Aquaphoton '22
Electrical Mega Project

Sections:

1. Mega Project Overview:

This **Mega Project** is an overall **simulation** of how we as an Electrical & Software Team handle the ROV competition tasks. In this project you will be able to have a better understanding and implement **everything** that you've learnt during this training.

You will be working on a **GUI** that combines all of your **autonomous software tasks** that are based on **image processing** in an organized way, gives you control over your whole **electrical PCB system** and also gives you feedback from your **camera**, **sensors** and **motors**.

2. Technical Tasks:

2.1. GUI :

In this section you are required to make a Graphical User Interface (GUI) that combines all of the necessary **GUI features** and the required **Software Tasks** together in an organized way.

This is a **simulation** that will give you a better understanding of what a software team does in order to give the Pilot/Copilot a better user experience in order to
1. Navigate the ROV
2. Finish some required tasks
3. Keep being updated with the ROV status at all times.

Your GUI will be **scored** according to the following :

- ❖ **Main features :**
  - ➢ Live Camera Feed :
    - Should contain a place for live webcam feed that you're going to use in some software tasks.
  - ➢ Timer :
    - A functioning timer with Start, Pause & Stop options.
  - ➢ ScreenShot button :
    - Gives you the option to take a screenshot from your webcam live feed at anytime
  - ➢ Indicator Icons :
    - Icons that change their colors according to connectivity with certain things. For example: USB connectivity Indicator.
  - ➢ Current State :
    - Sensors readings, motion indicators (forward, backward..etc.), Speed Indicators (low, medium, high)...etc.

- ❖ **Overall Design :**
  - Should have a nice looking overall design that is well organized and easy to use.

- ❖ **Modularity & Adaptability :**
  - Should be modular and have the ability to adapt to any changes that might happen.

- ❖ **Multi-Window :**
  - You are required to build a GUI that supports multiple windows. As an example: You can have a Main Window that allows you to navigate through Sub Window for each **Software Task**.

- ❖ **Back-End :**
  - ➢ OOP Concepts :
    Concepts like inheritance, polymorphism and abstract classes are strongly recommended for you to use as it will help you build a well organized code.
  - ➢ Clean Code :
    It's important that you maintain a clean code for your program especially if you're working in a team, like: variables, classes , functions naming, commenting ...etc.

2.2. Software Tasks :

In this section you are required to use your Image processing and software knowledge in order to finish the following tasks and represent them in your **GUI** in Sub Windows.

- ❖ **Stitching & Object detection :**
  - ➢ In this task you will be given five images, each image containing a different part of the same map. *Side Note : These five images are just for example, your program should be able to work with the same efficiency on images of any similar map.*
  - ➢ **First:** you are required to stitch these five images together and generate a correct image of the whole map.
  - ➢ **Second:** you will use the previously generated image to detect and identify the shapes shown in the whole map and count the number of each shape.
  - ➢ This task should be integrated in your **GUI** so that we can see the generated image and the number of each shape present in the map.
  - ➢ Link of the images : **https://drive.google.com/drive/folders/1L_kStLk2RaA-M9Fj4r GP96mwzVc-KxMQ?usp=sharing**

Example for the Output:
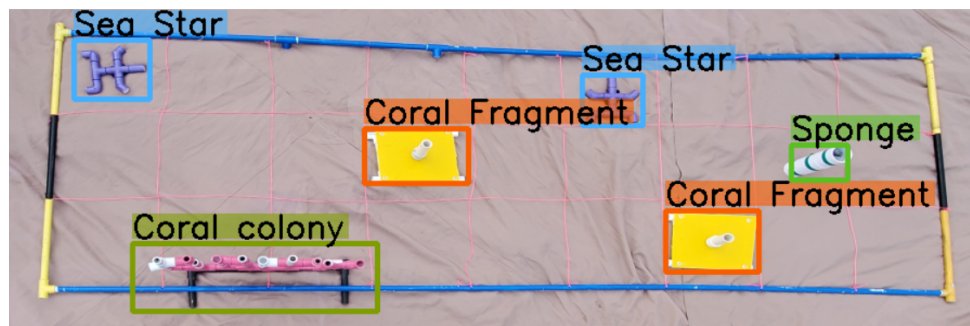
- ❖ **Mapping :**
  - ➢ In this task you are required to develop a code that takes keyboard keys [Up, Down, Left, Right] as inputs and draws a motion map according to the key pressed.
  - ➢ We should be able to see the live formation of the map according to the key pressed along with the current **direction** [Up, Down, Left ,Right] in your **GUI** .

➢ You are also required to control the speed and the motion of the two motors (DC or Brushless , *Side Note : you should find a way to have the ability to switch between them*) that will be connected to your **PCB** according to the input key that is pressed according to the following :

- *Up* Key :
  - The two motors will move in a clockwise direction
- *Down* Key *:*
  - The two motors will move in an anticlockwise direction
- Right Key :
  - Right motor will move in a clockwise direction & the other will Stop.
- Left Key :
  - Left motor will move in a clockwise direction & the other will Stop.
- 'L' key :Lowest Speed
- 'M' key :Medium Speed
- 'H' key :Highest Speed

❖ **Hand Detection:**
➢ In this task you are required to use your webcam in order to detect your hand in a live feed and control the movement of the servo motor in your **PCB** [section 2.3.] according to the number of fingers raised such as the following:

- if one finger is raised → adjust the servo to be at 0°
- 2 fingers → 45°
- 3 fingers → 90°
- 4 fingers → 135°
- 5 fingers → 180°

2.3. Hardware Tasks :

In this section you are required to design and fabricate a **PCB** that inputs **48V Source** on a **Buck Converter** which should step down the voltage down to **12V** so that you can use it. (side note : the 48V source & the Buck Converter will be **provided to you by the team**) .Your PCB should contains all of the following :

❖ **Arduino Nano :**
This will be the microcontroller that you're going to use for this project and should be a part of your PCB.

❖ **Relays :**

You should use relays in order to move the DC motors instead of motor drivers meaning you are not allowed to use any motor driver IC.

❖ **ESCs [2 Channels] :**

In the ROV industry, we tend to use brushless thrusters for movement so it's important for you to know how to connect and control those thrusters with ESCs.These ESCs will be **provided to you by the team.**

❖ **Sensors :**

Your PCB should contain the following sensors that we often use in the ROVs:

➢ Voltmeter Sensor up to 55 V :
> This sensor should be used to validate the 48 Voltage going into the Buck converter .

➢ Current Sensor up to 5 Ampere :
> This sensor detects electric current in a wire and generates a signal proportional to that current. *Side Note : place it in order to measure the current drawn from the Buck converter.*

➢ Leakage Sensor :
> This sensor should be able to detect if there is water leakage.

Side Note : you could make these sensors yourself if you want.

❖ **Motors :**

➢ Servo Motor :
> You're going to use this motor in the **Hand Detection** task as mentioned.

➢ 2 DC Motor :
> This will be **provided to you by the team** but you should prepare its connection on your PCB because you'll use these motors in the **Mapping** task as mentioned.

➢ 2 Brushless Motors :
> This will be **provided to you by the team** but you should prepare it's connection on your PCB because you'll use these motors in the **Mapping** task as mentioned.

❖ **Indicators :**

➢ LED Indicators :

■ You'll be using one **RGB LED** to indicate the Speed of the Motors as mentioned in the **Mapping** Task [you'll adjust 1 colour for each speed :Low, Med & High].

3. Non Technical Tasks:

3.1. Daily Progress Reports :

You are required to write and deliver a report before **12:00 AM everyday** explaining your **progress** and the **detailed division of labour** between the team members on this particular day. This will be the **official** way of communication between us so that we will be able to help you and know where you guys are at.

3.2. Technical Report :

In this task, you are required to write a technical report explaining your whole Project. It should include the following :

❖ **Electrical System :**
In this section, you are required to give a detailed explanation about everything in your **PCB** : Schematic connections, Layout Design & Routing.

❖ **Software tasks' Algorithms :**
In this section, you are required to give a detailed explanation of all your software algorithms that you used in order to finish the **required tasks**.

You should also design a flow chart for each required task and include them in this report.

❖ **GUI Features :**
In this section, you should explain and show off all of your **GUI** features that make your GUI unique. You should also include the following:

■ **Flowchart** Explaining Back-End Algorithm
■ **Main Window Features** including screenshot of the design itself
■ **Sub Windows Features** including how you integrated the software tasks in this GUI.

4. Teams & Deliverables:

4.1. Teams :

In this Project, you guys will be working in teams as follows:

- ❖ **Team 1:**
  Abdelrahman Khaled, Eslam Dyab, Raghad Abo El Eneen

- ❖ **Team 2 :**
  Youssef Fayed, Heidi Gad, Rodaina Salah, Youssef Okab

- ❖ **Team 3 :**
  Marwan Ahmed Rabea, Mahmoud ElShenawy, Islam Ashraf, Abdulrahman Masoud

4.2. Deliverables :

You are required to deliver the following :

- ❖ **Daily Progress Report**
  should be Delivered Everyday before 12:00 AM

- ❖ All the Software Project Codes you developed for both **GUI** & **Software tasks.**
- ❖ **PCB** with it's sticker & CAM outputs.
- ❖ **Technical Report.**
  The Deadline for delivering these files is : 16/9 at 12:00 AM