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Evaluating the Biological Impact of an Artificial Reef Using Deep Learning Techniques

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Abstract – This study focuses on assessing the impact of an artificial reef at the OBSEA underwater observatory near Barcelona. Using artificial intelligence (AI), specifically YOLOv8, the aim is to automatically detect species in the camera images of the SLAGREEF project. The previous manual process took a year to analyze 30,000 photos, while with AI it is possible to analyze 50,000 photos in 3 hours, improving efficiency significantly.

Keywords – *Artificial intelligence, artificial reef, objecct detection, YOLOv8, ecosystem monitoring*

I. INTRODUCTION

The study on the impact of an artificial reef has been carried out at the OBSEA (OBSEA), an underwater observatory wired at 20 meters depth located 4 km off the coast of Vilanova i la Geltrú (Barcelona), located in an area protected from fishing [1]. This observatory, the OBSEA, has a variety of instruments both on the seabed and on the surface, including 3 cameras at 20 meters depth. These cameras show different areas of the OBSEA. This study will focus on one of the cameras, which point out to an artificial reef under designed under the national project SLAGREEF.

The project execution is carried out by two research groups of the UPC (Universitat Politècnica de Catalunya). The project consists of making artificial biotopes with 3D printers using materials from the recycling of steel slag, such as rocks, cinder blocks and even old wood and tires. Blocks (Fig 1. a) are printed to form a structure like the one shown in the OBSEA camera of the SLAGREEF (Fig 1. b).

Fig 1. A) 3D blocks of the SlagReef project

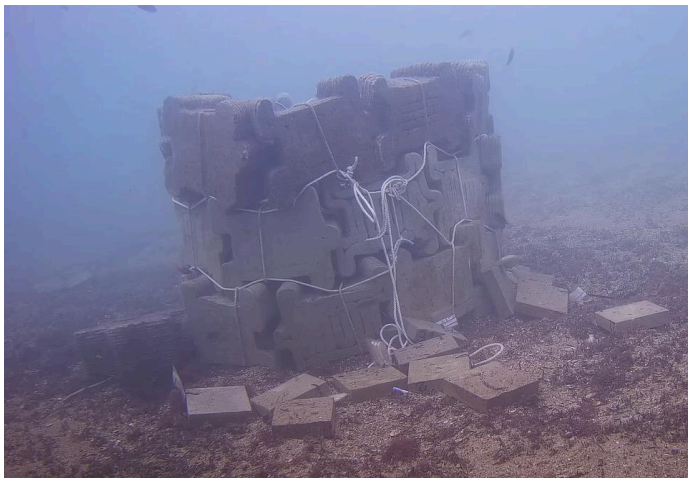

Fig 1. B) Images from the OBSEA SlagReef camera where we can see the biotope built with the blocks in image a).

This work evaluates how to use Artificial Intelligence would be useful to automatically detect the species appearing in the images provided by the SLAGREEF camera. Automatically detect the species appearing in the images provided by the SLAGREEF camera. The system uses the YOLOv8 models[2] together with our own dataset with joint images from the 3 OBSEA cameras and images from the MINKA[3] platform for completing it.

II. DESIGN and DEPLOYMENT

Two studies have been done; one with a scientific background focused on biological studies, and a second one with a more divulgative background.

For the first one, prioritizing better results by increasing the inference time per detections made with the AI on the images provided by the SLAGREEF camera every 30 minutes.

For the second, it has been used a neural network capable of taking the real-time video from the camera and performing the inference at 25 frames per second, allowing realtime stream from the SLAGREEF camera along with the real-time predictions. For this last neural network, have been prioritized that the inference time be as short as possible, knowing that the predictions would be less accurate than in the first case.

Until now this tedious work was done manually. On The other hand, a trained person could invest up to 1 year to analyse 30,000 photos. Now, using AI, and the configuration explained in the first case where time to make the inferences was increased to have better results, the system analyses in 50,000 photos in 3 hours.

The following example shows the same image analyzed manually (Fig 2. a) and analyzed by AI (Fig 2. b). For the first image (Fig 2. a) it took 150 seconds and for the second one (Fig 2. b) only 5 seconds.

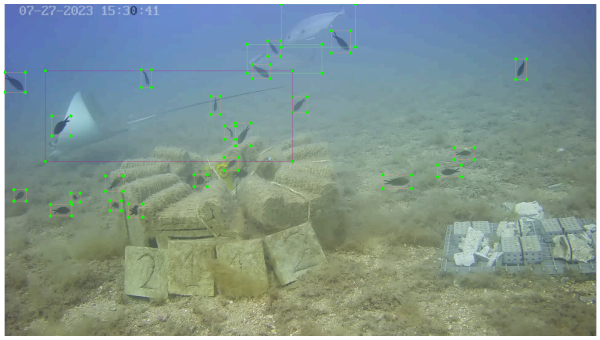

Fig 2. a) Images analyzed manually.

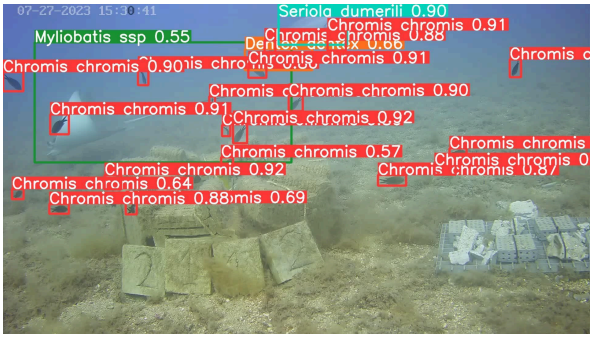

Fig 2. b) Image analyzed with AI.

III. CONCLUSIONS

As we have seen, when the first neural network has been used, it has been possible to analyze thousands of images with a minimum error, which can be the basis for future studies on the marine ecosystem.

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