Visual Identification of Oysters with Machine Learning

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Abstract

Agricultural technology has evolved significantly since the 1800s. However, modernization has been slow with respect to monitoring and farming oysters. This project aims to modernize oyster identification with machine learning. We implemented a machine learning algorithm using a convolutional neural network that is capable of accurately identifying and classifying oysters in three states. They include closed, meaning they are healthy, or open for long periods of time, indicating mortality. We also increased the scope of existing software with a website for real-time identification. In the process, we added support for video annotation, which previously was difficult for people to do without coding and training their own models.

Methods

Three principal methods were outlined this summer.

1) *YOLO (You Only Look Once) v10*: A convolutional neural network that can classify and draw bounding boxes around relevant objects. YOLOv10 had all the capabilities we wanted, with rapid inference for real time detection. We determined the benefits with lower latency outweighed negatives such as overlapping bounding boxes.

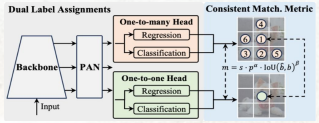

Figure 1. YOLOv10 architecture diagram

2) *Video Annotation*: The domain of inputs to our models now includes videos. This also allows for real time annotation. We opted for a home brewed method because there is no readily available code which can annotate time-dimensioned media with SOTA software.

3) *User Friendly Interface*: We made a GUI that allows anyone to identify their oyster colonies' states. Using bounding boxes, one picks out specimens which are ready for a new environment, which in our case is either a pearl checking tank or dinner plate.

Figure 2. Sample annotations from our best model

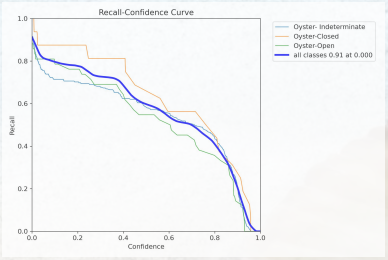

Figure 3. Recall curves from all classes

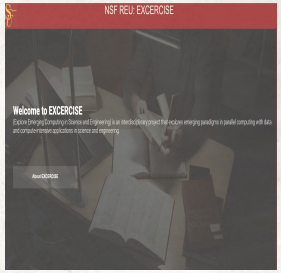

Figure 4. Website sign in page

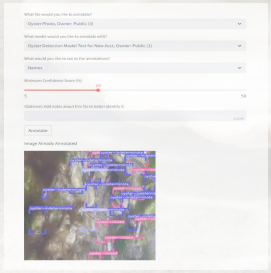

Figure 5. File annotation software

Results

- We trained an algorithm that accurately pinpointed 76% of the oysters within an image or video. The algorithm was able to accurately identify the state of each oyster 64% of the time.
- The video annotation process worked at a rate of 40 frame per second on 640x640 frames. The sampling rate appears sufficient as oysters are slow moving animals. It can use the same model as image annotations and was integrated into a webcam for live analysis of oyster tanks.
- We also designed a website that allows the general public to easily use and access the progress that has been made on this project.

Conclusions and Future Work

We made an improved algorithm that detects oysters in visual media with YOLOv10. Also, we implemented full stack web development to assist in monitoring and farming tasks. Other researchers could expand on our work by including models to classify whether they have disease and add clearer training images.

References

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Figure 6. Link to webpage of oyster detection