Wayfarer Class – HK IEEE ROV Regional Qualification.

1/ Underwater Gardening

The idea of aquaculture and terrestrial farming have been around for millennia. However, it was only recently that the thought of combining the two was fully realised. This “underwater gardening” goes beyond any aquaponic or hydroponic setup by taking the terrestrial produce (typically grown on the surface of the water) and bringing fully under the sea. The produce is housed in airtight plastic structures on metal struts, dubbed “biospheres” that operate on the same principle as a diving bell. As the structures are brought down to between 15-36ft below sea level, the bulbous spherical top of the structures trap air inside, creating an air pocket in which non-aquatic life and equipment can be housed safely.

The transition of farming from land to sea has demonstrated myriad benefits for crop growth and yield firstly, the constant temperature of seawater in Liguria, a temperate coastal town in Italy, means that the temperature inside the biosphere remains the same year-round, saving a fortune on heating and cooling systems, which are replaced instead by a solar-powered fan that regulates the airflow within the sphere.

The biospheres require no irrigation system – instead, sunlight warms the inside of the biospheres, causing the saltwater floating just under the air pocket to evaporate and condense on the walls of the spherical structure, allowing it to drip down onto the plants situated on the walls of the dome. The dome requires no pesticides as no bugs can reach the plants. Most interestingly, the higher pressure seems to improve the growth rate of the crops, based on the Garden's own research findings. Should the findings prove correct, this could revolutionise not only the way crops are grown, but competition for areas in which the crops are grown will move from farmland, to under the sea – greatly diminishing the need for deforestation, the forced evacuation of settlements and wildlife reserves.

Underwater Gardening

Manned excursions to the Biospheres require the right conditions (weather, currents etc) to avoid potential danger and injury for the divers. Given that the ROVs do not require a constant oxygen supply, a greater range of temperature tolerance and do not get injured in the way that humans do, The use of them are the first step towards automated maintenance. The ROVs need to be modified to carry out these activities - robotic arms need to be specialised to harvest crop samples, perform maintenance on the biospheres, and even to gather sensor data to monitor progress.

DESIGN BRIEF

Below is a summary of the product demonstrations organized by competition class.

Garden Maintenance

- 3 ripe fruit plants need to be returned to the surface
- 3 unripe fruit plants need to be moved to a better location.
- 2 rubbish plastic bags need to be removed from the area and returned to the surface
- 1 coke tin needs to be removed from the area and returned to the surface.
- 1 seaweed ball needs to be collected from the seabed and put onto the special rack
- 1 seaweed ball needs to be collected from the special rack and returned to the surface
- 1 seaweed ball needs to be attached to the ROV at the surface and fitted to the special rack.
- 2 predator starfish need to be removed from the area and returned to the surface

Scientific Data Collection

- A special data logger needs to taken from the surface and placed in the airspace under the air-dome.

ROV SPECS

- 12 volts, 25 amps DC. Conversion to lower voltages is permitted topside and on the ROV. Onboard electrical power is not permitted.
- There must be a **25amp fuse in the input power cable** of every ROV.
- A **15m** long umbilical cable is required.
- PWM motor speed control is allowed.
- Manually-powered hydraulics and pneumatics are permitted.
- Pneumatic systems cannot exceed ambient pool pressure.
- Lasers are NOT permitted.
- At least one Camera is required.
- Underwater light is required.
- Maximum size limit: None.
- One person must be able to deploy and retrieve the ROV from the water.
- Arm is allowed.

RESOURCES

Teams are permitted to use the materials of their choice provided that they are safe, will not damage or otherwise mar the competition environment, and are within the defined design and building specifications.

Teams are encouraged to focus on engineering a vehicle to complete the product demonstration tasks; when considering design choices, teams should ask themselves which one most efficiently and effectively allows them to solve the problem. Re-using components built by previous team members is

permitted provided that the current team members evaluate, understand, and can explain their engineering and operational principles. Using or re-using commercial components is also permitted, provided that team members evaluate, understand, and can explain their engineering and operational principles. Teams will be questioned extensively on their overall design and component selections during their technical sales presentations.

TIME
The time given for the mission run is 10 minutes.

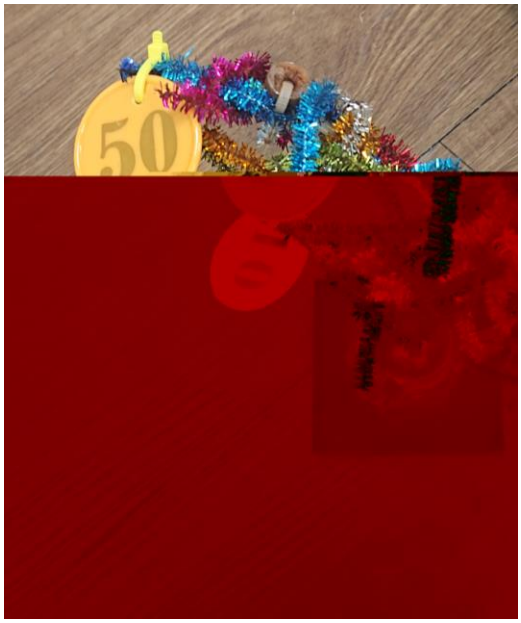
Wayfarer Missions

1. Plant Crop Collection & Rotation

The ROV is placed into the pool and navigates towards the makeshift biospheres. Crops will be placed around the biosphere and will consist of small plants with ripe (red) fruit disks on them or green (un-ripe) fruit disks on them. The ripe fruit plants need to be collected and returned to the surface. The green fruit plants need to be moved to a better location for ripening. These plants can be collected by magnets attached to the underside of the ROV or hooks.

Green Fruit

Ripe Fruit

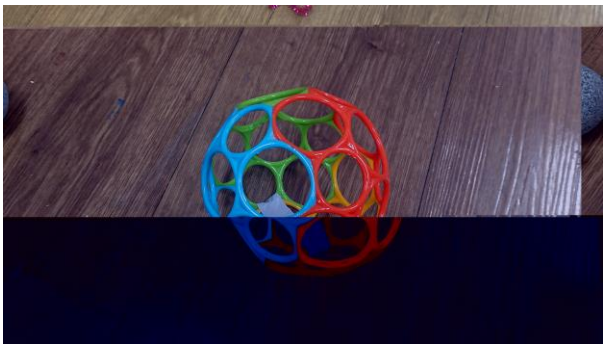


2. Garden Maintenance

There are several work tasks. Plastic bags and a coke tin needs to be removed from the garden area. One plastic bag has a small magnet. But the other one doesn't. The coke tin has a small weight to help with stability.

3. Seaweed ball collection, installation and re-attachment

There needs to be attention given to the seaweed racks. Some balls are no longer attached. The ROV needs to collect one ball from the seabed and attach it to the special rack. One seaweed ball needs to be collected off the rack and returned to the surface. Finally a seaweed ball needs to be taken from the surface and connected to the special rack.



Photos showing the special rack and the seaweed balls for this part of the skills.

4. Data logger installation

The data logger will be attached to the ROV on the surface and released on the airspace inside the underwater habitat.

The Surface Work

There will be marks awarded for the surface work. The breakdown will be issued in an up-date of this document.

1/ Discussion

Each Adventurer Class team needs to make a10min presentation about their ROV to the judges. During this time the judges may ask questions. This presentation may be in the English or Chinese languages or a mixture of both. No PowerPoint or multi-media tools allowed, just a discussion based around the poster. Details of this presentation are below:

- Introduce yourself and the team
- Explain who made what parts of the ROV
- Refer to the poster as the presentation material (no PowerPoint or other multi-media).
- Explain the cool parts in detail.
- Explain the challenges that the team had building the ROV.
- Anything else you want to add.

2/ Poster

Each Adventurer team needs to make a poster about their ROV. The theme of this shall be a reflection on the building of their ROV. This poster shall be in the Chinese or English language or a mixture of the two. The details of what this poster should contain are below:

- Should be A1 size.
- May be made up of sections of smaller sized sheets of paper.
- Title in large letters at the top.
- Name of the ROV & Team clearly shown.
- Photos **with captions!!**
- Illustrations and drawings
- A written description of the ROV

3/ Reflection

Each member of the team should write one or two paragraphs about the experience of building the ROV and working with their team members. This document can be in either Chinese or English language. It may be neatly written or typed. Each reflection piece should have the name, age and school grade / class level on the first line. Several reflection paragraphs can go onto the same page provided they fit. It should have a title page with the team name on it and be bound or stapled down one edge to resemble a book. Students may include drawings or other artwork to highlight the experience. The limit for each student's reflection is one A4 page.

Score Sheet:

Tasks			**Max**
a)	**50 points** - Collection of ripe fruit plants		100
b)	**40 points** - Move (push) the unripe fruit to the new locations		80
c)	**60 points** – Collect the seabed seaweed ball and put it back onto the frame		60
d)	**50 points** - Collect the pole seaweed ball and return it to the surface		50
e)	**50 points** - Put the poolside seaweed ball onto the frame		50
f)	**20 points** - If the poolside seaweed ball finishes less then 1m from the frame		20
g)	**50 points** - Data logger deployed correctly		50
h)	**30 points** - Data logger finishes less than 1m from the target location		30
i)	**20 points** - Collection of magnetic plastic bag		20
j)	**30 points** – Collection of non-magnetic plastic bag		30
k)	**60 points** – Collection of coke tin		60
Penalty Points			
Tether Pulling - Infractions * -5			
Diver Assistance - Infractions * -5			
Leaving Debris in Pool - Infractions * -5			
Total			550