Monitoring Coastal Environments Through Machine Learning

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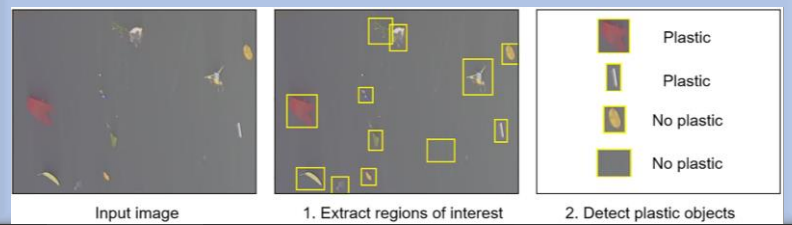
Problem Statement:

Understand the impact garbage accumulation in coastal environments is having on local wildlife and human ecosystems, as well as its contribution to the overall pollution problem plaguing our waterways and oceans.

Introduction:

I researched a non-profit organization (NPO) called The Ocean Cleanup. Founded by Dutch inventor Boyan Slat, The Ocean Cleanup was created with the intent to rid our planet's waters of 90% of their pollutants by 2040. Inspired by their work, my goal with this project was to research and plan a way to automate monitoring of IP cameras around the world to identify patterns in trash accumulation and their impact on the surrounding environment. This will help identify key concerns for the local environment and study current impact on wildlife and public health.
Google Cloud Video Intelligence API offers a user-friendly model to remotely monitor IP cameras. The model can be trained to distinguish between plastics, organic waste, and other floating materials. The ML service will also incorporate the use of Geographic Information Systems (GIS) capabilities by analysing tens of thousands of satellite images across various light spectrums; generate predictive models in ArcGIS or an open-source equivalent; develop autonomous cleaning systems for local municipalities and governments to implement on beaches, high-pollutant waterways, and riverbeds in coastal regions.



Design and Implementation:

Step 1: Planning. Review journals, magazines, social media, etc. for new posts and publications. Plan and design project implantation plan; what do we need? What free resources can we use?

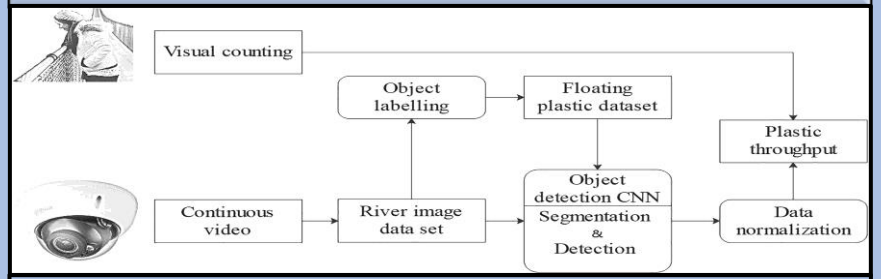
Step 2: Data Collection. Build model for data ingestion and collect data from IP cameras and remote sensor images. Segment videos and images and input into model.

Step 3: Model Exploration. Process images and video through ML program and classify detected debris to discriminate plastics. This will help to establish our performance baselines and understand how model performance scales with more data.

Step 4: Model Refinement. Perform model-specific optimizations (ie. hyperparameter tuning). Iteratively debug model as complexity is added. Perform error analysis to uncover common failure modes. Revisit Step 2 for targeted data collection and labeling of observed failure modes.

Step 5: Validation and Prediction. Identify key concerns for the local environment and study current impact on wildlife and compare to historical data. Use predictive modeling to back trace the source of pollution.

Step 6: Involve Local Support. Develop autonomous cleaning systems for local municipalities and governments to implement on beaches, high-pollutant waterways, and riverbeds in coastal regions.



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Research:

Until just a few years ago, very few people were looking into the problem of how coastal environments are being impacted by plastic pollution. Several groups around the globe have started work on this issue and have made great progress thus far. The Ocean Cleanup is currently working with Microsoft to develop coastal monitoring methods through their Azure Machine Learning services. A team of scientists also created a space called Ocean Plastic Webinars where biochemists, ocean modelers, deep-sea biologists, etc. can meet, collaborate, and undergo interdisciplinary 'open science' global efforts to uncover these knowledge gaps.

Future Work:

Since beginning this project, the Ocean Cleanup released their study using Microsoft Azure ML to monitor trash and debris in the ocean and rivers around Indonesia.

Utilize GIS services, such as ArcGIS, to build predictive models and density plots for high-pollutant areas.

Trash and plastic breakdown technologies.

Legal & Ethical Considerations:

- Data protection.
- Compliance with industry standards.
- How applications should handle personal information.
    - It is important to track if and how personal information of your users is transmitted to a third party, and what plan of action will be taken if the vendor suffers a data breach.
- Local regulations, if any, for tapping into and monitoring IP cameras.