High-tech solutions to protect our oceans

Drones help coastal cities stop the ocean trash problem at the source

"By moving to Oracle Cloud, we saw vast increases in processing speed that accelerated our progress and allowed us to actually do the work we really care about – protecting our waterways and oceans."

-Tony Hale, PhD, Program Director for Environmental Informatics, San Francisco Estuary Institute

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High-tech solutions for a trashy problem

Rivers of trash headed for the ocean

Like most populated areas around the world, the San Francisco Bay area and the state of California have a trash management problem. Human-generated trash including cigarette butts, paper, fast food containers, plastic bags, cans and bottles, used diapers, construction site debris, old tires, and old clothing is everywhere. Natural elements like rain and wind move the trash to waterways, storm drains, and wetlands where plastics, tires, and synthetics break down, but they never disappear. Every year, 7 trillion pieces of microplastic are carried by stormwater runoff, streams, creeks, and rivers and find their way into the San Francisco Bay, pass under the Golden Gate Bridge into the ocean, and end up in one of the huge Pacific gyres—like the Great Pacific Garbage Patch – threatening avian life, marine life, and public health.

In April 2015, the California State Water Board passed the Trash Amendments plan with the ambitious goal of reducing the trash waste that passes through California's waters into the open ocean. To attain its ultimate net-zero goal, the Amendment depends on consistent statewide trash monitoring, which is a lot harder than it seems.

Traditional monitoring methods require teams of trash practitioners to count, catalog, and collect trash along California's waterways and wetlands on foot at least once a year. These teams can only be so many places at one time; they can only do so much, and they can only see so much. California needed a scalable, consistent approach to measure and track trash in its waters. The California Ocean Protection Council, a public agency, turned to the San Francisco Estuary Institute (SFEI) and the Southern California Coastal Water Research Project (SCCWRP) to develop scientific measures to monitor trash in the water and to determine the effectiveness of state and local policies like plastic shopping bag bans.

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High-tech solutions for a trashy problem

A bird's eye view and machine learning optimize trash detection

- With the San Francisco Bay and the broader California coastline as their testing ground, researchers at SFEI, along with their SCCWRP counterparts, developed a scalable, cost-effective proof-of-concept trash monitoring method. Led by Dr. Tony Hale and Shelly Moore, the team used drones to fly above a specific assessment area, capture detailed imagery, and use a machine learning algorithm to detect trash in each individual image. The results were faster and more consistent than the traditional "boots on the ground" approach.
- The SFEI team used drones to collect over 35,000 images of the San Francisco Bay landscape. The aerial view vantage point of the assessment area gave a much broader picture than a trash practitioner's ground-based view of exactly how much trash was being transported by creeks, rivers, and storm runoff toward the San Francisco Bay and ultimately into the open ocean. In 15-minutes with two people and a drone they could collect the same amount of imagery it took three to five people on foot several hours to accomplish.
- The research team developed a machine learning algorithm to process the drone images and detect trash from other objects. But as the team began processing the images with their algorithm – using TensorFlow open-source software to tune it, test it and inference it to detect specific trash images – they discovered their on-premises data center GPU resources could not handle the workload they were throwing at it. On multiple occasions, they needed to start over, which caused delays. It took almost a month to process the images, a timeline that was not scalable.
- The SFEI team needed enterprise computing power to efficiently process and classify their database images. They leveraged Oracle Cloud Infrastructure GPU-powered virtual machines to develop their machine learning algorithm, and use it for tuning, testing, and inferencing. The result was accelerated image processing and a timeline that dropped from a month to just a few hours.

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