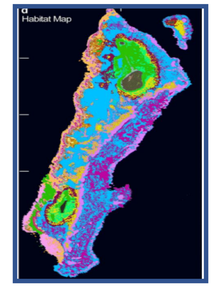
IDEAVENTIONS ACADEMY
FOR MATHEMATICS AND SCIENCE

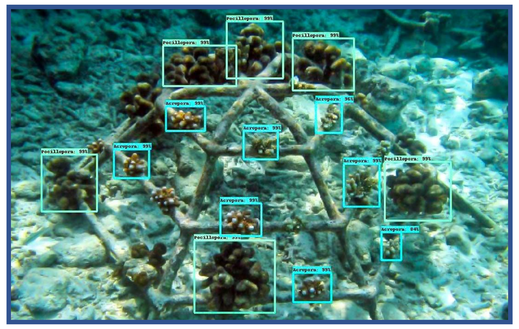
ROV Coral Reef Mapping using Artificial Intelligence

Abram Gatz, Zeke Wong
Ideaventions Academy Reston, VA USA
Agatz@ideaventionsacademy.org Zwong@ideaventionsacademy.org



1. Introduction

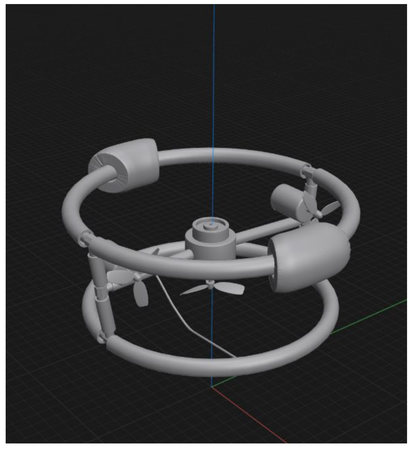
Coral reefs are in danger, and there are less and less coral inhabiting them. Making an affordable small ROV could help us gather valuable information to let us know the state of our reefs and which ones need attention. Our ROV would have a LiDar camera to map the terrain and an extra regular camera to give video feed and images to the AI that can detect and count the coral.



Our solution is to use the ROV as a platform for coral reef mapping using AI to identify corals and GPS to log position and orientation.
Image Credit:
Artificial Intelligence to Identify Corals. © Marine Savers & Four Seasons Resorts Maldives (2012 – 2024). Retrieved April 16, 2025, from https://marinesavers.com/artificial-intelligence-to-identify-corals/

2. Motivation and Background

Our team chose to look into a solution for this particular problem because we know how important coral reefs are to a healthy marine ecosystem. They are the most densely populated and diverse communities of creatures on the planet including different sharks, anemones, fish, and of course coral. It is important that we understand their situation so we can fix and restore these valuable homes to save the animals living inside of them. Our ROV would be perfect for gathering the data for the noble cause. Pollution, climate change and ocean acidification all damage coral reefs. It's believed that there are only 50-70% of the world's coral reefs are still standing. Pinpointing specific areas low on life could tell scientists where to increase restoration attempts and funding. The coral reefs need our help because over a quarter of all marine species rely on corals. Not to mention over 500 million people rely on coral reefs for food and protection from harsh waves. Coral reefs dissipate 97% of a waves energy, without them it would be drastically change the surrounding environment (Coral Restoration Foundation).



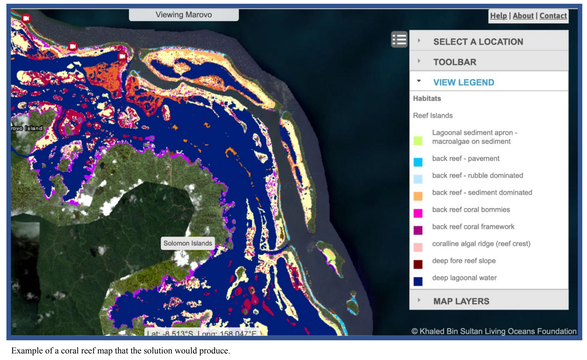
Coral Restoration Foundation. (n.d.). *Why save coral reefs?* Retrieved April 16, 2025, from https://coralrestoration.org/why-save-coral-reefs/

3. Methodology

- Mapping
  - Our design is to use Bathymetric LiDar, and camera to get a map of the surrounding terrain and use AI to detect what species, color, and size of the coral.
- Coral detection and Counting
  - A camera and a Raspberry Pi that runs an AI model that detects different corals and counts how many there are in each area
- GPS and location awareness
  - We would have a tether a couple feet long running from our ROV to a floating device that has a GPS on it.
  - This would cause extra drag so we would need more powerful thrusters.

4. Experimental Design

- We saw other team use PEX material which is a lighter weight alternative to PVC which is also flexible.
- To take advantage of the flexibility, and to have a tighter turning circle we decided to make the ROV a circle.
- There will be a camera will be integrated inside the tubing which will take images every 1 meter.
- Data with be stored locally on the ROV which will be offloaded when the mission is completed
- The GPS system will be connected by a semi-flexible rod to a buoy that floats on the surface of the water in order to obtain a stable connection to the satellites for more accurate location data.
- Data from the camera will be processed by Artificial Intelligence in order to identify points of interest and/or types of coral



Example of a coral reef map that the solution would produce.

Image Credit:
Reef Maps and GIS (interactive map). © Khaled Bin Sultan Living Oceans Foundation (n.d.). Retrieved April 16, 2025, from https://maps.lof.org/lof

5. Results

The data would be what coral species live in what areas of the coral reef and the final result would be a map of all the types.

6. Conclusions

- The ROV would give a map of coral species and their locations which could be used faster coral research as they would not need to look for coral sample. The solution could help with reef restoration efforts so they could find the best places to build with the most resilient corals.

7. Future Work

- Possible improvements could be would be a lidar system to measure the depth of the seafloor and the size of coral and to avoid hitting any possible sea life
- A Hydrostatic pressure sensor could be used to measure the depth
- A retractable pole to hold the GPS could be used so that the ROV could go to varying depths while still allowing the GPS to stay directly above the ROV