

## Will you Help Robots to Spot Novel Objects...?

### Multimodal object discovery for robotic vision in an open world

#### INTRODUCTION – ROBOTS OPERATING IN AN OPEN WORLD!

How to discover new objects in images? Help the robot to identify when it encounters something it does not know yet! Learn to discover by a multimodal model of images and depth using deep learning.

#### WHAT YOU WILL BE DOING – PUSHING SCIENCE, CREATING ALGORITHMS THAT WORK!

In an open world, a robot will encounter new objects. The key is to identify when an object is unknown, such that an operator can label it, or to defer to zero-shot techniques. Novelty detection in images is a well-known, hard problem. Especially for object detection, because that requires a sense of what a new object may look like, in order to localize it. Our hypothesis is that it is more feasible to detect novelties in depth images. Typically new objects have shapes that are different from the known objects, which provides a discriminative cue of novelty. And, segmentation of shapes is more straightforward than segmenting cluttered images. Therefore, shape information from the depth image (D), is a more direct cue of a novelty. After identifying the novel object, the robot may move around the object and take a few image shots of the object from different angles (RGB). The human operator only needs to provide 1 label, effectively labeling the few shots at once. From few-shot learning, it is known that a few labeled shots of an object may provide an initial model of the new object, such that it can be recognized a next time. The goal of this research is to identify novel objects in depth (D) images, to take various images (RGB) from a novel object, and to ask for one label in order to learn an initial model on these images. You are under both the guidance of Professor Kees Vuik as well as Dr. Gertjan Burghouts from TNO Intelligent Imaging.

#### THE RELEVANCE TO INDUSTRY – ROBOTS WITH MORE AUTONOMY

Being able to identify when an object is unknown, is very relevant for autonomous robots operating in the open world. With this capability, a robot is able to ask a human for help when the object is unknown, or it can go into safe mode, making sure no harm is done.

#### Literature:

Joseph, K. J., Khan, S., Khan, F. S., & Balasubramanian, V. N. (2021). Towards open world object detection. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (pp. 5830-5840).

Genc, E. U., Ahuja, N., Ndiour, I. J., & Tickoo, O. (2021, February). Energy-Based Anomaly Detection and Localization. In Energy Based Models Workshop-ICLR 2021.

#### Contact:

Kees Vuik, [c.vuik@tudelft.nl](mailto:c.vuik@tudelft.nl)

Gertjan Burghouts, [gertjan.burghouts@tno.nl](mailto:gertjan.burghouts@tno.nl)