ARC

WATER SPORTS
ENTERTAINMENT AND SAFETY

New Alamein City, Egypt
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/UWRChallenge
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Contents

1. Introduction

Underwater Robotics Challenges is a series of annual Underwater Robotics and Artificial Intelligence Challenges that occur in the MENA Region powered by the Underwater Robotics Research Center.

1.1. Vision

Providing the industry with a well-educated generation in the field of underwater technologies.

1.2. Mission

Provide technical challenges in underwater technologies to encourage the link between industry and academia in the MENA region.

2. Context and Need **|** Underwater Tourism

Tourism is not just about having adventures and fun toys; it is also about being present and enjoying the life beneath the oceans and seas.

It's widely acknowledged that water tourism has seen exponential growth and its importance as a strategy for local development and the diversification of the tourist offer. Nautical tourism occurs when the tourist moves away from the usual environment for a tourist experience, with an incidence in marine waters and the main motivation being the practice of nautical leisure or competition-related activities.

The main activities associated with nautical tourism are sailing, windsurfing, diving, rowing, cruise charter (30–40 people capacity), yacht cruising, surfing, snorkeling, sport fishing, bodyboarding, motor boating, rafting, canoeing, kayaking, water-skiing, spearfishing, hydro speeding, kite surfing, stand-up paddle, and waterboarding.

3. 2022 **|** New UWR Challenges' Theme

In 2022 UWR Challenges will take place in Alamein Robotics Championship for the first time an event will combine **science, technology, and tourism** in New Alamein city in Egypt to spread the technology of the robotics industry! Alamein Robotics Championship (ARC) is the first event that gathers all robotics competitions In Egypt's New Future City the New Alamein City on the Mediterranean Sea.

As the growing demand for qualified scientists and engineers, UWR Challenges do its best to provide the new engineering generation with new challenges with this class of underwater technology and innovation for the science, inspection, and research world

UWR Challenges with its slogan new challenges ahead new technologies to get, **supporting tourism and water sports** using technology is a new challenge to achieve a better experience for tourists and to maintain safety as well.

4. Underwater Mission Story

4.1. Introduction

Egypt's North Coast stretches out for about 1,000 km on Egypt's Mediterranean coast and has arguably some of the most pristine white sand beaches in the region; like that of Alexandria, The North Coast, Marsa Matruh, and also new cities like the New Alamein City that is currently being established.

The New Alamein City is located on the North Coast and is set to be the first of its kind in the area. The New Alamein City is planned to hold millions of residents, hitting a new milestone for the North Coast area. It comes with the new concept of an open-to-the-public tourism city on the North Coast.

4.2. Underwater Dive Guard Scenario – Water Sports

The Egyptian Government is notoriously protective of visitors to maintain its status as one of the most-visited destinations in the Middle East and North Africa. To keep visitors safe the AUV is used to provide information on beaches used by the public and whether a beach is subject to a water quality monitoring and public notification program. AUV is mapping a specific beach area and localizing the dangerous spots to avoid and the safe spots for tourism swimming.

Beach observation centers and ROVs are receiving signs from AUV if there is any potential danger or human drowning issue within the monitoring area

As tourists sign up with a group in a water sport, the ROV guide will take care of all the regulations and be responsible for their safety when the group discovers one of the safe underwater spots monitored by AUV.

It is equally pleasing to show how the best underwater robots are utilized in the tourism and leisure industry too! Happy to provide great memories for people.

The ROV and AUV challenges are going to be used for covering underwater activities during underwater tourism tours through two main aspects:

a) Entertainment

- Filming underwater activities.
- Underwater exploration.

b) Safety

- Monitoring human activities.
- Search and Rescue (SAR).

5. Background

Below is a brief background about the three tasks of the 2022 UWR Challenges.

5.1. Task 1 Background: Underwater Entertainment

Technology is getting upgraded every day. How about using technology to enhance people's experience with water sports? In the context of the Underwater Challenges, ROVs and AUVs can play a significant role when it comes to using technology for underwater entertainment. Although this sounds like a fun application for the technology, it introduces difficult challenges for these robots. In this task, your ROVs/AUVs are challenged to test their capabilities and show their competence.

5.2. Task 2 Background: Underwater Monitoring System

Ensuring safety inside water for recreational activities and water sports requires the deployment of monitoring systems. These systems collect data that determines how safe the water is, which in return aids in the detection of hazardous conditions (rip currents, high wind, pollution, …) and hazardous areas for different water activities (swimming, sailing, diving, …). It also provides information about the beach condition to the beach management.

The monitoring system components are installed either outside of the beach, or floating on water, or underwater. This task deals with using underwater robots (AUVs and ROVs) in the installment, inspection, and maintenance of the underwater components of the monitoring system.

5.3. Task 3 Background: Search and Rescue

Search and Rescue is about being ready in case things went wrong and having the ability to intervene when needed. The term Search and Rescue (SAR) is used in different fields, including mountain rescue, ground search and rescue, the use of search and rescue dogs, urban search and rescue in cities, combat search and rescue on the battlefield, and sea rescue.

The responsibility of securing water sports makes it necessary to get technology involved in the search and rescue process, thus, underwater robots are utilized for this purpose. This task provides some challenges to your robots to test their search and rescue capabilities.

6. Design Brief

Below is a summary of the UWR mission for both ROV and AUV challenges.
The underwater mission is divided into three tasks. The ROV tasks have two categories for seniors and juniors' classes. The AUV tasks have only one category.

6.1. ROV Challenge: Seniors Category

6.1.1. Task 1: Underwater Entertainment

- **Film an underwater scene**
  - Smoothly follow the trajectory
    - Manually position the ROV to the starting position
    - Autonomously move the ROV following the trajectory
    - Autonomously position the ROV to the ending position
- **Retrieve the lost camera from the cave**
  - Dive into the narrow cave
  - Identify the camera
  - Pick the camera and hang it to the safety line
- **Guide the diving group**
  - Discover the diving path into the cave
    - Explore the diving path and find out whether it is safe
  - Move an object to the other side
    - Collect an object from the end of the path and return it to the surface

6.1.2. Task 2: Underwater Monitoring System

- **Install new monitoring equipment to the target position**
  - Scan the area
    - Calculate the dimensions and find the total area
    - Determine how many pieces of equipment will be required
    - Draw a map for the area marking the location of the equipment to be installed
  - Collect and install the equipment properly
  - Connect the equipment cables to the system grid
- **Remove the waste covering the equipment**
  - Scan the already existing equipment and check for the one covered with waste
    - Identify the type of the waste
  - Remove the waste
    - Carefully detach the waste from the equipment
    - Move the waste to the designated underwater waste container based on the type identified
  - Carry the collected waste container to the surface
    - Check the containers of different types of waste and identify the most filled one

- ▪ Carry the most filled container to the surface
- **Inspect the already existing equipment and detect the faulty ones**
  - o Count the number of the equipment and detect the faulty ones
  - o Inspect the main cable and repair the damage if any.

6.1.3. Task 3: Search and Rescue

- **Determine the lifting capability of your ROV**
- **Search for the missing diver**
  - o Find the diver
    - ▪ Find the diver's location
    - ▪ Determine the coordinates of the diver's locations
  - o Calculate the amount of force needed to lift the diver
  - o Determine if the ROV is capable of lifting the diver
- **Remove the weighting belt**
  - o Unbuckle the weighting belt
  - o Carefully move the weighting belt away
- **Drag the diver to the surface**
  - o Drag the diver to the surface
  - o Finish the task within the specified time frame

6.2. ROV Challenge: Juniors Category

6.2.1. Task 1: Underwater Entertainment

- **Film an underwater scene**
  - Smoothly follow the trajectory
    - Manually position the ROV to the starting position
    - Manually move the ROV following the trajectory
    - Manually position the ROV to the ending position
- **Retrieve the lost camera from the cave**
  - Dive into the narrow cave
  - Pick the camera and hang it to the safety line
- **Guide the diving group**
  - Discover the diving path into the cave
    - Explore the diving path and find out whether it is safe
  - Move an object to the other side
    - Collect an object from the end of the path and return it to the surface

6.2.2. Task 2: Underwater Monitoring System

- **Install new monitoring equipment to the target position**
  - Scan the area
    - Calculate the dimensions and find the total area
    - Determine how many pieces of equipment will be required
  - Collect and install the equipment properly
- **Remove the waste covering the equipment**
  - Scan the already existing equipment and check for the one covered with waste
    - Identify the type of the waste
  - Remove the waste
    - Carefully detach the waste from the equipment
    - Move the waste to the designated waste area based on the type identified
- **Inspect the already existing equipment and detect faulty ones**
  - Count the number of the equipment and detect the faulty ones
  - Inspect the main cable and repair the damage if any.

6.2.3. Task 3: Search and Rescue

- **Determine the lifting capability of your ROV**
- **Search for the missing diver**
  - Find the diver
- **Remove the weighting belt**
  - Unbuckle the weighting belt
  - Move the weighting belt away
- **Drag the diver to the surface**

6.3.   AUV Challenge

6.3.1. Task 1: Underwater Entertainment

- **Retrieve the lost camera from the cave**
  - Navigate following the direction reported
  - Identify the camera and report back its location

6.3.2. Task 2: Underwater Monitoring System

- **Install new monitoring equipment to the target position**
  - Scan the area
    - Navigate across the direction of the equipment and count them
    - Determine the number of the missing ones and report it back
    - Determine the order of the missing ones relative to the first one and report it back

6.3.3. Task 3: Search and Rescue

- **Search for the missing diver**
  - Scan the area
    - Navigate following the direction reported
    - Scan the ground for the diver
    - Determine the diver's position along the search direction and report it back

7. References

7.1. Task 1 References

underwater entertainment created for large water tanks across the world.
Underwater Filmmaking Basics
Diving Technology

7.2. Task 2 References

Access global marine weather data and ocean insights
Underwater Monitoring for Oil and Gas Market Report
Deepwater Monitoring System Using Logistic-Support Vessels in Underwater Sensor Networks

7.3. Task 3 References

Security and Search and Rescue (SAR)
Underwater Search & Rescue ROVs to the Call
(PDF) R3Diver: Remote robotic rescue diver for rapid underwater search and rescue operation

8. Important Notes

- Teams can choose to participate only in one of the two challenges and work only on its tasks.

- The teams who will participate in both AUV and ROV challenges can choose to build either one robot for each challenge **or** to build only one robot; that can operate both **manually as an ROV** and **autonomously as an AUV,** following the rules and guidelines of both challenges.

- The teams who will participate in both AUV and ROV challenges will get **bonus points.**

- All AUV tasks are to be done **autonomously** by the AUV without any interventions from the team unless specified within the challenge rules.

- It is permitted for the AUVs to be tethered ONLY for **power supply** and/or for the **communications** required by the challenge tasks. (These communications are only for receiving data from the AUV or sending instructions provided by judges and NOT for controlling the vehicle).

- AUV teams who will not need an external power supply for their vehicle, i.e., by using batteries, will get **bonus points**.

- AUV teams who will use wireless communication for their vehicle will get **bonus points**.