UNIVERSIDAD DE GUADALAJARA

CENTRO UNIVERSITARIO DE LOS VALLES

MAESTRÍA EN INGENIERÍA DE SOFTWARE

Author:
Ilse Aribei Hernández Meza

Subject:
Administración de la configuración del software

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Contents

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Version History

Date	Version	Description	Author
2022-08-26	1.0	Homework	Ilse Aribei Hernández Meza
2022-09-03	1.1	Add context and improve system design	Ilse Aribei Hernández Meza
2022-09-20	1.2	Improve the content	Ilse Aribei Hernández Meza

2022-10-9	1.3	Add content and complete the requirements and software design	Ilse Aribei Hernandez Meza

Table 1: Version History

Title

Design and implementation of a software for the mental control of terrestrial robots with therapeutic purposes

Context

The attention deficit hyperactivity disorder (ADHD) is a psychiatric neurodevelopmental disorder characterized by inappropriate levels of inattention and / or impulsivity and hyperactivity, this affects an estimated between 8% and 12% of the young people in the world being a mental disorder with more presence during childhood Children with ADHD commonly present symptoms of hyperactivity, impulsivity, lack of concentration what triggers another suffering like a poor tolerance of frustration, low self-steam and humor changes that are presented mainly during childhood but also that can persist into adolescence and adulthood in about 50 % of diagnosed cases. Adults with ADHD presents higher rates of college dropout, poor job performance, difficulty keeping a job, and lower wages than peers of similar intelligence as well as higher-risk impulsive behaviors, substance abuse, self-harm, and suicide attempts. However, a timely treatment in childhood can conduce to improve both mental health and style of life during adulthood. Commonly, ADHD treatments are classified in pharmacological, nonpharmacological, and multimodal treatments. Whereas pharmacological treatments are based on the use of different drugs non-pharmacological treatment are based on different strategies such as diet, exercise, cognitive training, behavioral therapy, and neurofeedback. Neurofeedback (NF) it is a non-pharmaceutical and non-invasive neuromodulation technique whose objective is to provide participants with information about their brain functions, in particular, electrical brain activity (electroencephalogram; EEG) during the production of a certain behavior in real time using a brain-computer interface.

Introduction

Social robots are developed as support tools in various health treatments. However, the focus that has been given to these robots has been in 3 areas: physical trainers, care for the elderly and as a tool for therapy in children. Social robots have been used in therapies for children with cancer, cerebral palsy, communication disorders and neurodevelopmental disorders to mention a few. Studies reveal that the use of social robots in therapy for children with autism and in play therapy in hospitals is favorable. The child perceives the robot as a pet or a toy, which allows him to take a pleasant and comprehensive therapy; In addition, the child faces a position of superiority towards the robot, which generates an environment of trust. Robot-assisted therapies and brain training programs in children are becoming more popular, providing benefits for populations with neurological problems, such as pediatric patients diagnosed with attention deficit hyperactivity disorder (ADHD), this being a psychiatric and neurodevelopmental disorder that statistically affects a population of 11% of children worldwide. That is why, at the Centro Universitario de los Valles, a group of professors and students have started with the development of a project called CogniDron-EEG, which aims to be a system with therapeutic purposes for patients with ADHD. A series

of exercises are proposed through the mental control of physical drones or in virtual reality scenarios to help train some cognitive functions through therapies with the support of a portable electroencephalogram (EEG), which allows the reading of the brain electrical signals of the patient in real time.

The present work describes the baseline for the development of therapeutic exercises based on the mental control of terrestrial robots and integrate them into the Cognidron-EEG system with the aim of increasing its functionality.

Objectives of a system

General objective

Increase the functionality of the CogniDron-EEG system, through the design and implementation of new exercises to train the functions.

Specific objectives

- Study the CogniDron-EEG module that allows access to the Emotiv epoc+ electroencephalogram data and, if necessary, modify it to integrate the cognitive training exercises to be developed.
- Identify the necessary characteristics in a robot so that it can be considered a social robot.
- Implement in the robot the behaviors necessary for it to be considered a social robot and to be used in therapeutic exercises.
- Design and implement 5 therapeutic exercises.
- Integrate the modules developed in the CogniDron-EEG system.
- Design and implement functionality tests to validate the functionality of the developed modules.
- Design and implement integration tests to validate the correct integration of the modules developed within the CogniDron-EEG system.

Functional requirements

Functional requirements:

RF-01: Design a module that allows defining the user and password to be used to connect to the database management system used by the CogniDron-EEG system.

RF-02: Allow the CongiDron-EEG System Administrator user to modify the user password used to connect to the database.

RF-03: The username and password used to access the CongiDron-EEG system database must be stored in an encrypted file.

RF-04: Show a window that allows registering the username and password that will be used to access the CongiDron-EEG system database if the file containing the credentials to access the database is missing. empty or does not exist.

RF-05: Modify the lines of code of the current version of the CongiDron-EEG system in which the username and password to access the database have been embedded.

RF-06: Make use of the module that obtains the patient's electroencephalographic information through the Emotiv Epoc+ EEG device to implement it in the training routines based on the NAO robot.

RF-07: Connect to a virtual NAO robot that will be displayed from the Choregraphe program.

RF-08: Connect with a virtual NAO robot that will be displayed from the Webots simulator.

RF-09: Create virtual scenarios in the Webots simulator where the NAO robot can interact.

RF-10: Implement at least 5 cognitive training exercises.

RF-11: Offer both inhibitory and excitatory exercises.

RF-12: Implement a motivational phrase made by the robot to indicate that it is ready to start cognitive training.

RF-13: Implement a phrase made by the robot to motivate the patient to reach the concentration goal (excitatory or inhibitory as the case may be) in case the patient fails to reach the goal for a period of 30 seconds.

RF-14: Implement a motivational phrase performed by the robot to indicate the cognitive training session has ended.

RF-15: The patient must be selected to perform a cognitive training session.

RF-16: To carry out a cognitive training session, the exercise must be selected.

RF-17: Before starting a cognitive training session, the robot must greet the patient, personalizing the greeting with the patient's name.

RF-18: Control the “walk forward”, left, right, back movements of the robot with the data obtained from the EEG in real time. (Restriction: the movements to be implemented will depend on the routines implemented in the robot)

RF-19: Show an image on the therapist's screen that indicates the next movement that the robot will perform.

RF-20: Provide visual Neurofeedback to the patient in real time.

RF-21: When an automatic threshold is specified, it will be updated every 3 seconds according to the power averages obtained from the last 3 seconds.

RF-22: Allow to set a threshold manually that will remain static, but can be modified if the therapist wishes.

RF-23: Allow to establish a hybrid threshold in which it will be updated automatically every 3 seconds, but the therapist can modify it manually at any time during the session.

RF-24: Allow scaling from 1 to 100 the values obtained from the patient's brain activity during a cognitive training session.

RF-25: Stop the exercise at the time the therapist wants.

RF-26: Show a summary of the cognitive training exercise at the end of it.

RF-27: Save training data in csv format.

Specification of functional requirements

Functional Requirements Specification			
Code	Name		Degree of need
RF-01	Design a module that allows defining the user and password to be used to connect to the database management system used by the CogniDron-EEG system		High
Description	The system will allow the user to enter the username and password of your SQL database in order to establish a connection with it		
Inputs	Source	Outputs	Restrictions
*User *Password *Name of the database	User	Connection established with the database	It is necessary that the system has been previously installed SQL server database manager and having previously created a user, in addition, the database referring to the system to be developed must be stored on the computer where the connection is to be established

Process	The patient goes to the section corresponding to the administration of connections, select the option corresponding to establishing a connection with the database, enter the user rio, the password and the name of the database and then press accept.

Specification of Functional Requirements			
Code	Name		Degree of need
RF-02	Allow the Administrator user of the CongiDron-EEG system to modify the password of the user used to access the database		High
Description	The system will allow the administrator user to modify the password that used to establish a connection with the database manager, through a window		
Inputs	Source	Outputs	Restrictions
*User *Password	User	Updated password	It is necessary to have previously installed the SQL server database management system and to have created a user previously, in addition
Process	The user goes to the section corresponding to connection management, selects the option corresponding to change password, enters the username and the new password, later, the system will notify him of the success or failure of updating the password		

Functional Requirements Specification			
Code	Name		Degree of need
RF-03	The username and password used to access the CongiDron-EEG system database must be stored in an encrypted file		High
Description	When installing the CogniDron-EEG v3 system, it should look for the file containing the username and password to access the database in order to establish a connection to the database		
Inputs	Source	Outputs	Restrictions
*File	System Database	connection established	The path to the location of the file will be defined by the programmer
Process	The system will automatically search for the file that will contain the credentials		

Specification of Functional Requirements		
Code	Name	Degree of need

RF-04	Show a window that allows registering the username and password that will be used to access the CongiDron-EEG system database if the file containing the credentials to access the database is empty or does not exist	High
Description	When installing the CogniDron-EEG v3 system, it must look for the file that contains the username and password to access the database in order to establish a connection with the database, if it is not found, the user will be shown a window where they must enter the username and password	

Inputs	Source	Outputs	Restrictions
*User Password	User	Connection to the established database	The window will appear automatically if the file that contains the username and password is not found
Process	The system will automatically search for the file that will contain the credentials, in case if not found, a window will be displayed where the user must create a username and password		

Specification of Functional Requirements

Code	Name	Degree of need
RF-05	Modify the code lines of the current version of the CongiDron-EEG system in which the username and password have been embedded to access the database	High
Description	The lines of code that do not allow the user the freedom to define their own username and password and force them to use the “root” user or a weak password	

Inputs	Source	Outputs	Restrictions
*Source code	CogniDron-EEG v1	CongiDron-EEG v3	Lines will be modified of code necessary to implement the requirement
Process	The programmer will modify the source code of the CogniDron-EEG v1 system		

Specification of Functional Requirements		
Code	Name	Degree of need
RF-06	Make use of the module that obtains the electroencephalographic information of the patient through the EEG Emotiv Epoc+ device to implement it in the training routines based on the NAO robot	High

Description	Obtain the electroencephalographic information of the patient in real time using the Emotiv Epoc+ electroencephalogram device		
Inputs	Source	Outputs	Restrictions
*Emotiv Epoc+	User	Temporary storage of data referring to electroencephalographic information	A stable internet connection and the correct placement of the electrodes on the patient's head are required
Process	The patient the EEG device is placed correctly and the system will obtain the electroencephalographic information of the patient		

Functional Requirements Specification		
Code	Name	Degree of need
RF-07	Connect to a virtual NAO robot that will be displayed from the Choregraphe	Alto
Description	The user will be allowed to enter the port and IP of the virtual robot in order to establish a connection with said robot	

Inputs	Source	Outputs	Restrictions
*IP Port	User	“Connection established” message	It is necessary to have the Choregraphe application installed and started before establishing the connection with the robot
Process	Once the user has entered the system, they can go to the section corresponding to the connection with devices, choose the option that will allow you to establish the connection with the virtual robot and then enter the IP address and port of the robot, then the system will inform you through a pop-up window about the success or failure of the connection		

Functional Requirements Specification			
Code	Name		Degree of need
RF-08	Connect to a virtual NAO robot that will be displayed from the Webots simulator		High
Description	The user will be allowed to enter the port and IP of the virtual robot in order to establish a connection with said robot		
Inputs	Source	Outputs	Restrictions
*IP Port	User	“Connection established” message	It is necessary to have the Webots application installed and started before establishing the connection with the robot

Process	Once the user has entered the system, they can go to the section corresponding to the connection with devices, choose the option that will allow you to establish the connection with the virtual robot and then enter the IP address and port of the robot, then the system will inform you through a pop-up window about the success or failure of the connection

Functional Requirements Specification			
Code	Name		Degree of need
RF-09	Create virtual scenarios in the Webots simulator where the NAO robot can interact.		High
Description	Virtual scenarios must be created in the Webots simulator so that the virtual robot can interact and move in such scenarios		
Inputs	Source	Outputs	Restrictions
----------	CogniDron-EEG v3 System	Virtual scenario	The number of virtual scenarios will depend on the time available to carry out this requirement

Process	Scenarios can be viewed depending on the cognitive training exercise on the Webots simulator screen

Specification of Functional Requirements			
Code	Name		Degree of need
RF-10	Implement at least 5 cognitive training exercises		High
Description	At least 5 different cognitive training exercises must be implemented		
Inputs	Source	Outputs	Restrictions
Emotiv Epoc+	User	5 cognitive training exercises	The design and implementation of cognitive training exercises will be limited by the characteristics of the robot
Process	At least 5 cognitive training exercises will be designed and implemented. Of which the therapist will have the freedom to choose the exercise to implement		

Specification of Functional Requirements			
Code	Name		Degree of need
RF-11	Offer both inhibitory and excitatory		High
Description	The exercises offered may be both excitatory and inhibitory, which are described below: • Inhibitory: The goal of therapy is to maintain the average brain waves over 3 seconds below a threshold as many times as possible. • Excitatory: The goal of therapy is to maintain the average number of brain waves for 3 seconds above a threshold as many times as possible.		
Inputs	Source	Outputs	Restrictions
*Type of exercise	Database	Excitatory or inhibitory exercise	The therapist must select the type of exercise before starting therapy, otherwise the type of exercise will automatically be considered excitatory

Process	Once the user enters the cognitive training window will display the field corresponding to "Type of exercise" where you can indicate to the system the type of exercise to implement

Functional Requirements Specification			
Code	Name		Degree of need
RF-12	Implement a motivational phrase made by the robot to indicate that it is ready to start cognitive training		High
Description	When choosing to perform a therapy using the robot, it must make an auditory expression that indicate that the robot is ready to support cognitive training.		
Inputs	Source	Outputs	Restrictions
*Conformation to start cognitive training	User	Motivational auditory	expression The expression will be limited according to the characteristics of the robot used
Process	Once the user selects and confirms the therapy, the robot will make a motivational expression indicating that it is ready to start cognitive training.		

Functional Requirements Specification			
Code	Name		Degree of need
RF-13	Implement a phrase made by the robot to motivate the patient to reach the concentration goal (excitatory or inhibitory, as the case may be) in case the patient fails to reach the goal during a period of 30 seconds		High
Description	The robot will say a phrase with the aim of motivating the patient to reach the objective of the session		
Inputs	Source	Outputs	Restrictions
*electroencephalographic information *Desired threshold	User Emotiv Epoc+	Motivational auditory	expression The expression will be limited according to the characteristics of the robot used
Process	If the patient fails to reach the target threshold within 30 seconds, the robot will express a phrase to motivate him		

Specification of Functional Requirements			
Code	Name		Degree of need
RF-14	Implement a motivational phrase made by the robot to indicate the cognitive training session has ended		High
Description	At the time of finishing a therapy using the robot, it must make an auditory expression that indicates that the session has ended		
Inputs	Source	Outputs	Restrictions
*End session	User	Auditory	expression The expression will be limited according to the characteristics of the robot used
Process	Once the user selects and confirms the end of the session, the robot will perform an auditory expression indicating that the session has ended		

Specification of Functional Requirements

Code	Name	Degree of need
RF-15	The patient must be selected to perform a cognitive training session	High
Description	Before starting the cognitive training, the user must select the patient from a displayed list	

Inputs	Source	Outputs	Restrictions
*Patient name	Database	Selected Patient	Only patients who have previously been registered in the system will be allowed to choose. You will not be allowed to start therapeutic exercise without first selecting a patient.
Process	Once the user enters the cognitive training window, he will see the field corresponding to the patients, he will be able to display a list with the name of the patients registered in the system from which he will be able to select one, he will see the name of the patient selected in the corresponding field		

Specification of Functional Requirements		
Code	Name	Degree of need
RF-16	To carry out a cognitive training session, the exercise must be selected	High
Description	Before starting the cognitive training, the user must select the exercise from a displayed list	

Inputs	Source	Outputs	Restrictions
*Name of the exercise	Database	Selected	exercise Carrying out the exercise will depend on the robot being fully functional
Process	Once the user enters the cognitive training window, they will see the field corresponding to the exercises, they will be able to display a list with the name of the existing exercises in the system of which you can select one, you will see the name of the selected exercise in the corresponding field.		

Specification of Functional Requirements		
Code	Name	Degree of need
RF-17	Before starting a cognitive training session, the robot must greet the patient personalizing the greeting with the patient's name	High
Description	Before starting the session, you will have the option to make a personalized configuration . That is, if the therapist chooses “Personalize session” the robot must greet the patient by name	

Inputs	Source	Outputs	Restrictions
*Conformation of “personalize interaction” *Patient name	User	Personalized expression	It will only be personalized if the user selects “Personalize session”
Process	The user selects "Personalize interaction" and later the robot will emit the phrases used during the personalized therapy with the patient's name.		

Functional Requirements Specification			
Code	Name		Degree of need
RF-18	Control the movements “walk forward”, left, right, back of the robot with the data obtained from the EEG in real time		High
Description	The data obtained from the EEG will be used so that the robot performs or not the programmed exercises according to the therapeutic exercise (inhibitory or excitatory)		
Inputs	Source	Outputs	Restrictions

*Emotiv Epoc+ *Name of the exercise	User	Movement of the NAO robot	A stable internet connection and the correct placement of the electrodes on the patient's head are required patient. It is necessary for the robot to be functional, either physical or virtual The movements to be implemented will depend on the routines implemented in the robot
Process	The system obtains the data from the EEG device in real time, in turn, it sends them to the robot so that the robot performs or not the programmed actions according to the cognitive training exercise		

Specification of Functional Requirements			
Code	Name		Degree of need
RF-19	Show on the therapist's screen an image that indicates the next movement that the robot will perform		High
Description	In the window referring to the cognitive training exercise, an image will be shown with a description indicating the following movement that the robot will perform once the threshold is reached		
Inputs	Source	Outputs	Restrictions

Threshold	Patient	Image of the next robot movement and its description	It is necessary to have previously selected an exercise The image will change until the user reaches the threshold
Process	At the moment that the user chooses a therapeutic exercise in the window corresponding to the exercises using the robot, an image will be shown alluding to the next movement to be carried out by the robot, likewise, it will change as the exercise progresses		

Specification of Functional Requirements			
Code	Name		Degree of need
RF-20	Provide neurofeedback to the patient in real time		High
Description	The system will offer the patient feedback according to the behavior of their brain activity through the movements of the robot NAO		
Inputs	Source	Outputs	Restrictions
Activity cerebral	EEG	Neurofeedback	A stable internet connection and the correct placement of the electrodes on the patient's head are necessary. It is necessary for the robot to be functional, either physical or virtual.

Process	The patient places the EEG device properly, subsequently, the connection between the system and the EEG device is established, a connection is established with the NAO robot, whether physical or virtual, therapy begins and the patient will observe the robot execute certain movements controlled by his brain information obtained in real time

Specification of Functional Requirements			
Code	Name		Degree of need
RF-21	When an automatic threshold is specified, it will be updated every 3 seconds according to the power averages obtained from the last 3 seconds		High
Description	The neurofeedback type therapy window will have the options to represent a goal by means of a threshold which is a numerical value that is on a scale of 0 to 100 and will be represented by a red line. The threshold will be updated every 3 seconds according to the power averages obtained from the last 3 seconds.		
Inputs	Source	Outputs	Restrictions

*Automatic threshold selection	User	Automatic threshold set	The threshold will be updated every 3 seconds according to the power averages obtained from the last 3 seconds.
Process	When entering the window corresponding to therapy, the user will see the section corresponding to the type of threshold, the user will select the automatic threshold option		

Specification of Functional Requirements			
Code	Name		Degree of need
RF-22	Allow to establish a threshold manually that will remain static, but can be modified if the therapist wishes		High
Description	The neurofeedback type therapy window will have the options of representing a goal by means of a threshold which is a numerical value that is on a scale from 0 to 100 and will be represented by a red line. The manual threshold value will be established by the therapist and can be modified at any time during the session		
Inputs	Source	Outputs	Restrictions

*Manual threshold selection *Numeric value	User	Manual threshold set	The threshold value must be an integer between 0 and 100
Process	At the moment in which the window corresponding to the therapy is entered, the user will observe the section corresponding to the type of threshold, the user will select the manual threshold option and enter a numerical value between 0 and 100		

Specification of Functional Requirements			
Code	Name		Degree of need
RF-23	Allow establishing a hybrid threshold in which it will be updated automatically every 3 seconds, but the therapist can modify it manually at any time during the session		High
Description	The therapy window of neurofeedback type will have the options of representing a goal by means of a threshold which is a numerical value that is on a scale of 0 to 100 and will be represented by a red line. The manual threshold value may be set by the therapist or it may be automatic and may be modified by the therapist at any time during the session		
Inputs	Source	Outputs	Restrictions

*Manual threshold selection Numerical value	User	Hybrid threshold established	The threshold value must be an integer between 0 and 100 The user will enter a value and it will be automatically modified 3 seconds later according to the power averages obtained from the last 3 seconds.
Process	When entering the window corresponding to therapy, the user will see the section corresponding to the type of threshold, the user will select the manual threshold option and enter a numerical value between 0 and 100		

Specification of Functional Requirements			
Code	Name		Degree of need
RF-24	Allow to scale from 1 to 100 the values obtained from the patient's brain activity during a cognitive training session		High
Description	The neurofeedback-type therapy window will have the option of modifying the degree of visual representation of the power bar with the intention of providing greater ease of use in therapy. This configuration will be done through a field where a new threshold scale can be entered and will be applied by pressing a button		
Inputs	Source	Outputs	Restrictions

*Integer	User	Increase or decrease the representation visual brain waves in the power bar	The value to enter it must be an integer between 0 and 100 otherwise it will not be allowed to enter it. The scale must be able to be modified at any time during the therapy A connection with the EEG device must be established previously and the electrodes must be correctly placed on the patient's head
Process	At the time the user enters the window corresponding to the therapy You will see the section corresponding to the threshold scale and a bar that will show the power in real time, the user can enter a value and then press accept to change the threshold scale. The new threshold scale is calculated with the following formula: (Average power * 100) / the entered value = Threshold Scale		

Specification of Functional Requirements			
Code	Name		Degree of need
RF-25	Stop the exercise at the moment the therapist wants		High
Description	The exercises offered can be finished by pressing a button at the moment the therapist requires it		
Inputs	Source	Outputs	Restrictions
*Button “ Stop”	User	Ended Exercise	The therapist must press the “Stop” button, otherwise the training will continue until the program is closed
Process	Once the user has started a cognitive training session, they can end the session by pressing the button with the legend “ Having"		

Specification of Functional Requirements		
Code	Name	Degree of need

RF-26	Show a summary of the cognitive training exercise at the end of it		High
Description	Once the cognitive training ends, a window will be displayed with a summary of the most relevant exercise data		
Inputs	Source	Outputs	Restrictions

Patient data: *Name *Age -Location *Tutor Session data: *Type of therapy *Date *Environment *Device *Name of exercise *Cognitive functions *Electrodes *Number of times threshold was reached *Type of exercise * Duration of the session *Average power *Worked band Data of the therapist: *Name -Age -Location -Status *Contact	System	Summary of cognitive training	The data displayed will be those that are most relevant to the therapist

Process	Once the user starts the cognitive training will see in a window the most relevant data of the cognitive training activity

Specification of Functional Requirements			
Code	Name		Degree of need
RF-27	Save the cognitive training data save the data in csv format		High
Description	Once the cognitive training ends, the most relevant exercise data will be stored in the database		
Inputs	Source	Outputs	Restrictions

Patient data: *Name *Age -Location *Tutor Session data: *Type of therapy *Date *Environment *Device *Name of exercise *Cognitive functions *Electrodes *Number of times threshold was reached *Type of exercise *Duration of the session *Average power *Worked band Data of the therapist: *Name -Age -Location	System	Stored	data The stored data will be those that are most relevant to the therapist and will be stored only if the therapist clicks on “Save data”

-Status *Contact *Confirmation of storing data			

Process	Once the user starts cognitive training, they will see the most relevant data in a window. relevant to the cognitive training activity, in that window you will find a button to save the information, the user will press it and the information will be stored in the database

System design

Use cases

The use cases of the system are shown below describes the interaction between actors and functionalities of the module to develop.

Actors

Actors are two, the main actor is the therapist. Therapist function is to guide therapy and to be the operator of system and the main user. He has access to all modules through his account.

Second actor is patient. Patient will not directly use the system; he is only observer but not editor. Him register in system is responsibility of therapist. Him role is to receive therapy and use the electroencephalogram and to proportionate brain activity.

Modules

Select device: This function is represented by a screen and its function is permit therapist choosing between the different disponible devices to give therapy, current exists one functional device, a physical drone.

Start training: Start training permits therapist star cognitive training. When the therapist presses the button to refers start training the cognitive training will start and the movements of robot depending on brain activity and kind of exercise.

Modify threshold: The threshold is a "goal" that the user is expected to reach using their brain activity. It is represented by an integer numeric value from one to 100 and can be modified manually or automatically.

Select threshold: Permit user select a kind of threshold for therapy, it can be manual or automatic.

Record session: Permit user save important information of therapy in the data base.

Capture observations: Permit to therapist write relevant information about therapy.

List patient: This function allows the therapist to choose the patient through a drop-down list that appears in screen. Patient must be previously registered in database.

Select patient: Therapist can select one registered patient of the drop-down list.

Select exercise: This function permit to choose one of the programed exercises available in the system. Exercises are different and depends on the selected device (Robot or drone).

List exercise: This function allows the therapist to choose the exercise through a drop-down list that appears in screen.

Control the robot: This function consists in control some movements and behaviors programed on robot through brain information obtained of patient in real time. Movements depends on kind of exercise.

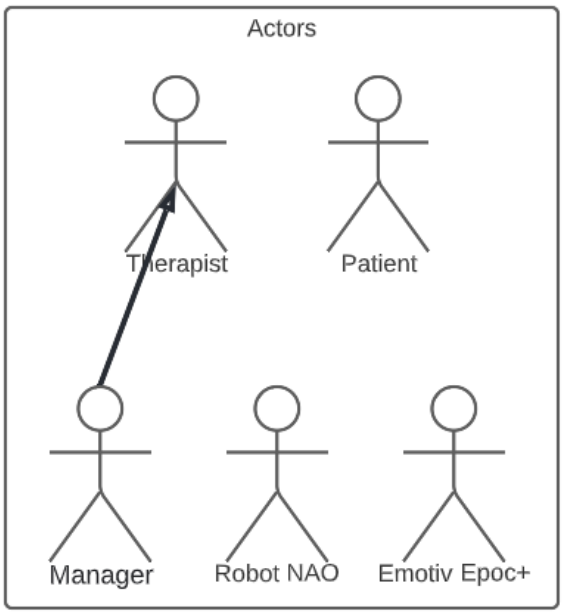

Figure 1: Actors

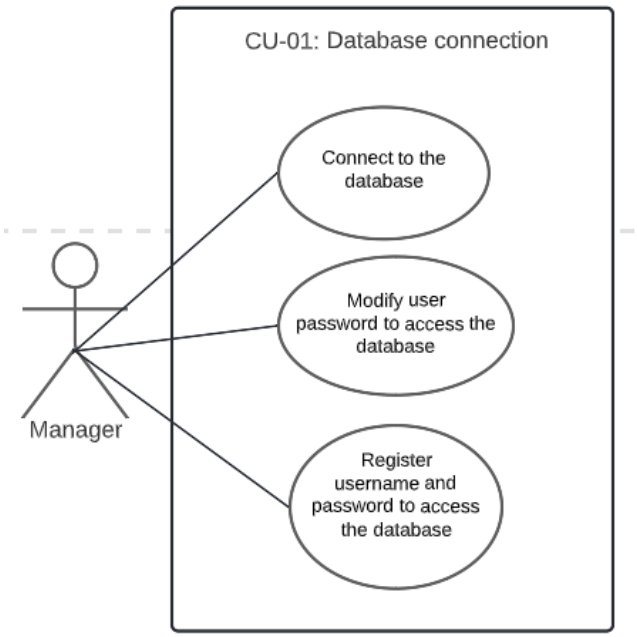

Figure 2: Data base connection

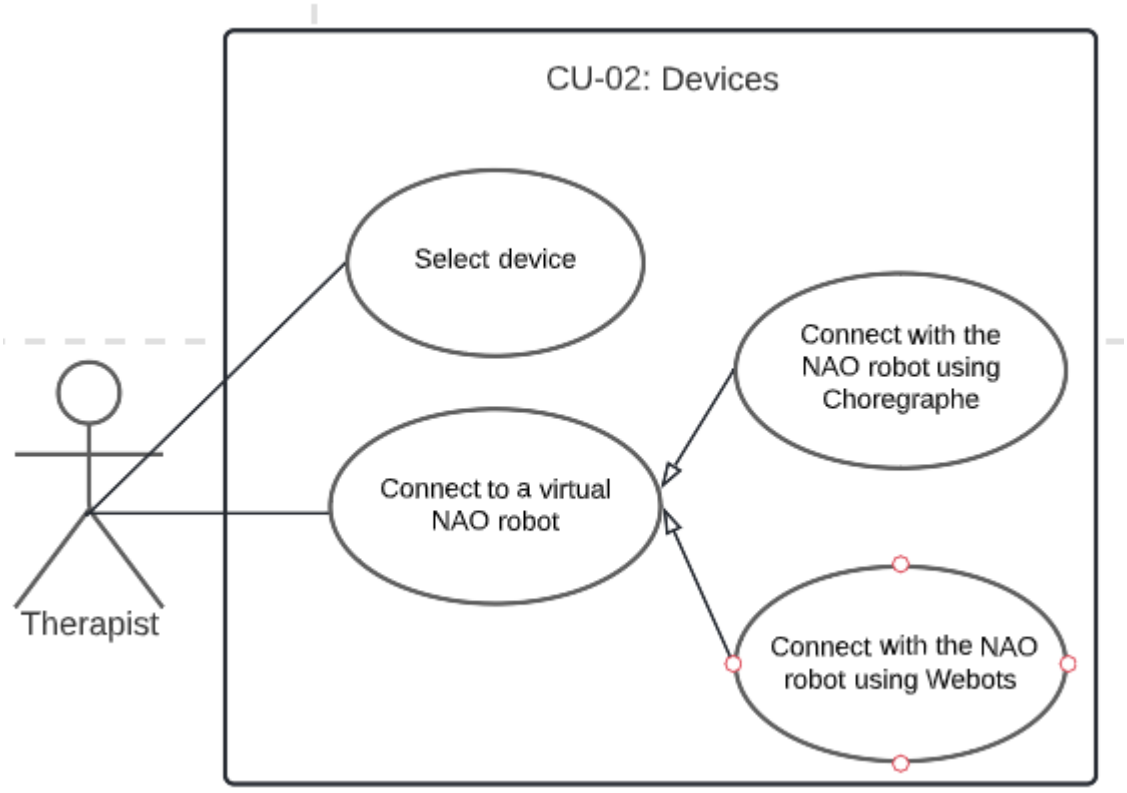

Figure 3 Devices

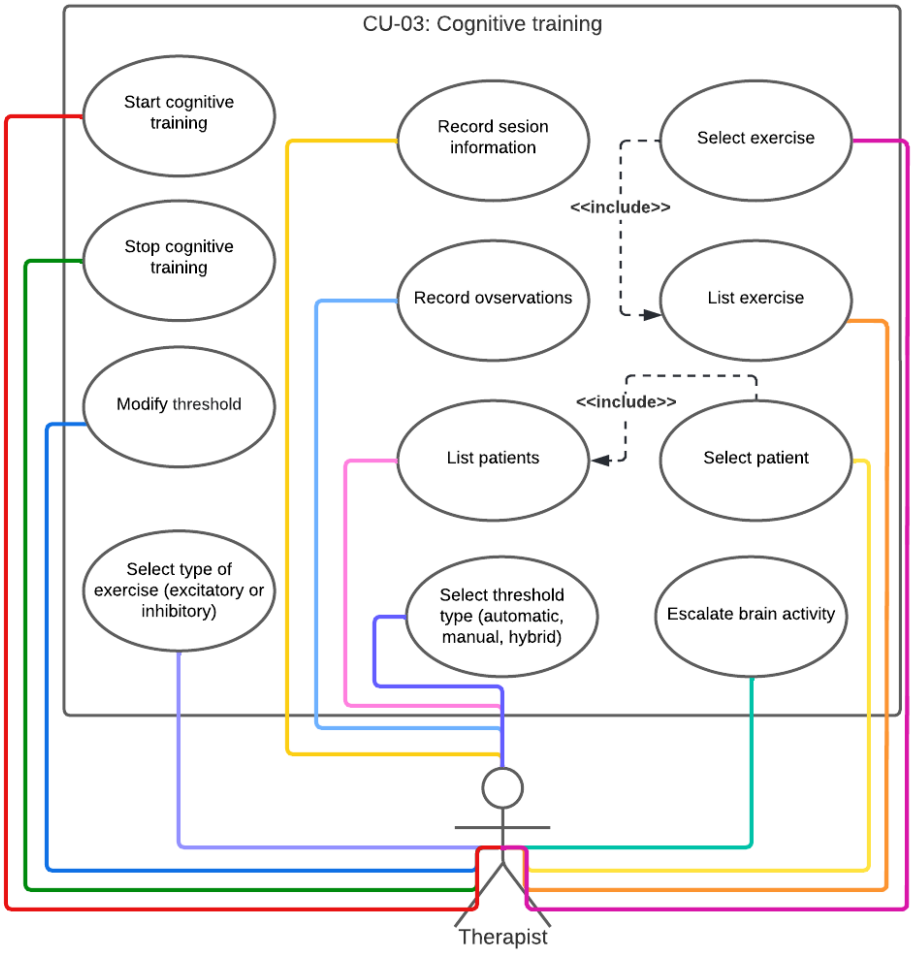

Figure 4 Cognitive training

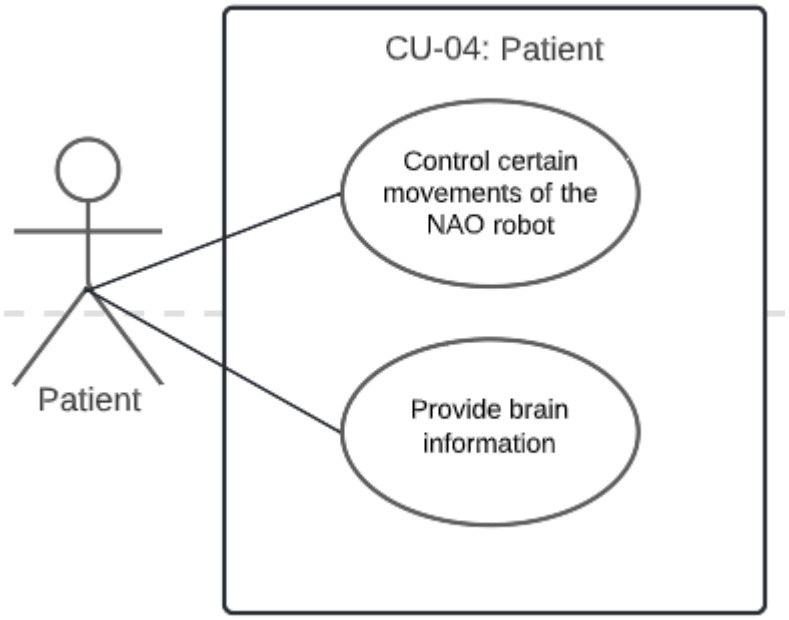

Figure 5 Patient

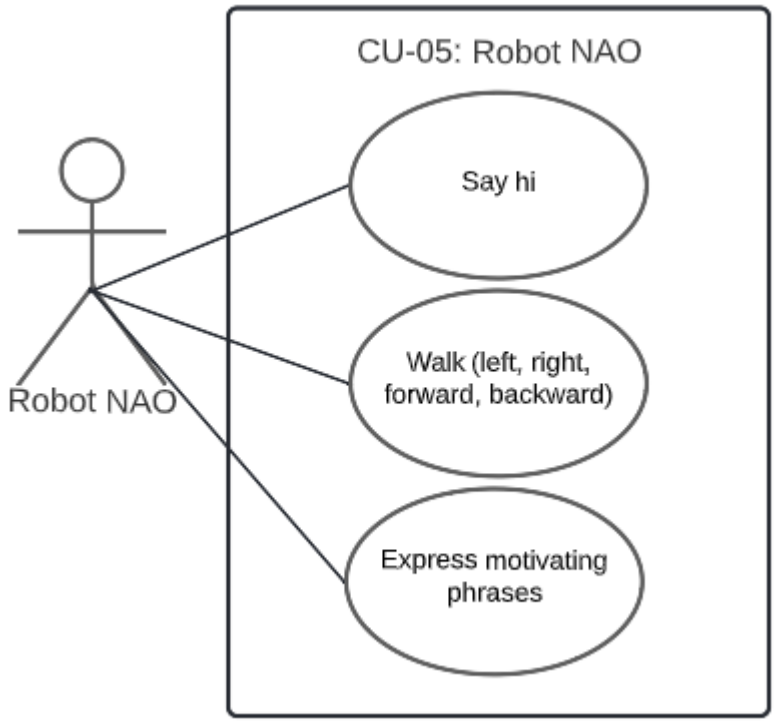

Figure 6 Robot NAO

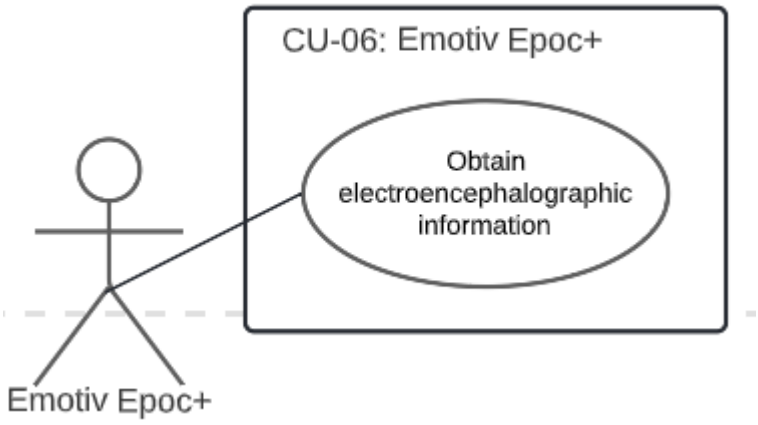

Figure 7 Emotiv Epoc+

Interface design

Below are shown interface design of two windows: Select device and neurofeedback therapy. The first window is the connection of Cognidron-EEG with the module to realize, if therapist select the option “Robot”, will be open the second one window. The most important window is the second one because in this the therapeutic exercises are realized and permit to connect with the robot.

Figure 8: Screen "Select device"

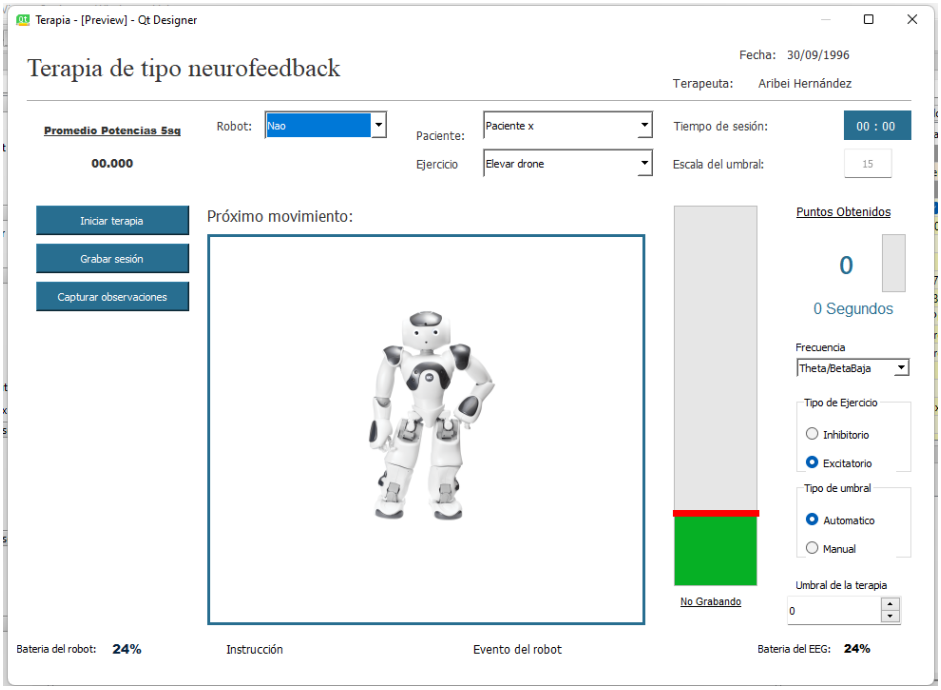

Figure 9: Screen "Neurofeedback training"

Test design

Static tests will be carried out on the documentation and requirements in order to find possible inconsistencies, unit tests testing each function individually, functional tests to test if the system meets the requirements and integration tests to verify the correct integration of the module to the system Cognidron-EEG.

Static tests: Static tests will be performed by the developer and the project advisor throughout the documentation process.

Unit tests: they will be carried out by the developer and will be white box. These tests will be performed during the coding stage. The release of functions and methods will be conditional on the success of the unit tests.

Functional tests: The functional tests will be carried out by the developer and will be a positive and a negative at least for each functional requirement.

Integration tests: These tests will be carried out by the developer and will verify the correct integration of the module to the cognidron-EEG system. They will be carried out once the first prototype of the module to be developed has been completed.

The tests will be limited by time, it is estimated that the first prototype of the module will be finished in January 2023, however, this may be subject to change.

Human resources

The following is a list of the people involved in the project and the role they play.

Name	**Role**	**Liability**
Dr. Antonio Cervantes Alvarez	Project consultant	Give feedback and advise the developer throughout the development process
Dra. Sonia Lopez Ruiz	Project consultant	Give feedback and advise the developer throughout the development process
Ilse Aribei Hernández Meza	Developer	Design and develop the module
Dr. Jahaciel Molina del Río	Client	Provide requirements