **(W12)**

D5.3 Prototype of model implementation. **(W24)**

1. Implementation

description

Work package number	WP6	Starting week	1
Work package title	Real Life Application		
Participant number	1		
Short name	UoC		
Person-weeks	12		

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.

Description of work

Task T6.1: Task1 (W1-W12)

Here we will test the WP Task code.

Task T6.2: Task2 (W6-W9)

In this task UZH will integrate the work done in ??.

Task T6.3: Task3 (W9-W12)

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

Deliverables

D6.1 Report on the definition of the model specifications. **(W36)**

D6.2 Report on Feasibility study for the model implementation. **(W12)**

D6.3 Prototype of model implementation. **(W24)**

description

Work package number	WP7	Starting week	1
Work package title	Universal Model, n Commands		
Participant number	1		
Short name	UoC		
Person-weeks	12		

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.

Description of work

Task T7.1: Task1 (W1-W12)

Here we will test the WP Task code.

Task T7.2: Task2 (W6-W9)

In this task UZH will integrate the work done in ??.

Task T7.3: Task3 (W9-W12)

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

Deliverables

D7.1 Report on the definition of the model specifications. **(W36)**

D7.2 Report on Feasibility study for the model implementation. **(W12)**

D7.3 Prototype of model implementation. **(W24)**

List of work packages

Table 1.1b: List of work packages

Work package number	Work package title	Lead participant no.	Lead participant name	Person-weeks	Start week	End week
WP1	Virtual HID, Data Collection, and ML Code	1	UoC	12	1	36
WP2	Model 1 Command A	1	UoC	3	2	36
WP3	Model 1 n Commands	3	UoP3	12	1	36
TOTAL				27		

List of deliverables

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Table 1.1c: Deliverable list

Deliverable number	Deliverable name	WP no.	Lead participant name	Nature	Dissemination Level	Delivery date (proj. week)
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
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

1.2 Management and risk assessment

List of milestones

¹If 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 weeks 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).

Table 1.4a: Summary of staff effort

Partic. no.	Partic. short name	WP1	WP2	WP3	Total person weeks
1	UoC	12	3	0	15
2	UoP2	0	0	0	0
3	UoP3	0	0	12	12
Total		12	3	12	27

Table 1.2a: List of milestones

Milestone number	Milestone name	Related WPs	Estimated date	Means of verification
W1	Completed simulator development	1	24	Software released and validated
W2	Final demonstration	WP ??	36	Application of results

Critical risks for implementation

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 ??	Resort to Software simulations

1.3 Consortium as a whole

1.4 Resources to be committed

Summary of staff efforts

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

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	
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

2.1 Ethics

2.2 Security

2

²Article 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).