Call for Proposals: Hackathon in honor of Retired Captain Mr. Dov Shafir

HiCenter, through the Israeli National Center of Blue Economy & Innovation and the Institute for Maritime Policy and Strategy (MPS) in Haifa, is honored to announce the first hackathon in honor of Rt. Captain Mr. Dov Shapir. The goal of this hackathon is to promote technological research and innovation in the blue economy.

The event is scheduled for December 17, 2024. Our goal for this event is to promote the sustainable use of ocean resources for economic growth, improved livelihoods, and job creation while preserving the ocean ecosystem's health. We are excited about your participation and the innovative solutions that will emerge from this event.

Dov Shafir (born December 28, 1931) is a retired naval officer who served in the 13th Fleet (Shayetet 13) of the Israeli Navy, commanded it in the Six-Day War, and later was the head of the Personnel Division of the Israeli Navy. After he retired from the Israeli Navy, he became a director of Teva Pharmaceutical Industries, an investor in the capital market, and a member of the Board of Directors of Ashkelon College and the Board of Trustees of the University of Haifa. He had the vision and support to establish the Center for Maritime Policy Center (HMS) at the University of Haifa and 2024 establish MPS – Maritime Policy and Strategy Institute in The Israeli National Center of Blue Economy & Innovation in Haifa.

What is expected?

1. All applications be submitted until November 29th, 2024, via: info.mps@blueconomy-il.com
2. Our team will examine all the applications that were submitted according to each challenge requirements.
3. Candidates who passed the 2nd stage will be introduced to the relevant mentor. The mentor will be available to answer any questions throughout the prosses.
4. The final stage will take place on December 17th. There, the candidates will have the chance to meet with their mentors and finalize their topic. During

the event, each candidate (from each challenge) will have the opportunity to present their topic with a 10 min presentation to the judging team.

5. The judging team will decide on a winner in each challenge category.

The prize for each challenge will be a NIS 12,000 grant.

First challenge: <u>Multi-Source Energy Harvesting System for Ocean Drifters - Integrated Multi-Source Energy Harvesting for Autonomous Ocean Drifters</u>, Mentored by Professor Morel Groper

Objective:

Design and prototype an innovative, integrated energy harvesting system for small ocean drifters that efficiently captures energy from multiple sources: solar, wind, and wave energy, etc. The system should maximize power generation while adhering to size constraints and overcoming marine environment challenges.

Key Requirements:

1. Multi-Source Harvesting: Develop a system capable of harvesting energy from solar, wind, and wave sources simultaneously or adaptively.
2. Size Constraints: Ensure the entire energy harvesting system fits within the specified geometry of a typical small ocean drifter (dimensions to be provided).
3. Power Output: Maximize total power generation from all sources to meet or exceed the energy needs of a typical small ocean drifter.
4. Marine Environment Adaptation: Design the system to function effectively in various marine conditions, including saltwater exposure, fluctuating weather patterns, and different sea states.
5. Energy Storage: Incorporate a suitable energy storage solution to maintain power during low-energy periods.
6. Adaptive Power Management: Implement an intelligent power management system that optimizes energy harvesting and usage based on environmental conditions and available sources.
7. Durability: Ensure the design is robust for long-term use in harsh marine environments, considering factors like corrosion resistance, waterproofing, and mechanical stress from waves and wind.
8. Cost-Effectiveness: Balance performance with affordability to enable widespread adoption.
9. Integration: Ensure the system can be easily integrated with standard drifter components and does not interfere with the drifter's primary functions.

Evaluation Criteria:

1. Total Energy Generation Efficiency: Combined power output from all sources and efficiency of energy harvesting.
2. Innovation: Novelty and practicality in integrating multiple energy harvesting technologies.
3. Energy Storage Effectiveness: Efficiency and reliability of the energy storage solution.
4. Adaptive Power Management: Sophistication and efficiency of the adaptive power management system.

5. Durability: Expected lifespan and performance in various marine conditions.
6. Space Utilization: Clever use of limited space to incorporate multiple harvesting methods.
7. Cost-Effectiveness: Affordability and potential for scalable production.
8. Environmental Performance: Ability to perform in a wide range of environmental conditions.

Participants Should Provide:

1. Design Specifications: Detailed design specifications of their multi-source energy harvesting system.
2. Prototype or Simulation: Prototype or comprehensive simulation demonstrating the system’s feasibility.
3. Documentation: Detailed explanation of their approach.

Second challenge: Design an Underwater Docking Station for Autonomous Underwater Vehicles (AUVs)

Mentored by Mr. Sharon Erlichman

Overview / Problem Statement:

Autonomous Underwater Vehicles (AUVs) are revolutionizing ocean exploration, scientific research, and marine industry operations. However, one major limitation is the need for AUVs to return to the surface to upload or download data, recharge batteries, and undergo maintenance such as part replacements. This process is time-consuming and inefficient, especially for long-term missions in deep or remote areas.

The Challenge:

Design an innovative, efficient, and sustainable Underwater Docking Station that allows AUVs to dock, recharge their batteries, download/upload data, and replace modular parts, all while remaining submerged. Your solution should enhance the autonomy and operational efficiency of AUVs, reducing the need for surface interventions.

Goal / Objective:

Participants are tasked with developing a conceptual or functional prototype of an Underwater Docking Station that meets the following requirements:

- Autonomous Docking: The station should enable AUVs to autonomously dock with minimal human interaction.
- Data Transfer: AUVs should be able to upload and download data efficiently while docked.
- Battery Recharging: The station must offer a reliable method for recharging AUV batteries.
- Modular Part Replacement: Design a system that allows for the autonomous replacement of key parts, such as sensors or mechanical components.
- Scalability: The docking station should be scalable for different ocean depths and adaptable for various AUV models.
- Durability: The station must withstand the harsh underwater environment, including pressure, temperature, and corrosion.

Technology Stack / Tools:

Participants are encouraged to use the following technologies or concepts:

- Robotics and Autonomous Systems: For designing docking mechanisms and autonomous AUV operation.
- Wireless Communication: To facilitate data transfer between the AUV and docking station.

- Renewable Energy Sources: For powering the station (e.g., tidal, solar, or kinetic energy).
- IoT (Internet of Things): For real-time monitoring of the docking station's status and the AUV's condition.
- Artificial Intelligence: To enable autonomous docking and part replacement procedures.
- 3D Printing & Additive Manufacturing: Use 3D printing to create adaptable, modular components for the docking station. Focus on environmentally friendly materials that can withstand underwater conditions while minimizing environmental impact.

Evaluation Criteria:

- Innovation - How creative and forward-thinking is the docking station design?
- Feasibility - Is the solution technically viable in real-world underwater conditions?
- Sustainability - Does the station operate in an environmentally sustainable way?
- Scalability - Can the docking station be deployed in various ocean/lake/river/port environments and for different AUVs?
- Technical Complexity - The quality and sophistication of the technology used (e.g., AI, IoT, robotics).

Participants Should Provide:

1. Design Concepts:

A clear and well-illustrated concept for the Underwater Docking Station:

Visual mockups or 3D models showing the docking station's structure and how it integrates with AUVs.

Descriptions of the docking process, battery charging, data transfer, and modular part replacement systems.

2. Technical Specifications:

Detailed explanations of the technologies and materials involved:

o The mechanisms for AUVs autonomous docking and alignment.

o Data transfer methods (e.g., wireless communication protocols).

o Power management and battery recharging processes.

o Use of 3D printing with environmentally friendly materials.

o Any AI or IoT applications for monitoring and managing the station.

3. Environmental Sustainability: Demonstrate the use of environmentally friendly materials to ensure minimal impact on the marine ecosystem.

4. Functionality and Feasibility: A breakdown of how the docking station would function in real-world environments, including scalability & adaptability to various AUV models.
5. Prototype or Simulation (Optional but Encouraged): If possible, participants are encouraged to build a functional prototype or create a simulation that demonstrates the concept in action, either physically or digitally.
6. Documentation: Detailed explanation of their approach.

Third Challenge: AI-Driven Data Fusion for Satellite, UAV, AUV, and Ocean Sensors to Build Integrated Ocean Big Data GIS Models

Mentored by Doctor Semion Polinov

Objective

Develop an AI-powered system that performs real-time data fusion from diverse sources, including satellite imagery, unmanned aerial vehicles (UAVs), autonomous underwater vehicles (AUVs), and oceanographic sensors, to create comprehensive, high-resolution ocean big data GIS models. These models will support monitoring, anomaly detection, and predictive analysis of marine environments.

Key Requirements

1. Multi-Source Data Fusion: Integrate data streams from satellite imagery, UAVs, AUVs, and other marine sensors (e.g., buoys, fixed cameras) to produce cohesive ocean GIS models. The AI must combine these sources to enhance resolution, accuracy, and coverage of the marine environment in real time.
2. Real-Time Monitoring and Analysis: Develop an AI system capable of fusing large datasets in real-time to monitor sea surface, water column, and seabed conditions. The system should provide actionable insights, such as identifying pollution hotspots, mapping temperature or salinity gradients, and tracking marine life or human activities.
3. Predictive Modelling and Environmental Forecasting: Utilize machine learning techniques to build predictive models based on historical and real-time data to forecast future environmental conditions, such as algal bloom occurrences, pollution spreads, or changing ocean currents.
4. Geospatial Modelling: Incorporate the fused data into an interactive, scalable ocean GIS platform that visualizes key ocean parameters and anomalies. This should include tools for analysing long-term changes and comparing spatial patterns across various marine environments.
5. Adaptive AI Algorithms: Implement adaptive AI techniques that optimize the data fusion process based on environmental conditions and data quality (e.g., sensor noise, satellite image clarity). These algorithms should intelligently prioritize the most relevant data for fusion and analysis.
6. Scalability Across Ocean Zones: Ensure the solution is adaptable to different scales, from localized coastal zones and ports to vast open ocean areas. It should handle varying levels of data availability and quality, allowing for seamless monitoring in both remote and densely populated marine environments.

Evaluation Criteria

1. Data Fusion Accuracy: Effectiveness of the AI system in fusing diverse data sources to create a unified and high-resolution view of the marine environment.

This includes precision in integrating satellite images, UAV footage, AUV data, and sensor readings

2. Real-Time Performance: The system's ability to process, fuse, and analyse data streams in real-time or near real-time, generating timely and relevant insights for decision-making.
3. Predictive Power: The accuracy and reliability of the predictive models in forecasting future marine anomalies or environmental changes
4. GIS Integration and Visualization: Quality of the GIS model in terms of interactivity, visualization, and usability. The system should present complex data in an accessible format that enables exploration and analysis of marine conditions over time.
5. Innovation in AI Algorithms: Novelty and sophistication of the AI algorithms used for data fusion, anomaly detection, and predictive analysis. Preference will be given to approaches that demonstrate significant advancements in processing multi-source marine data.
6. Scalability and Adaptability: The solution's ability to scale across different marine environments and adapt to new data sources or evolving environmental conditions.
7. Environmental Impact: How effectively the solution contributes to environmental monitoring, protection, and sustainability. Emphasis on its potential for real-world applications in marine conservation and resource management.

Participants Should Provide:

- AI and Data Fusion Models: Detailed explanation of the AI-driven data fusion techniques used to integrate satellite, UAV, AUV, and sensor data, including any preprocessing, machine learning, or deep learning methods.
- Prototype or Simulation: A working prototype or simulation that demonstrates real-time data fusion, anomaly detection, and GIS visualization.
- GIS Platform: An interactive ocean GIS platform showcasing the integration of multi-source data into a geospatial model. This platform should include features for visualizing temporal and spatial data, tracking anomalies, and providing long-term environmental insights.
- Predictive Model Performance: Documentation of the predictive models, including their performance metrics and validation against historical data