USER MANUAL

Robotic Arm Control Using Motor Imagery

NeuroComputing LAB,
Korea Institute of Science and Technology

This work was supported by Institute of Information & communications Technology Planning & Evaluation (IITP) grant funded by the Korea government (MSIT) (No. 2017-0-00432, Development of Non-invasive Integrated BCI SW Platform to Control Home Appliance and External Devices by User's Thought via AR/VR Interface)

Copyright

Any trademarks mentioned in this document are the protected property of their rightful owners. The reproduction, distribution and utilization of this document as well as the communication of its contents to others without express authorization is prohibited. Offenders will be held liable for the payment of damages. All rights reserved in the event of the grant of a patent, utility model or design. Subject to change without notice. For the latest version of this document, please contact to Neurocomputing LAB website(Kist | Neurocomputing Laboratory)

Published by

NeuroComputing LAB
Korea Institute of Science and Technology (KIST)
(02792) 5, Hwarang-ro 14-gil
Seongbuk-gu Seoul
Republic of Korea

Web:
https://neurocomputinglab.wixsite.com/neulab

Published on 10. Nov 2023

TABLE OF CONTENTS

Chapter 1

Installation

Under normal conditions, This Program does not impact on any programs already installed. However, only guarantees that programs will interact without problems if the programs concerned have been tested for compatibility. This applies to systems with the Microsoft operating system Windows® 10 or later, provided no modifications have been made to the provided operating system configuration (including official service packs and updates).

System requirements

The following hardware and software requirements must be fulfilled:

- ✓ Operating system: Windows® 10 or later (It may work in lower versions, but we are not sure about that)
- ✓ Minimum configuration: Intel Core i5 or higher, 512 MB of RAM, 8 GB hard disk, graphics adapter with 64 MB of RAM
- ✓ We recommend that a monitor with a screen diagonal of at least 15 inch is used.
- ✓ You must have equipment to acquire brain waves. We provide LSL programs for Biosemi, BrainProduct(actiCHamp), Cognionix, and G.tec (gNeedaccess) equipment. If you use other equipment, please install and use a separate LSL(Lab streaming layer) link program required for that equipment.
- ✓ Since all devices acquire data through LSL, LSL must be available. For more information about LSL, see Lab Streaming Layer (https://labstreaminglayer.org/#/)
- ✓ When installing for the first time, an internet connection is required.

1. Installing program under Windows

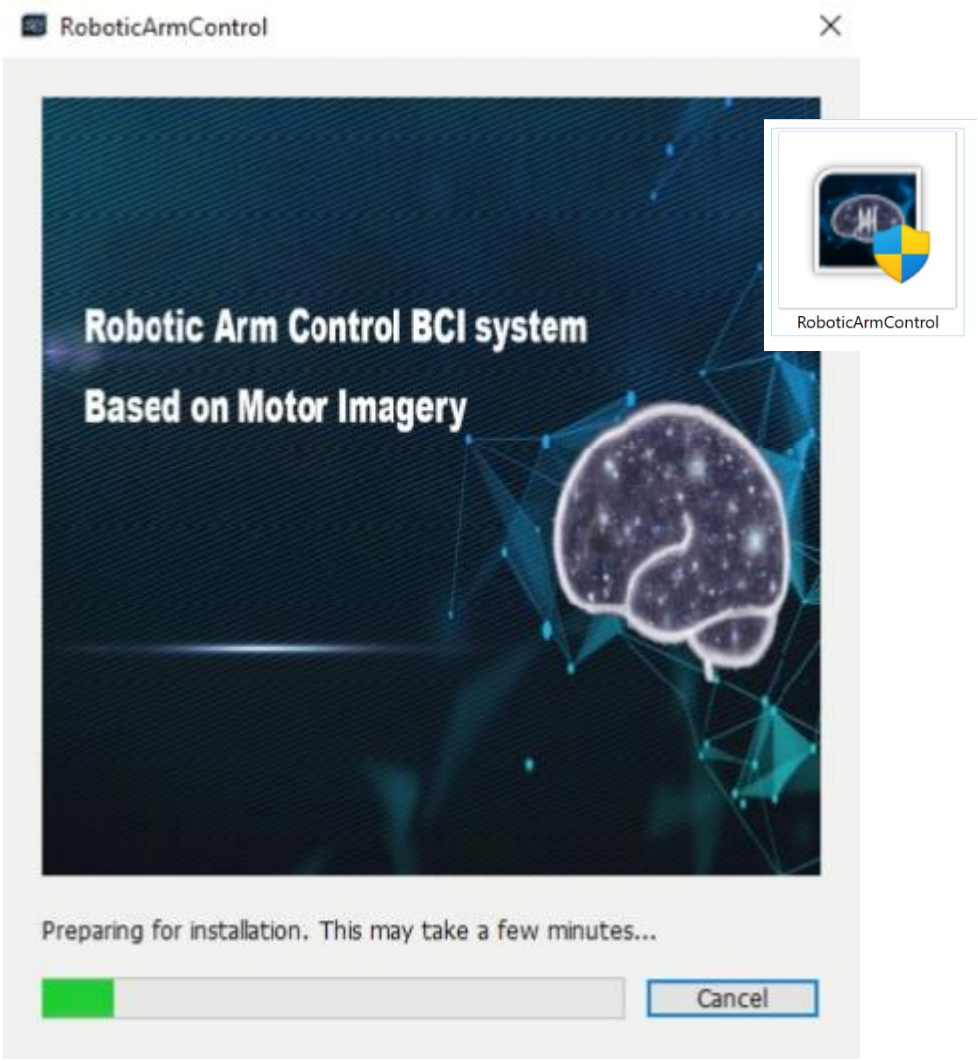
Proceed as follows to install Analyzer under Windows

1 Start Windows

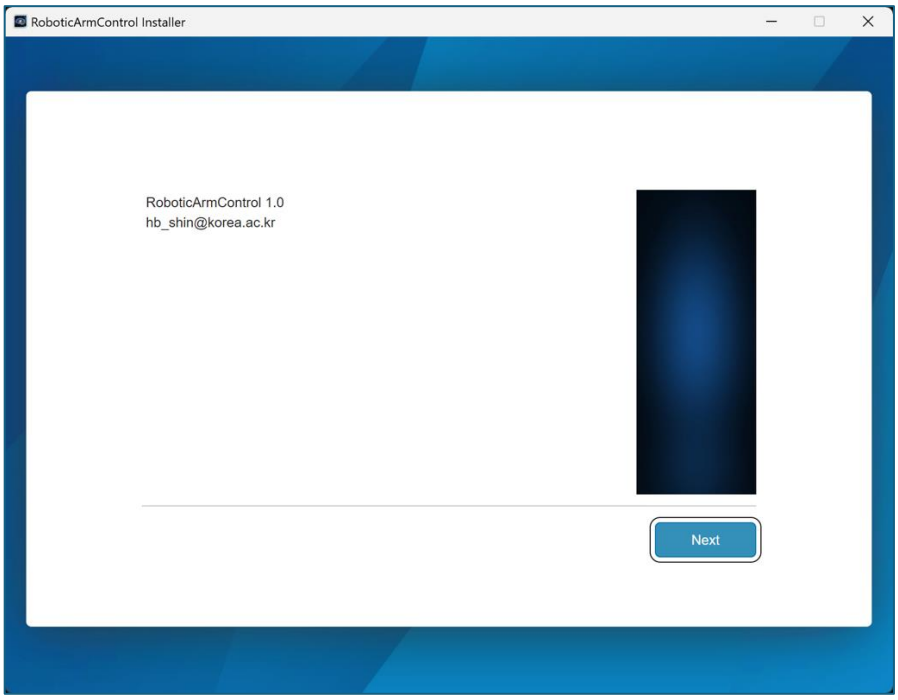
2 Download the program from the link here - NIBCI/IntegrationBCI (github.com) (https://github.com/NIBCI/IntegrationBCI)

3 Open the folder and double click Integration.exe to run the program. (See Figure 1)

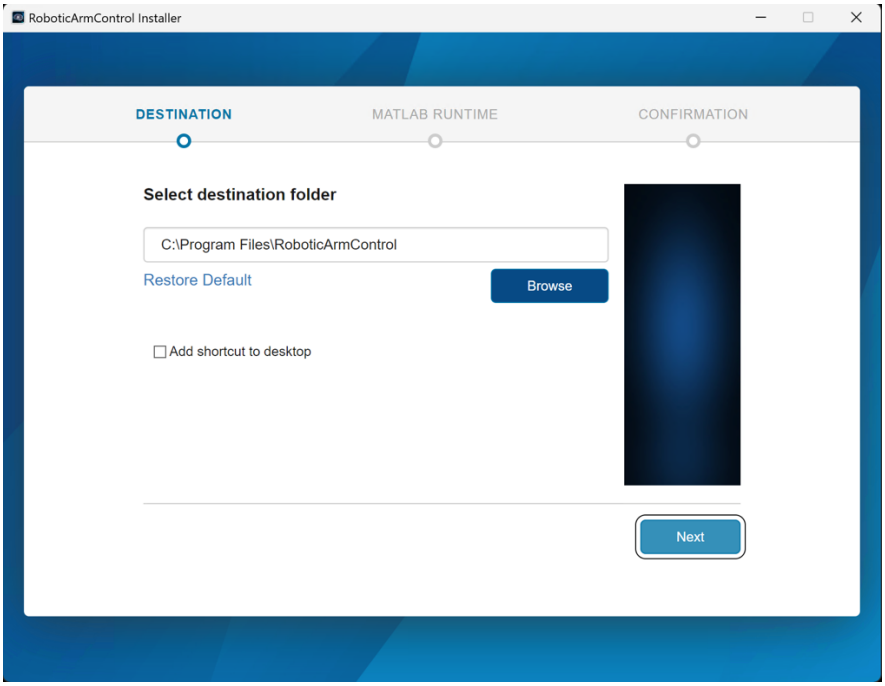
Figure 1. Run this .exe file



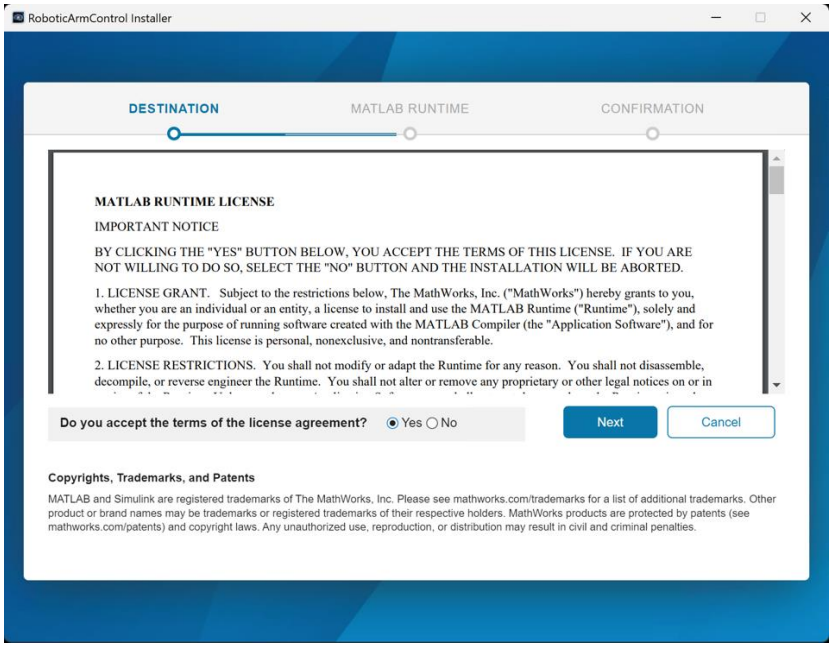
4 Click Next.



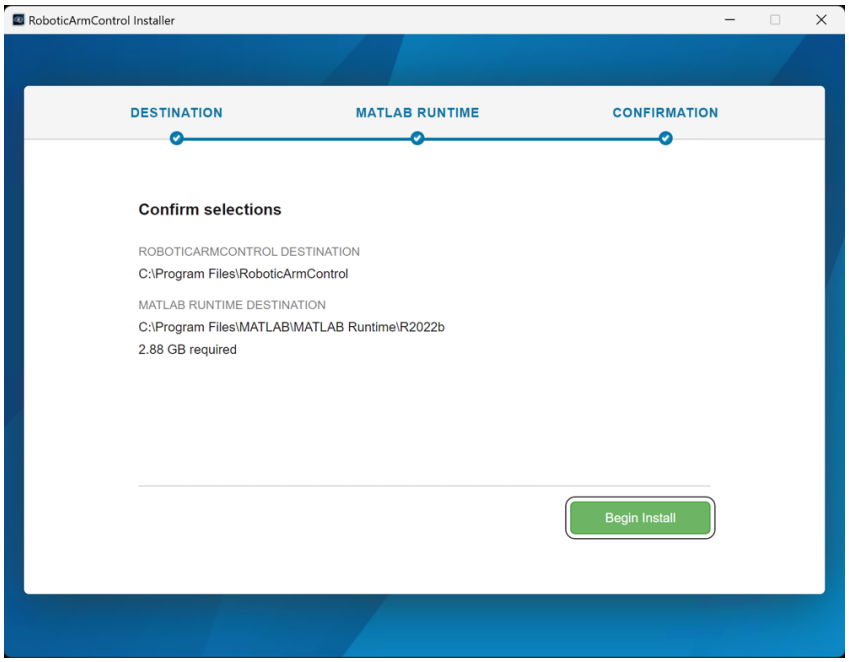
5 After checking the installation path, click Next.



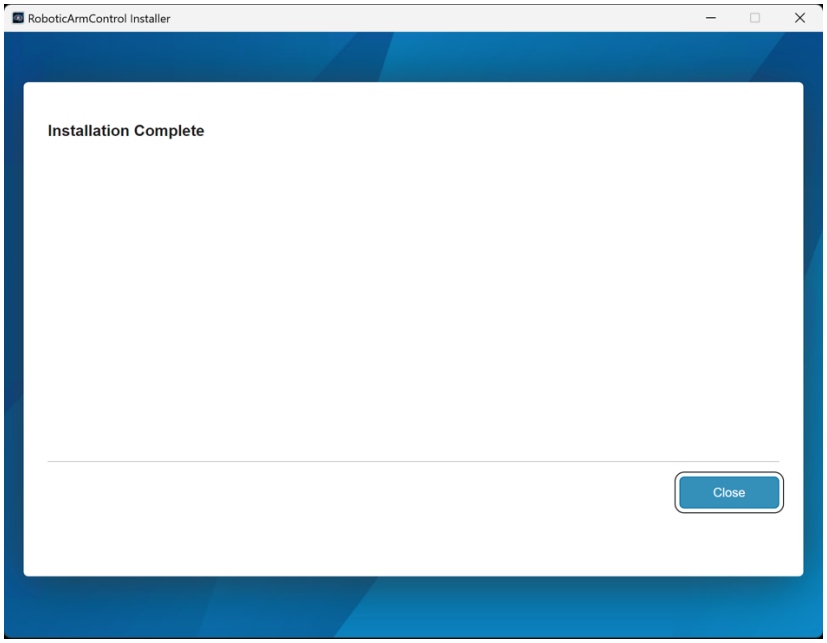
6 This program requires the runtime environment MATLAB. If MATLAB Runtime is not present on your system, then a message is displayed.



7 After checking the installation environment for MATLAB Runtime, click Begin Install.

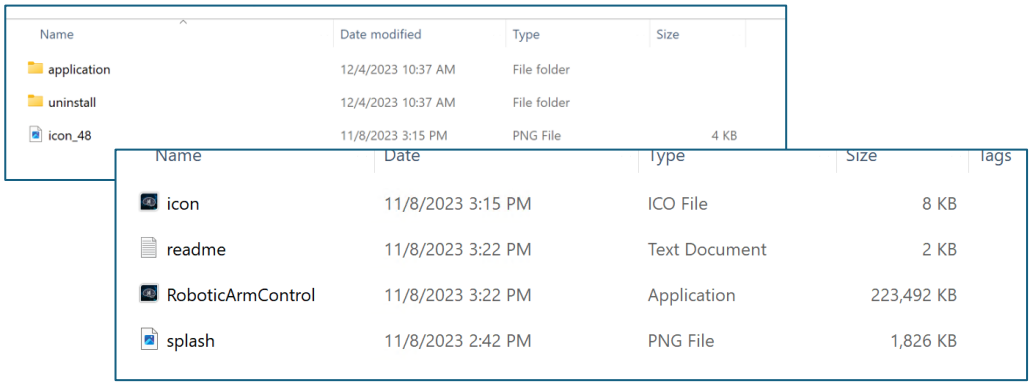


8 When installation is complete, click Close.

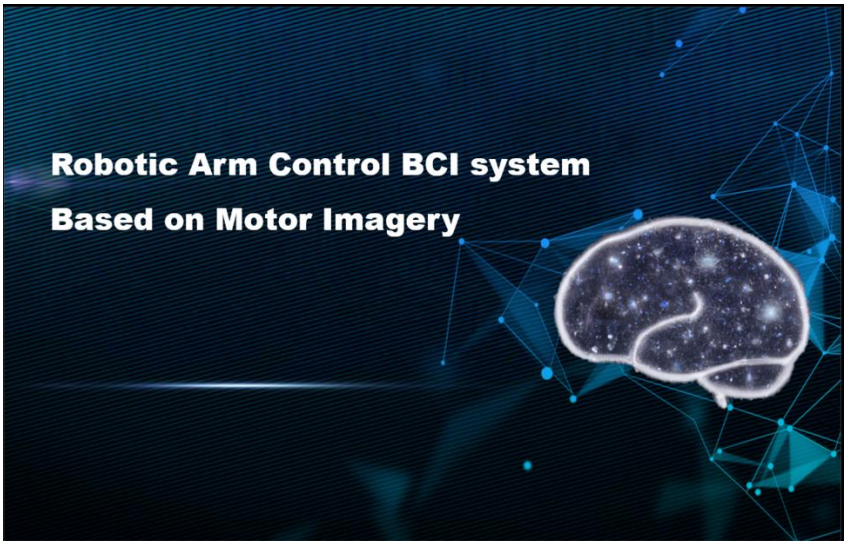


9 If you check the installation path, the **RoboticArmControl** folder has been created.

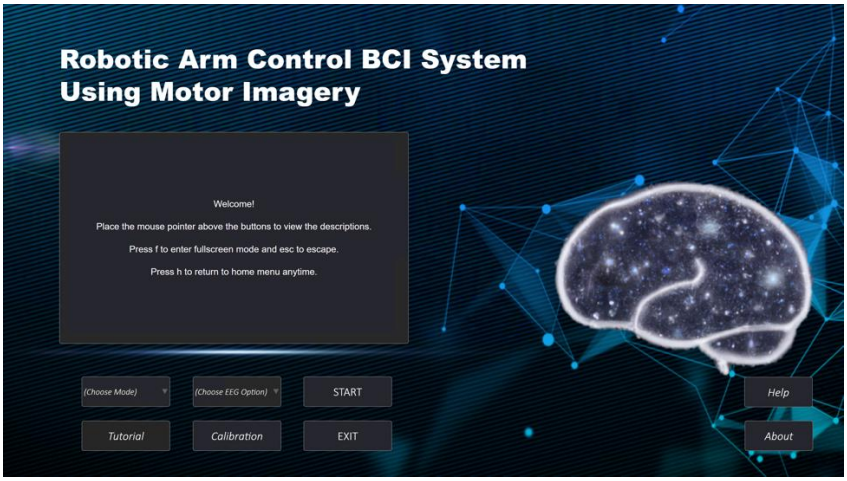
10 Enter the folder and enter the application. Find the **RoboticArmControl.exe** in the Application folder. Double click to open it.



11 The program startup background appears as shown below.

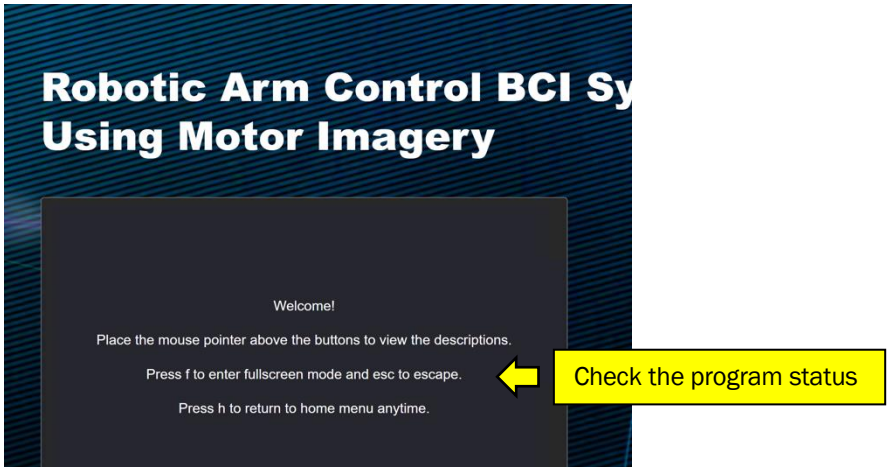


12 If the program runs as follows, you are ready to use Integration for BCI.

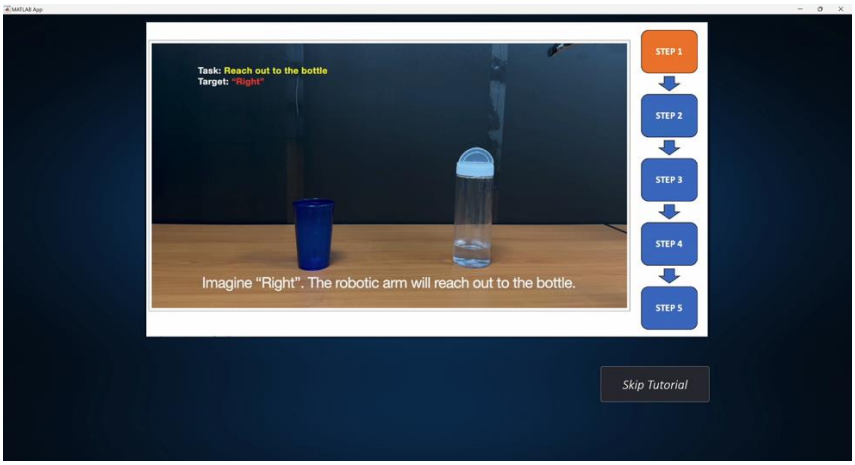


2. Running the program and how to use it

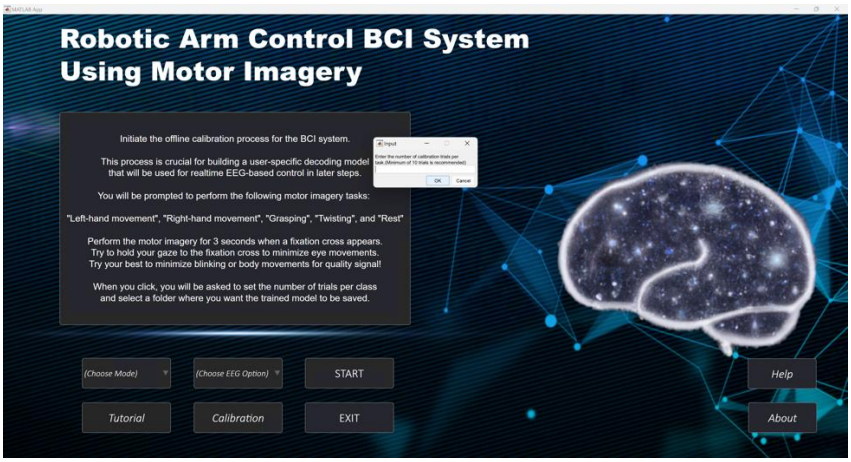
1 Check the program status window as shown below. You can get help on how to perform through the program status window.



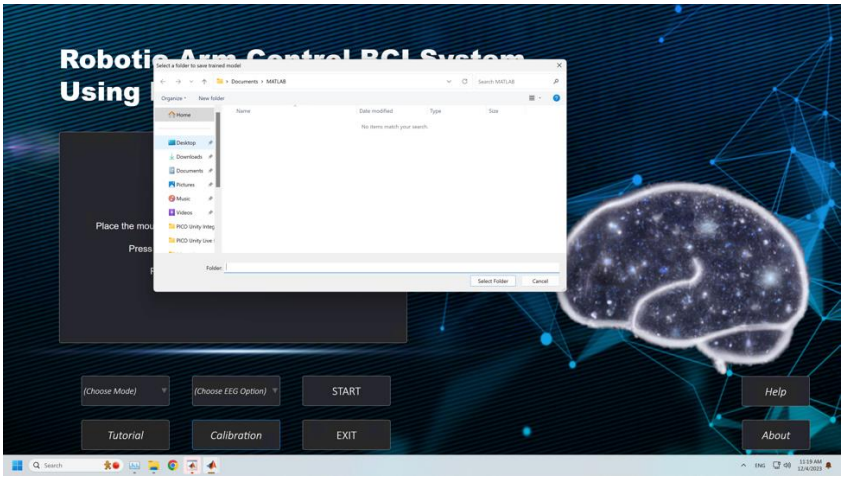
2 Click the 'Tutorial' button to have an overview of how this app works.



3 Click the "Calibration" button and choose the number of calibration trials per task.

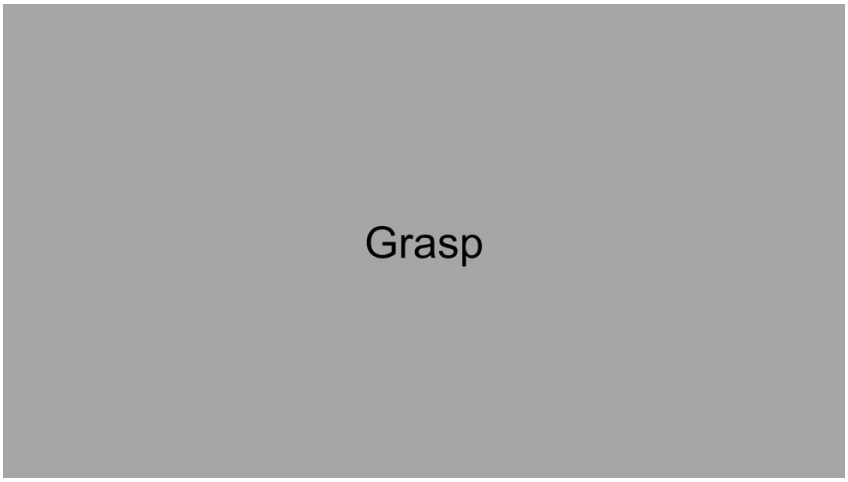


A. Next, select the place that you want to save the model.

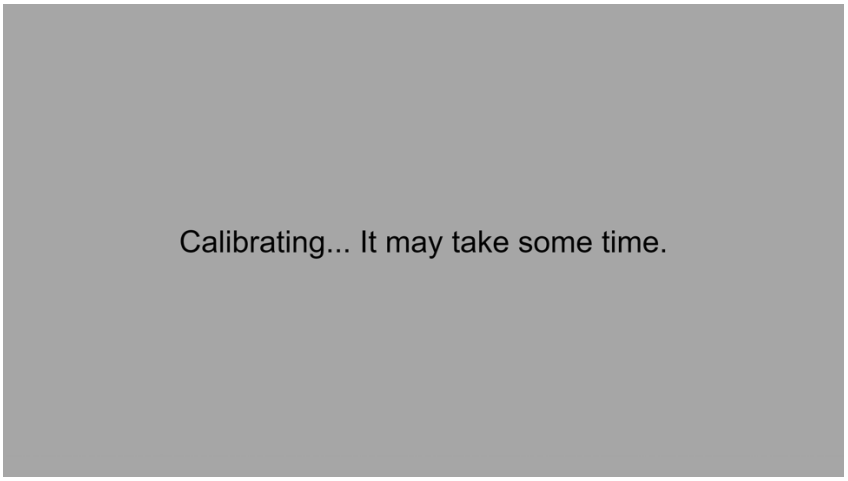


B. After a 3-second countdown, the calibration starts.

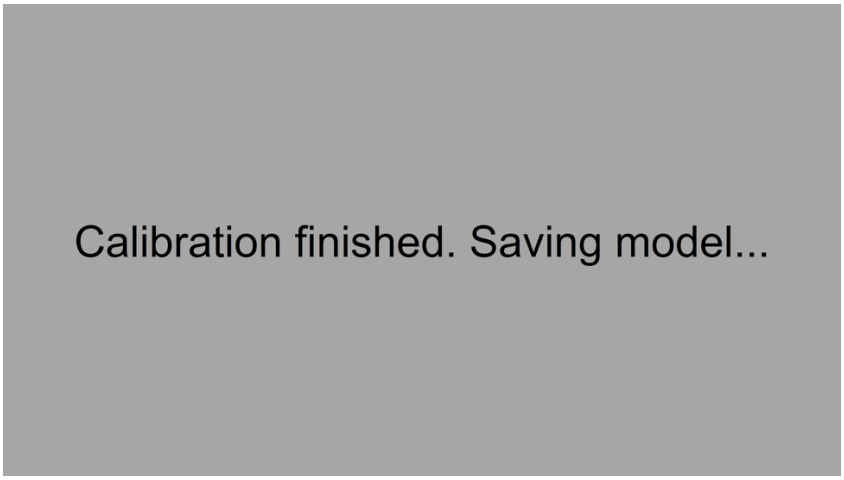
C. Each trial starts with a 2-second cue, and a 3-second MI.



D. Model training starts right after all trials are done.



E. The calibration ends, the model is saved at the specified location.

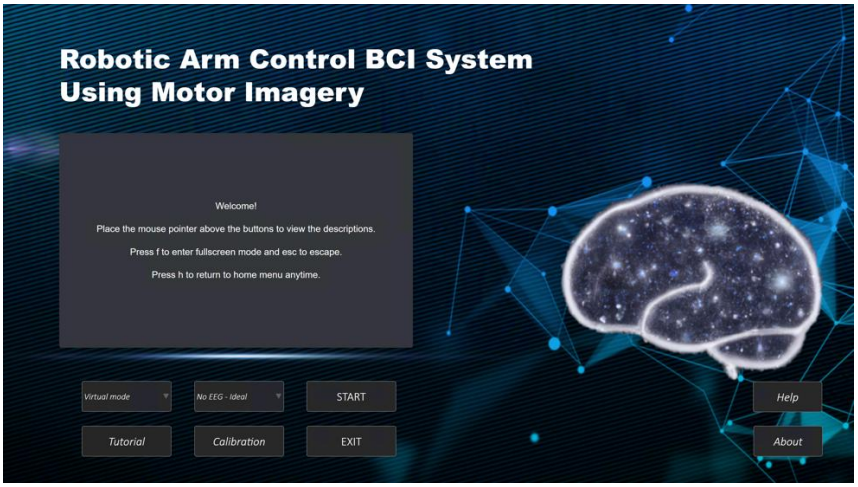


4 Go to **Mode** and **EEG Option** toggle to choose the settings that you want to use.

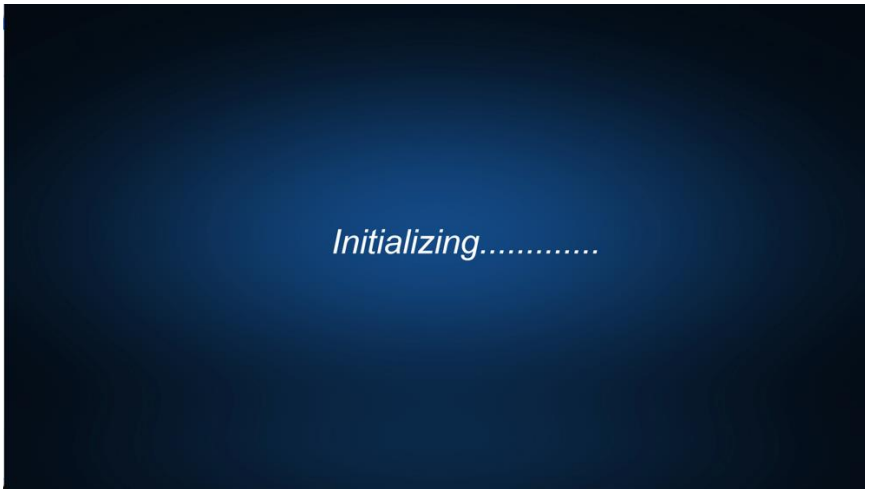
- ***Real Robot*:** When you want to control the real robotic arm. This requires the connection with the Jaco robotic arm, please make sure the arm is connected to your computer.
- ***Virtual Mode***: When you want to experience the whole system virtually. Corresponding videos will be played according to EEG decoding results.

- ***With EEG device*:** This the default setting, where EEG acquisition device is connected and ready for data collection.
- ***No EEG – Realistic***: This is for user to experience without connection to EEG devices, and it should be used together with ***Virtual Mode***. The decoding results are pre-defined to depict realistic using scenarios.
- ***No EEG – Ideal:*** This is for user to experience without connection to EEG devices, and it should be used together with ***Virtual Mode***. The decoding results are pre-defined to depict ideal using scenarios.

A. After choosing **Mode** and **EEG Option**, click 'START' button. For instance, we choose **Virtual mode** and **No EEG – Ideal** here, and click 'START'.

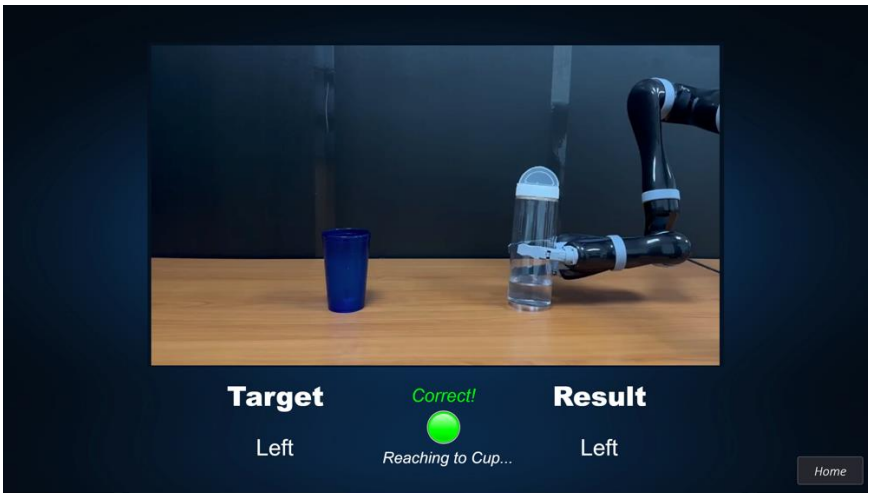


B. It will take a while to load necessary resources.

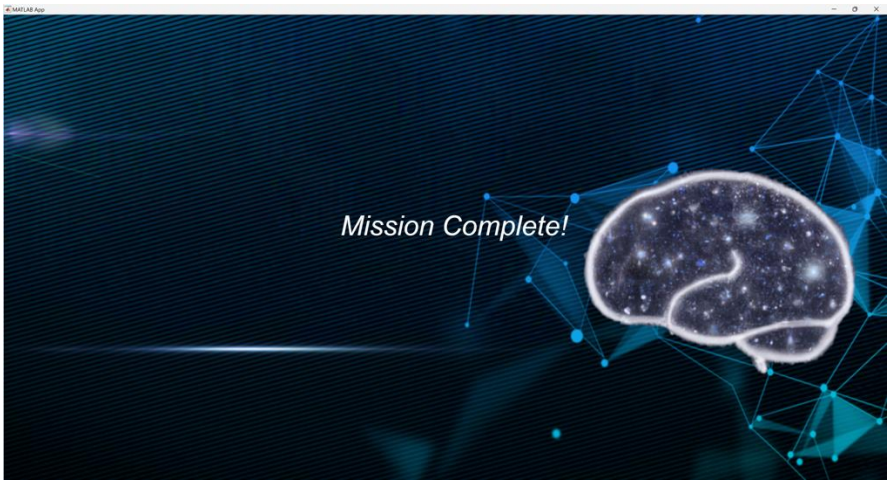


C. After a 3-second countdown, the experiment starts.

D. The calibrated model is used here to decode the EEG trial. If the decoding result corresponds to **Target**, green lamp lights up and corresponding video is played. **No EEG – Ideal** gives a perfect demonstration of the whole task, while by choosing other two options, a red lamp may light up if the decoding result is different from the **Target**. Once the decoding result is wrong, everything rolls back to the initial state.

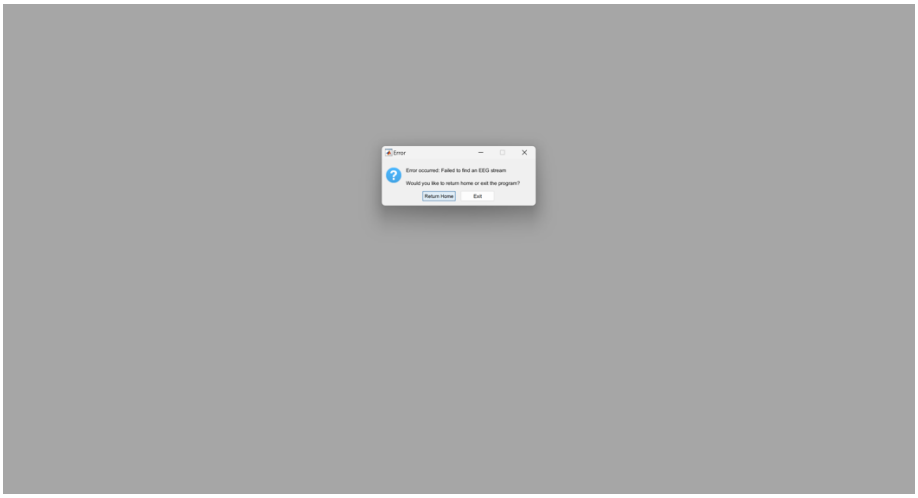


E. When the whole task is done, it returns home automatically.



3. If you have some problem with this program

Case 1. During calibration or any other situation that requires EEG device connection, such error happens if the app cannot make connection with Lab Streaming Layer (LSL). Please check if LSL and EEG devices are correctly installed and configurated.



For any other problems, please contact us through our website and we will respond as soon as possible.