Knight Foundation of Computing and Information Sciences

Spring 2024 Senior Design Project

Using AI with a Low-Cost Camera to Detect Harmful Algae in Water Samples

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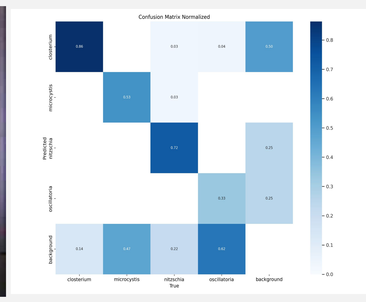
PROBLEM

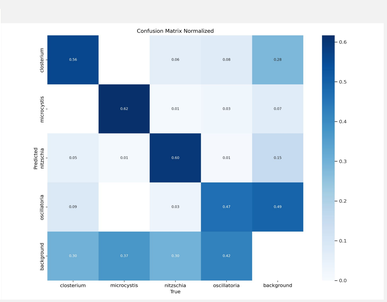
- Living in Florida, algae blooms can rapidly form in any body of water.
- While algae can be helpful, it can quickly take over an ecosystem and steal oxygen and sunlight from the other plants that need it, this project aims to use Artificial Intelligence to determine what type of algae is growing in a body of water with ease, speed, and precision.
- This will save time for the researchers and take workload off of them, allowing them to focus on what matters.

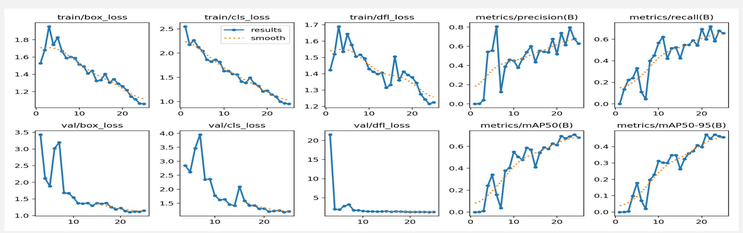
CURRENT SYSTEM

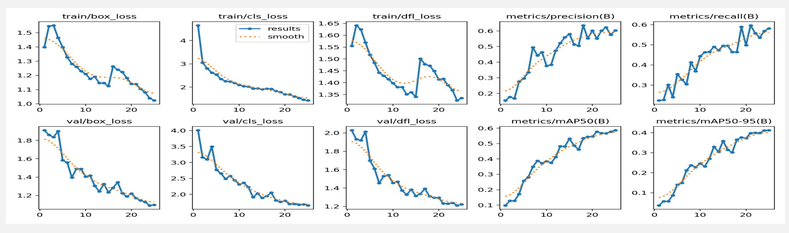
- An ESP32-CAM chip is used for this model. The cam is then mounted to a microscope and streams what the microscope would see. The image is then input into the Python model.
- Development this semester has allowed us to use an iPhone in replacement to the ESP chip; Android has not been tested.

VERIFICATION









IMPLEMENTATION

Hardware:
- ESP32-CAM AI Thinker
- Nikon SKT Optical Microscope with 200x resolution lens
- MacBook Pro M3 Max with 64 GB memory, 2 TB storage, 16 core CPU, 16 core NPU, 40 core GPU, arm64 architecture

Software:
- Platformio, Espressif framework, Arduino framework
- Roboflow, Ultralytics YOLOv8, OpenCV, Pytorch, Colab
- Python, C++, HTML, Jupyter, Anaconda, Visual Studio Code

Dataset:
- Around 2000 images (downscaled to 256 x 256) of non-algae and 4 types of algae, though only a subset was used for training
- Training, Validation, Testing Split: 0.88, 0.08, 0.04

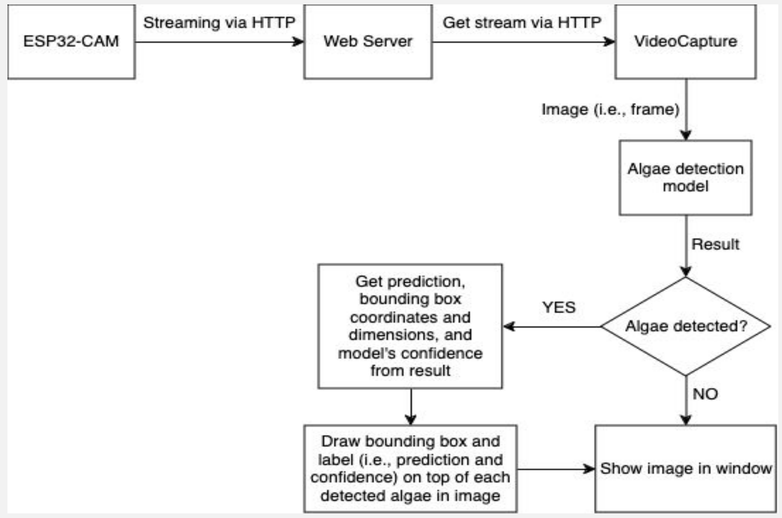
Classes:
- Closterium
- Nitzschia
- Microcystis
- Oscillatoria
- Non-algae

Model Architecture:
- YOLOv8 (Extra Large)
- YOLOv8 (Nano) with SAHI

SUMMARY

- A huge improvement to be made to the model would be a larger dataset. At least 6000 total photos would be ideal, with at least 1500 per class, due to this, model accuracy might be inconsistent.
- Large improvements have been made since we first got the model, despite the sample size.

SYSTEM DESIGN



REFERENCES

https://github.com/lynkos/algae-detection
https://github.com/rzeldent/esp32cam-rtsp/tree/develop

ACKNOWLEDGEMENT

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