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Detect and Follow a Custom Object, using OBSEA Underwater Crawler

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***Abstract* – The strategic advancement of monitoring protocols relies on cabled marine observatories for obtaining real-time multiparametric biological and environmental data. The integration of docked mobile platforms, such as underwater crawlers, proves beneficial, extending the surveillance radius of underwater observatories and enhancing their overall performance and functionality. Normally, underwater crawlers are controlled manually, resulting in considerable time and cost expenditures for both crawler operation and monitoring seabed species. To overcome this challenge, the OBSEA Underwater crawler was employed to detect and track a custom object in the laboratory environment. The detection process involved the preparation of a dataset, training a model with YOLO, and finally utilizing an algorithm to track the custom object.**

***Keywords* -** *underwater robot, underwater crawler, custom object tracking, remotely operated Vehicle (ROV), Autonomous Underwater Vehicle (AUV) and Internet Operated Vehicles(IOV).*

I. INTRODUCTION

The adoption of marine cabled video-observatories, equipped with multiparametric environmental data collection capabilities, is gaining significance in ecological monitoring strategies. For instance, OBSEA underwater observatory [1] enable real-time, remote, and continuous ecosystem surveillance. However, a common limitation arises as many observatories rely on stationary cameras for monitoring. To address this, the utilization of docked mobile robotic platforms becomes pivotal, expanding data collection to larger and more ecologically representative areas. Among the diverse underwater robotic platforms currently available, benthic crawlers stand out as excellent candidates for executing ecological monitoring tasks in conjunction with cabled observatories.

Typically, operators control underwater crawlers manually, which is leading to significant time and costs consumption in both crawler control and seabed species monitoring. This study introduces an innovative approach: OBSEA underwater crawler [2] specifically designed to autonomously detect and track a customized object. This is achieved through the implementation of a model, streamlining the process and reducing the manual intervention required for effective operation and seabed species observation.

II. DETECT AND TRACK A DESIRED OBJECT

The task following a custom object, involves two distinct components: firstly, detecting the desired object, and secondly, tracking that specific object. In order to detect a custom object, initially we need to get an enough photo dataset of that object and in our case a dataset included 320 photos gathered. Then, we opted for YOLOv8 [3], a robust and extensive generalized neural network to train a model. The training process was carried out utilizing 'Google Colab' harnessing the power of a Google GPU to expedite computations and reduce training duration. With a dataset comprising 320 images (70% training, 20% validating and 10% testing), the training of the model on the Google TESLA T4 GPU was completed in approximately 90 minutes. In Figure 1.A, the outcomes of the trained model are shown for both train and validation groups. By using this model, the detection of the custom object becomes possible, and a bounding box is generated around the object in new images.

Following the model training and the establishment of a bounding box around the targeted object, we implemented a closed-loop algorithm to facilitate the continuous tracking of the desired object (figure 1.B). In summary, this algorithm processes an image captured by the Crawler IP camera, streaming video to an external computer. The image undergoes object detection, resulting in a bounding box around the desired object. Subsequently, commands such as "turn left" or "turn right" are sent to the crawler based on the initial position of the target object, then the crawler adjusts its orientation to center the desired target in the image. In the next step, depending on the area of the bounding box, if it is large, indicating proximity, the crawler stops. Conversely, if the bounding box area is small, signaling distance, the crawler moves forward to approach the desired object closely.

III. CONCLUSION

The OBSEA underwater crawler presents a creative solution for autonomous object detection and tracking in marine ecological monitoring. This innovative approach utilizes the YOLOv8 neural network for the accurate detection of custom objects. The integration of a closed-loop algorithm ensures continuous tracking, streamlining the operation of the crawler and reducing time and costs associated with manual control. This advancement holds great promise for enhancing the efficiency of seabed species monitoring and expanding data collection to larger and more ecologically diverse underwater areas.

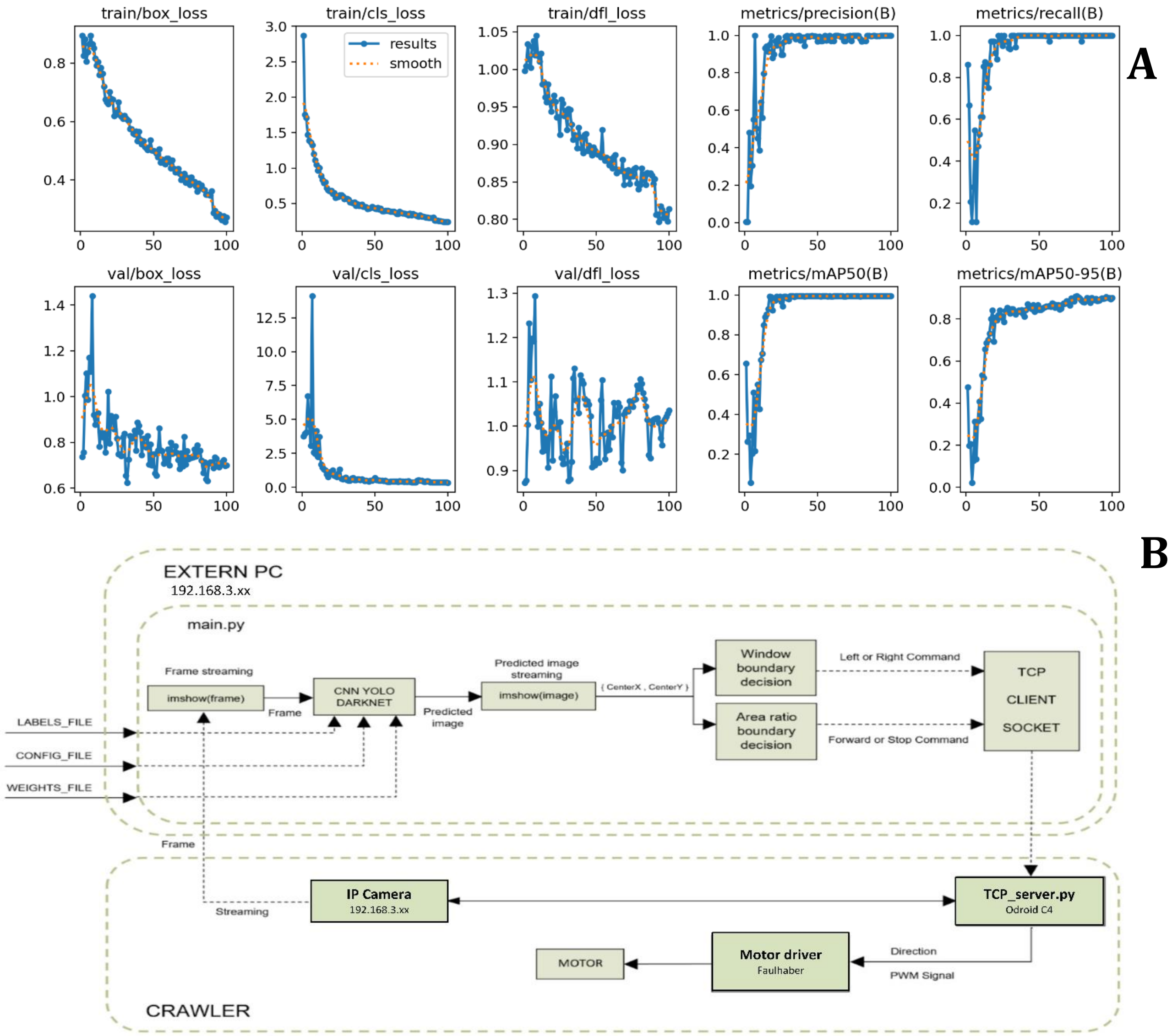

Figure 1. A The results of the trained model and B the structure of the OBSEA underwater Crawler

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