Detection and Mapping of Plastic Debris at Scale

How Au-Zone Technologies Plays a Key Role in The Ocean Cleanup Automated Debris Imaging System (ADIS)

Challenges in Ocean Cleanup

DETECTION AND MONITORING OF OCEAN PLASTIC

As part of the United Nations "10 Challenges, Ocean Decade Challenges for Collective Impact," ADIS (Automated Ocean Debris Imaging System) offers a low-cost solution to monitor and digitally represent plastic debris concentrations in the ocean. This smart camera fleet enhances understanding of plastic sources, movement, and impacts, laying the groundwork for targeted cleanup efforts and improved strategies. By integrating with other data sources, digital representations of the ocean help model pollution dispersion, identify hotspots, assess ecosystem health, and track the success of restoration activities, contributing to more effective ocean protection initiatives. One of the significant challenges The Ocean Cleanup faced was accurately identifying plastic debris dispersed across vast ocean areas. Initially, the project relied on physical sampling and human observers aboard vessels to monitor and document debris size, type, and location. This manual approach was labour-intensive, error-prone, and limited in scope.

Founded in 2012 in Rotterdam, The Ocean Cleanup is developing and scaling technologies to rid the oceans of plastic with ocean cleanup systems and river interception technologies. With over 150 employees, The Ocean Cleanup operates offshore and in collaboration with local governments and stakeholders to implement and test their solutions. The challenge of identifying and collecting plastic debris, particularly in remote areas of the ocean, required the adoption of cutting-edge technology to address inefficiencies in manual detection, mapping and data collection processes.

To enhance this process, a first prototype AI system using PC and GoPro cameras was introduced. However, managing and processing the data from these off-the-shelf cameras still required significant manual effort, consuming considerable time and resources and impeding The Ocean Cleanup's ability to efficiently scale its operations.

CONSTRUCTING HARDWARE RESISTANT TO SEA CONDITIONS

"The key to designing a successful visual perception solution begins with the hardware. It must withstand the harsh marine environment, which is no easy feat. Many companies claim they can build such solutions, but once deployed in the ocean, failures occur. Without reliable hardware, nothing else matters." - Robin de Vries

Solution: Au-Zone's EdgeFirst 3D Spatial Perception Technology

In 2022, The Ocean Cleanup began collaborating with Au-Zone Technologies to develop and integrate an EdgeFirst-based AI-enabled 3D visual perception system into their operations. The sensing systems, which The Ocean Cleanup calls Autonomous Debris Imaging System (ADIS), are based on Au-Zone's MAIVIN camera and provided The Ocean Cleanup with a robust solution to detect plastic debris at sea using real-time, AI-driven object recognition.

The new system employs cameras installed on numerous vessels. Images are processed directly at the edge, on the cameras themselves, rather than relying on centralized servers. This allows the cameras to autonomously detect, classify and locate plastic debris in real-time, transferring data remotely to The Ocean Cleanup's offices for analysis over LTE once the ship returns to port. The technology also features IP67-rated enclosures that protect the cameras from harsh marine conditions, ensuring they remain operational for extended periods without needing replacement or frequent maintenance.

Implementation and Integration

In 2022, the initial prototypes of the system were developed, and in 2024, twelve cameras equipped with Au-Zone's 3D Spatial Perception technology were gradually deployed across seven vessels. While the physical/mechanical aspects of shipboard deployments were relatively straightforward, finding access to power sources for the cameras on vessels required some logistical planning to meet safety and regulatory requirements for each different vessel. Once installed, the cameras were then configured to operate autonomously, significantly reducing the need for constant manual oversight. Whenever ships return to port, devices "call home" with new data and perform seamless system updates when available.

## High-Fidelity Data for Large Scale Modelling

ADIS enables The Ocean Cleanup to shift from sparse, geographically limited data collection to a significantly more scalable, global approach to mapping debris. The AI-driven system enables The Ocean Cleanup to continuously gather data and efficiently predict plastic debris hotspots in ocean convergence zones such as the Great Pacific Garbage Patch and lesser-studied areas like the Indian Ocean.

Benefits and Outcomes

SCALABILITY

The ADIS system allows The Ocean Cleanup to leverage merchant vessels and cruise ships already transiting trade routes and travelling across the oceans, minimizing the cost of dedicated research expeditions while maximizing the volume of data collected.

"It is indeed a different kind of approach where we are now. We've hopefully simplified the camera workflow so much that we can just send it with instructions, shifting more to external partners for self-installation. With some instruction videos and materials, we've found this is possible." - Robin de Vries
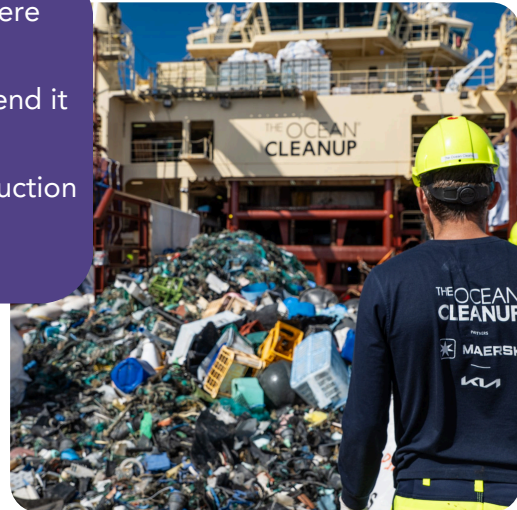
REAL-TIME PROCESSING

With fully integrated Edge AI computing capabilities, the ADIS cameras process all images in real-time, significantly reducing the volume of data that needs to be handled. By storing only critical meta-data about detected debris, ADIS becomes more scalable, enabling data collection over extended voyages lasting several months between uploads.

OPERATIONAL EFFICIENCY

By automating much of the data collection and processing workflow, the ADIS System frees up human resources to focus on data analysis and advanced research models rather than logistics, increasing overall productivity. Without this capability, scaling up to the needed levels would not be possible.

COST SAVINGS

Installing cameras on third-party vessels opens up the potential for a significantly broader research footprint compared to traditional methods that rely on expensive, dedicated research vessels. This approach has drastically reduced the costs associated with gathering ocean plastic data and greatly expanded the scope of data collection, eliminating the need for research expeditions that previously cost up to half a million dollars per voyage.

"It is both a saving and a scale step. Without this, we wouldn't even consider having so many data points due to the cost. Now it's possible to generate a lot of affordable data that would otherwise cost us millions in fuel and manning hours." - Robin de Vries.

Integrating Au-Zone's EdgeFirst technology has allowed The Ocean Cleanup to map global plastic densities more accurately, which is vital for planning future cleanup operations and attracting corporate partnerships and funding.

Conclusion

The collaboration between The Ocean Cleanup and Au-Zone Technologies has significantly improved The Ocean Cleanup's ability to identify, track, and remove plastic debris from the world's oceans. The use of AI-driven 3D visual perception technology has not only streamlined operations but also increased the scalability of The Ocean Cleanup's mission, making it a powerful tool in the global fight against ocean plastic pollution. As this technology continues to evolve, it promises even greater precision, efficiency, and environmental impact for The Ocean Cleanup's future cleanup efforts.

About Au-Zone Technologies

Au-Zone Technologies stands at the forefront of embedded Computer Vision, AI, and spatial Precision technologies, empowering its clients to confidently deploy the latest in intelligent perception and applied solutions. With over 15 years of experience as a trusted technology partner, the Au-Zone team collaborates with OEMs, engineering teams, and research groups across diverse industrial sectors, including Commercial Video Telematics, Marine Mapping, Space Automation, Off-Road Equipment, and Autonomous Robotics Platforms. EdgeFirstTM Studio, Au-Zone's advanced 3D Spatial Perception Technology, featuring an industry-first Radar+Vision Perception Engine, AI-accelerated tooling, and field-proven AI models, facilitates the rapid development of machines capable of safe and autonomous operation in dynamic and unpredictable environments.