ARAtronics Research Center for
Opto-Mechatronics Engineering

ARAtronics Research Center,
Mechatronics Engineering Department,
Faculty of Engineering and Material Sciences (EMS),
The German University in Cairo (GUC)

Bachelor's Thesis, Term Project

Brain-Computer Interface for a Prosthetic Hand Using Haptic Feedback

Supervisor (s): (**Assist. Prof. Dr. Eng.** Amir Roushdy)

Brain-Computer Interface (BCI) uses electrophysiological measures of brain function to enable individuals to communicate with the external world, bypassing normal neuromuscular pathways. While it has been suggested that this control can be applied for neuroprostheses, few studies have demonstrated practical BCI control of a prosthetic device. In this project, an electroencephalogram (EEG)-based motor imagery BCI is presented to control movement of a prosthetic hand. The hand was instrumented with force and angle sensors to provide haptic feedback and local machine control. Using this system, subjects demonstrated the ability to control the prosthetic's grasping force with accuracy comparable to an EMG-based control scheme. **There is a Master's student from Mechatronics engineering Department and The Lab Engineer from ARAtronics, guiding and directing the student with Assist. Prof. Dr. Eng. Amir Roushdy.**

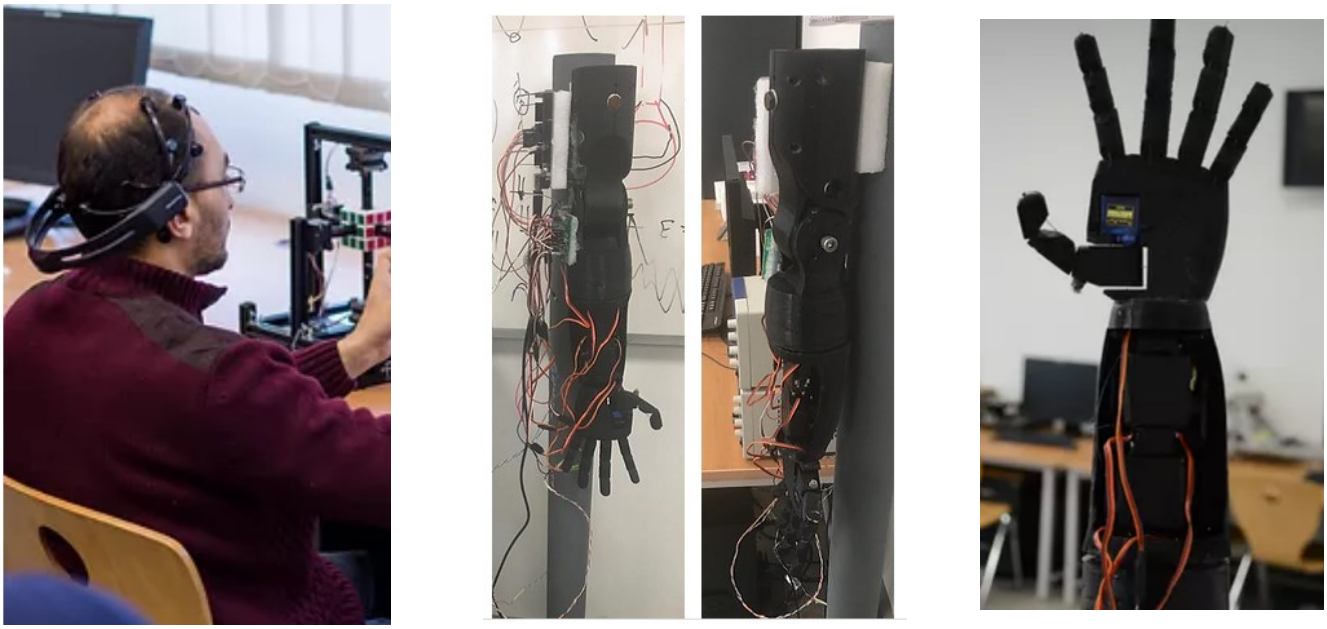

Fig.: Brain-Computer Interface for a Prosthetic Hand

Project description and objective:

In this project, Prosthetic hand acts as a tool that enables the amputee to perform daily tasks. Instead of passive devices which are aesthetically pleasing, current devices come with improved functionality utilizing robotic technology. There are various ways to control a prosthetic hand. One of it includes Brain Computer Interface (BCI) which has advanced technologies and creates new possibilities in providing healthcare solutions for people with severe motor impairment. Generally, Electroencephalography (EEG)

For more details please contact:
Assist. Prof. Dr. Eng. Amir Roushdy, Room: C7.108, E-mail: amir.ali@guc.edu.eg, Web site: www.aratronics.com

is dominated by BCI researchers as it provides non-invasive, inexpensive equipment, good resolution, ease of use, portability and no implantation approaches. EEG signals were recorded from healthy subjects through brain waves at specific locations on the scalp using Emotiv EEG Headset. This device can capture brain waves that include artifacts such as movement of a limb, respiration, speech, heartbeat and many more.

Research focus of this project:

- Literature review on the project should be studied properly.
- Not only, creating a software control system for the project but also the hardware.
- Experiments using the gadget and control system should be built properly.
- The outcomes must be documented.

Requirements:

- Passionate to learn more about Neuroscience, 3D Printing design, Robotics and control.
- Prior mechatronic design expertise is desired like "SolidWork".
- Enthusiasm for completing actual practical work with 3D printing staff (design fabrication and construction).
- A method of working that is both structured and self-contained.

General tasks of the project:

- The complete methodology is already available in the ARAtronics Lab, so we will discuss it from the first day to start the automation process for it
- Fabricate the machine/system using 3D printer/CNC machine (small parts).
- Assembly all parts of the Robot.
- Changing the working variables and see the effect on the locomotion of the robot.

Other notes:

- A weekly meeting with the advisors will be required for this project, as well as weekly progress updates (***The meeting could be more than once during the week based on your progress and based on your achievements***).
- You should to be in the Lab two days per week (***It could be more than two days based on your progress and based on your achievements***).
- All reports must be prepared in the style of a research paper.
- The outcome of this project will be publish into one of the coming international conferences/journals.

For more details please contact:
Assist. Prof. Dr. Eng. Amir Roushdy, Room: C7.108, E-mail: amir.ali@guc.edu.eg, Web site: www.aratronics.com