



Plastic FINDER

PRODUCT SHEET

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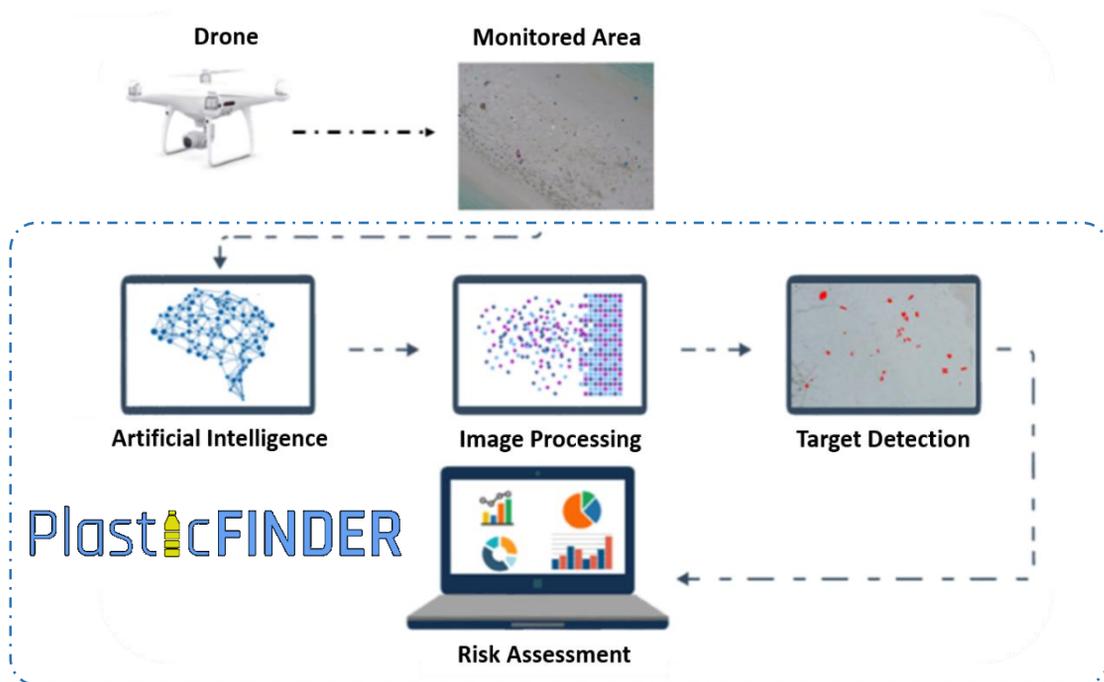
THE PROBLEM

Anthropogenic Marine Debris (AMD) is one of the major environmental issues of our planet to date, and plastic accounts for 80% of total AMD. Beaches represent one of the main marine compartment where AMD accumulates, but few objective and automated methods exist to date for an efficient monitoring needed to activate preventive actions.



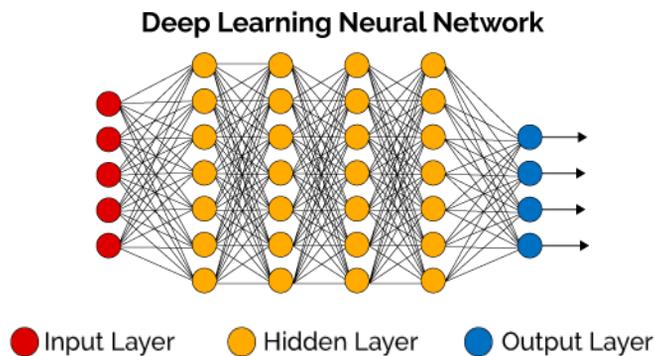
OUR SOLUTION

PlasticFinder is a licensed commercial software that uses deep learning to automatically detect and quantify the presence of plastic debris on the shore-lines by analyzing drone images.



HOW DEEP LEARNING HELPS PLASTICFINDER TO SPOT ANTHROPOGENIC MARINE DEBRIS

Deep learning (DL) is a powerful AI method to tackle image classification and object detection problems. Neural networks used in DL are made of trainable multilayers that learn automatically the features through geometric transformations and gradual adjustments of learning weights with respect to a feedback signal. Convolutional Neural Networks (CNNs) are a class of multilayer architectures suitable for processing RGB images for classification and object detection tasks, allowing the algorithm to detect a target object independently of its position in the image [1-3].



PlasticFinder uses trained CNNs tailored with layers dedicated to thousands of images including the classes of interest for the marine environment ("vegetation", "sea", "sand" and "other" - i.e. items such as wood, stones, algae), and plastic debris ("anthropogenic debris") [4].

When an image is given as input, PlasticFinder uses the tailored CNN to analyze it with a sliding-window classification approach. The software returns as output pixel-wise heatmaps, representing a pixel-probability map for each class, and a bounding-boxes map with the detected AMD. Also, PlasticFinder is meant to be a scalable software, i.e. adaptable to different scenarios.

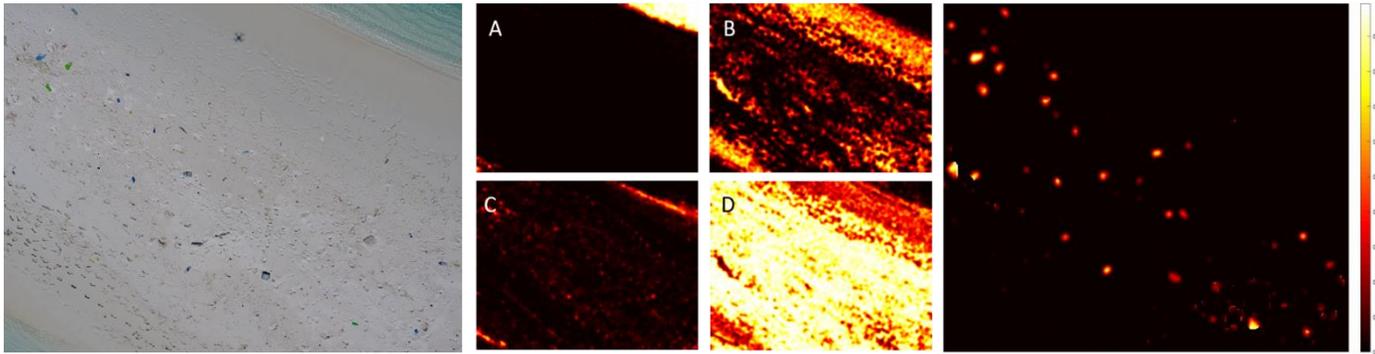
[1] LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. *Nature*, 521(7553), 436–444.

[2] Russakovsky, O., Deng, J., Su, H. et al. (2015). ImageNet Large Scale Visual Recognition Challenge, *Int J Comput Vis* (2015) 115: 211.

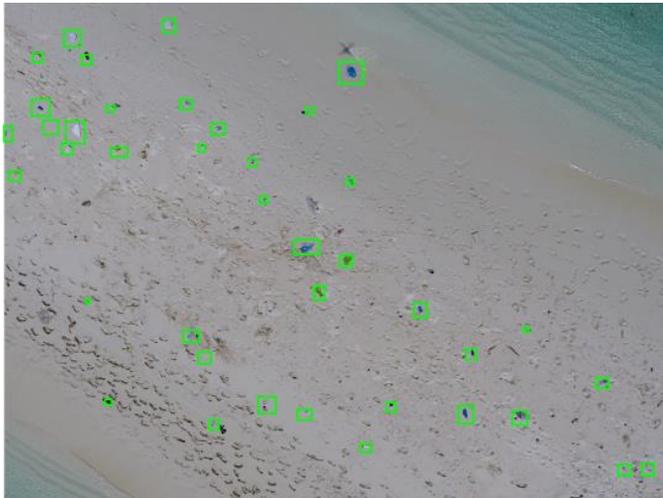
[3] Francois Chollet. *Deep Learning with Python*. Manning Publications Co., Greenwich, CT, USA, 1st edition, 2017.

[4] Fallati, L., Polidori, A., Salvatore, A., Saponari, L., Savini, A., Galli, A. Submitted to *Science of Total Environment* (June 2019)

Setting up the protocol to automatically detect and quantify Anthropogenic Marine-Debris on beaches using Unmanned Aerial Vehicles: the contribution of Deep Learning in the Republic of Maldives.



Canvas on the left: example of drone input-image. Central canvas: PlasticFinder output heatmaps for classes sea (A), sand (B), vegetation (C) and other/AMD (D). Canvas on the right: AMD class.



PlasticFinder bounding-boxes map with the detected AMD.

AMD Detection Metrics

Sensitivity 67 %

PPV 94 %

F-Score 78 %

PERFORMANCES

The performances were tested during a case-study, comparing the AMD collected on the shores with the AMD detected on the images by PlasticFinder. The software reached a Sensitivity of 67%, with a Positive Predictive Value of 94%, in the automatic detection of AMD.

SCALABILITY

The present version of PlasticFinder has been tailored using images of Maldivian islands, but the training set can be enlarged and/or customized for other settings. The software can be customized depending on users' needs, and available data.