



Knight Foundation
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AI on Low-Cost Camera For Counting and classification of Microbes In Nature Water



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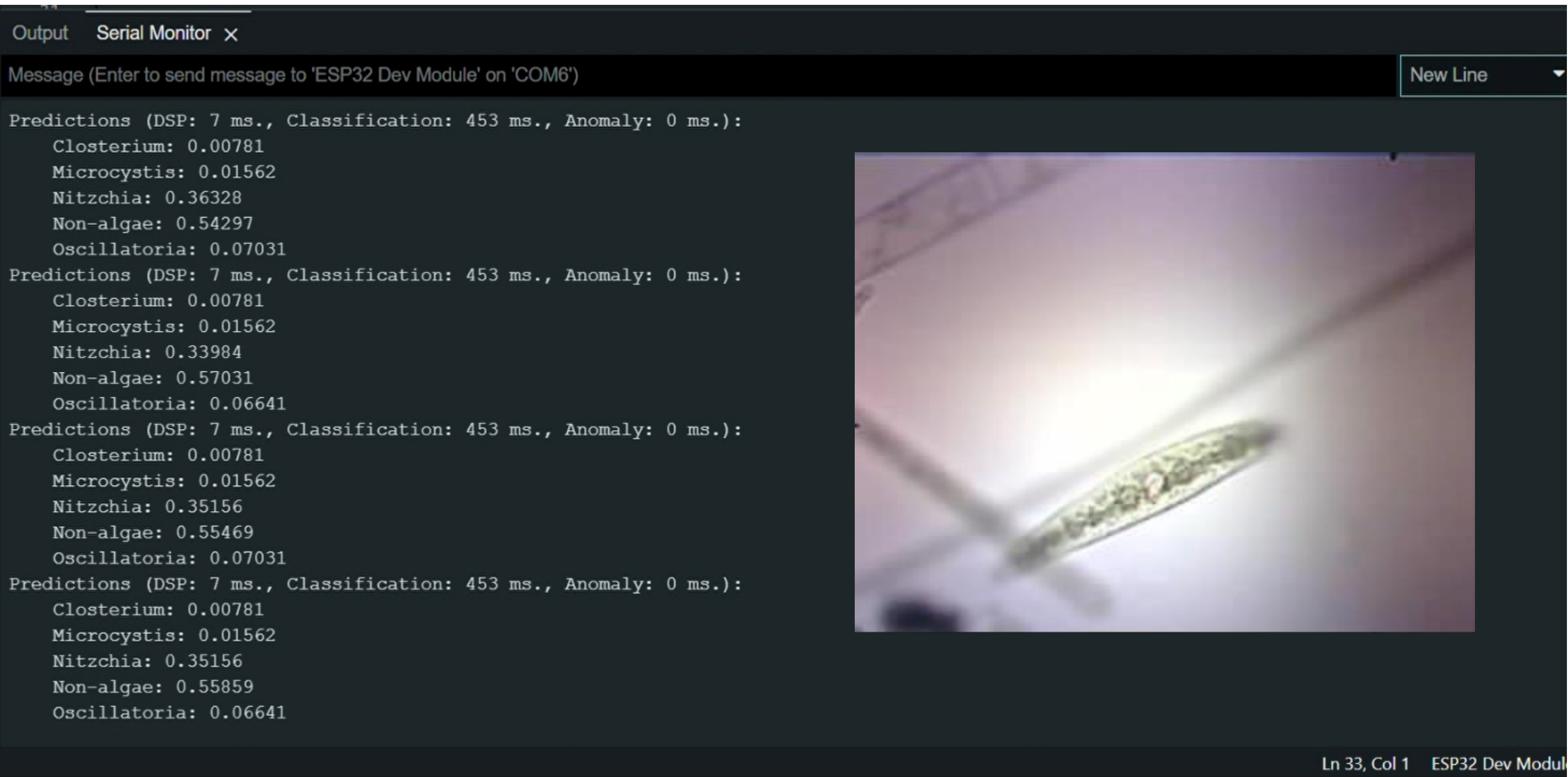
Problem

Computer vision enables computers to analyze data from digital images with the goal to extract meaningful information. With artificial intelligence we can train computers to detect people and objects. We can even use it to identify microscopic objects like algae. The problem is that the traditional monitoring of microbe samples can be costly. This is where we consider a less costly approach of using a cheap camera capable of running an AI model regardless of resolution. A cheap ESP32-CAM, a camera integrated with microcontrollers and facial recognition capabilities, is used for this. Thus we have a device along with developing systems to classify harmful and nonharmful microbes in open water to protect the environment.

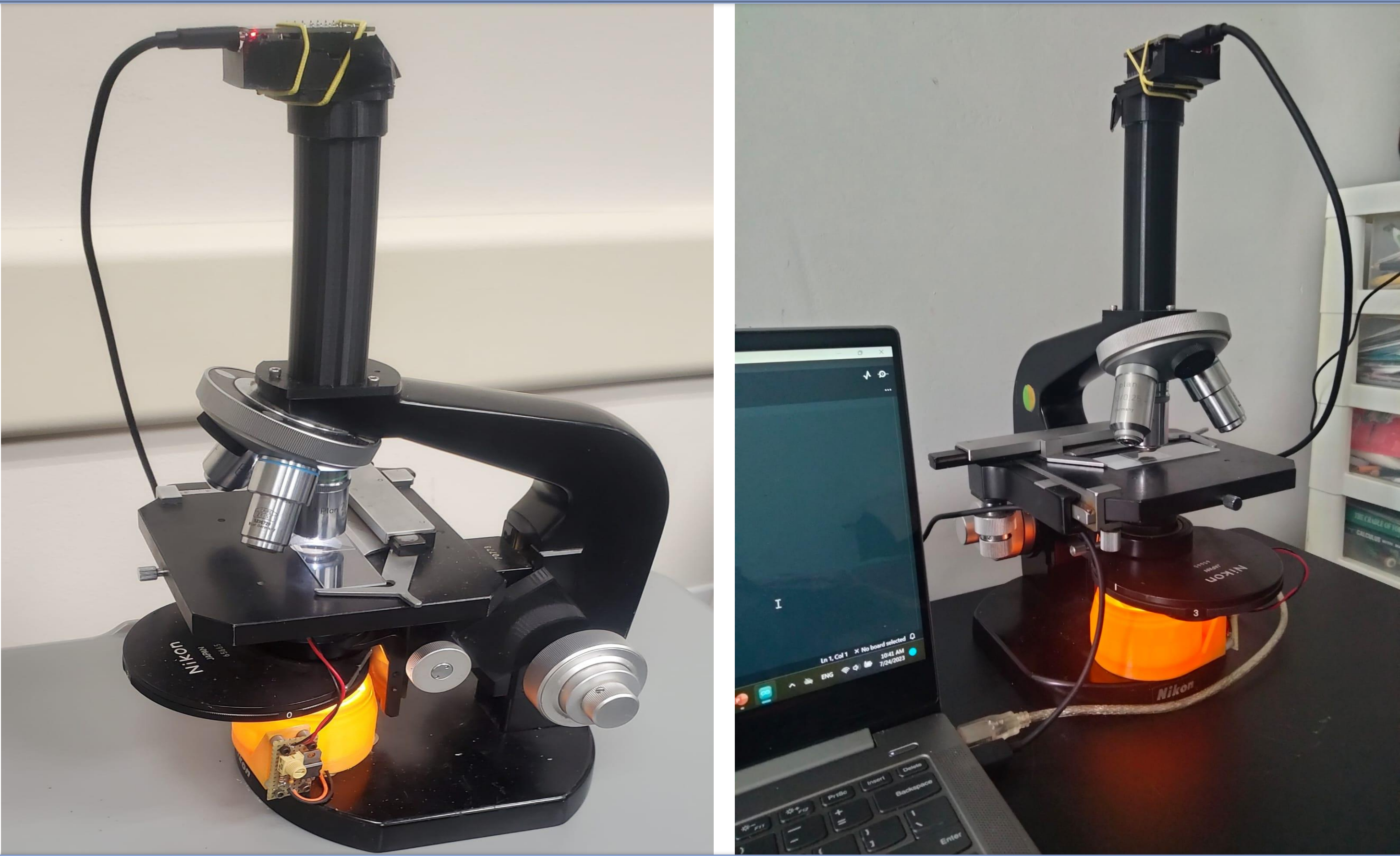
System Design

The system uses a light microscope and a ESP32-CAM to record any images and video of live microbe samples. The ESP32-CAM web server was used to collect pictures of the microbes. These pictures acted as the dataset used to train the inference model using Convolutional Neural Networks (CNN). The model was trained on Edge Impulse with parameters and dataset provided to it. From there the trained model is then deployed into a library to be included in the Arduino IDE. The included library is then uploaded to the connected ESP32-CAM to be inferred. The resulting output is an inference on the classifications of detected algae from the microscope and ESP32-CAM live feed.

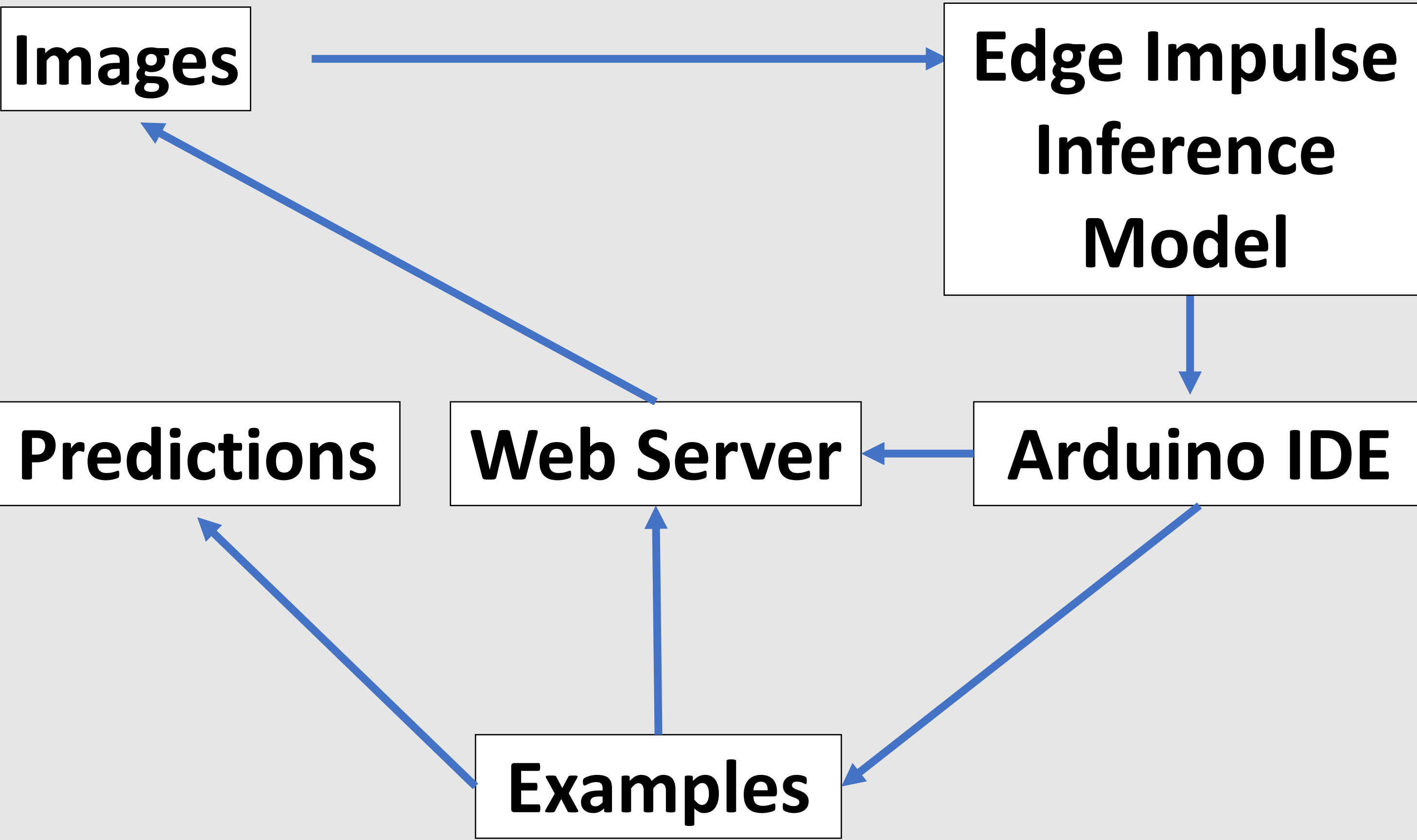
Verification



Current System



Object Design



Summary

Traditional water monitoring relies on expensive and time-consuming methods, limiting the extent of work and discovery possible. Developing efficient AI-driven detection for water quality and microbe assessment is of interest for the advancement of water monitoring efforts. This project developed an artificial intelligence-based model for the automatic detection of microbes in natural water working in conjunction with a low-cost camera for real-time inference, with the goal of proposing a novel approach to water monitoring efforts available today that reduces costs, and is convenient, efficient, and reliable.

Requirements

- Nikon light microscope
- ESP32-CAM and Chipset
- Arduino IDE
- ExpressIf library
- Edge Impulse
- Python and C++

Implementation

The system was implemented on a windows computer with a 64-bit operating system, a storage of 256GB and memory of 12GB, and an Intel® Core™ i5- 10210U CPU at 1.60GHz. We used the Arduino IDE as a development environment from which to run our system's programs, and a ESP32-CAM development board mounted on a Nikon light microscope to collect live sample images

References

1. <https://www.edgeimpulse.com>
2. <https://github.com/CIS495algaeAI>
3. https://fiuditmy.sharepoint.com/:x:/g/personal/sadjadi_fiu_edu/EUKFXI7wm1xGrcIiEin_xl5gBLupDOIFNjikeKvy45DS3A?e=0I3Gn6

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