DATA SCIENCE
SUMMIT ML EDITION

Waste detection in Pomerania -
non-profit project for detecting waste in environment

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AGENDA

- Presenters
- Motivation
- Data
- Framework
- Results
- Application
- Project&Team
- Sponsors
- Takeaway message

PRESENTERS

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MOTIVATION

5 000 000 000 tons

Of garbage in Oceans and Seas

100 kg

Of plastic is produced by average European every year

30 years

Left until the number of litter in the ocean will exceed the number of animals

DATA

TrashNet

Openlittermap

Waste Pictures

Extended TACO

Wade-AI

UAVVaste

TrashCan

Trash-ICRA

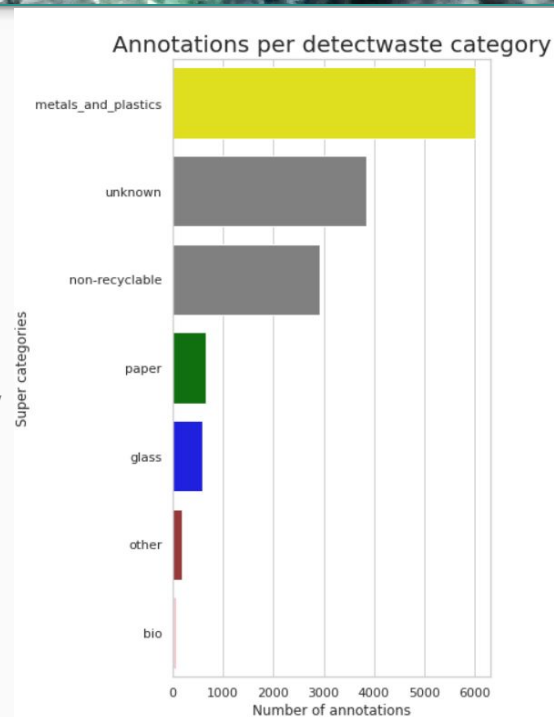Drinking Waste

MJU-Waste

Cigarette butt

Places

DATA – CHALLENGES

- Small dataset
- Unlabeled pictures
  - Broken glass
  - Potato chips bag
- Imbalanced categories and backgrounds
- Sometimes it is hard to determine what do we really
- When a thing became a litter?

Annotations per detectwaste category

Dataset	#classes	#images	Comment
drink-waste	4	9640	Indoor, plain background
mju-waste	1	2475	Indoor, in hand-held
TrashCan	8	7212	Underwater, video frames
UAVVaste	1	772	Waste in the wild, taken with a drone
Extended TACO	1	4614	Waste in the wild, diverse backgrounds
Wade-AI	1	1400	Waste in the wild, Google street View
Extended TACO	7	4614	Waste in the wild, diverse backgrounds
Trash ICRA-19	7	5700	Underwater, selected trash categories, video frames

DATA – CONSEQUENCES
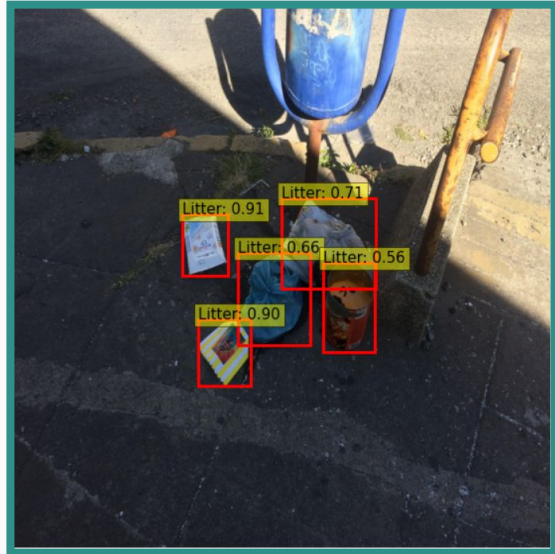
SOLUTION
Inspired by Gdańsk

background

bio

glass

metal and plastic

non-recyclable

other

paper

unknown

Stage 1: Localization. Detect litter with object detector

Input image → Detect litter → Region proposal

Detection results

Crop predicted bboxes

Stage 2: Classification. Classify detected litter

8 classes

Not litter: background (0)
Litter: bio (1), glass (2), metals and plastic (3), non-recyclable (4), paper (5), other (6), unknown litter (7)

Proposed objects to classify

Classify proposed objects

Litter: Paper

Litter: Metals and Plastic

Not litter: Background

Classification results

Remove false positives and visualize results

FRAMEWORK

Stage 1
Detection

Stage 2
Classification

DETECTION

- *The most effective model: EfficientDet-D2*
- *Tested detectors: EfficientDets, YOLO, Mask R-CNN, Faster R-CNN, DETR*
- *Augmentation*

CLASSIFICATION

- *The most effective model: EfficientNet-B2*
- *Semi-supervised approach: labelled and unlabeled data*
- *Augmentation*

RESULTS

Litter: 0.96

Litter: 0.97

Detect-waste detr-resnet50 Threshold=0.50 Inference 800x800 GPU: GeForce RTX 2080 Ti Inference time 0.086s

Non recyclable 64.4%

mAP@0.5 ~ 70%

Acc ~ 75%

APPLICATION

- Automation

- Monitoring - Illegal landfills detection

- Monitoring - Environment contamination measurement

- Cleaning costs optimization

Agnieszka Mikołajczyk

Passionate PhD Candidate,
ML researcher at Voicelab, PI
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Magdalena Kortas

Data Scientist | Women in
Machine Learning & Data
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Machine Learning Engineer

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Project Manager, co-owner of
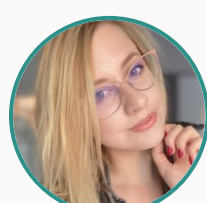soil laboratory, data science
enthusiast

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SPONSORS

Digital Innovation Hub
Gdańsk

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Efficient data annotation

neptune.ai
Experiment management tool

O4 Flow Gdańsk
Coworking in Poland for women

TACO
Trash Annotations in Context

VoiceLab.AI
Conversational Intelligence

WiMLDS
Women in Machine Learning and
Data Science Trójmiasto

TAKEAWAY MESSAGE

- Environment contamination level dangerously grows year by year

- Humanity may face many side effects

- Artificial Intelligence may help

- Available data that can be used for ML systems is not ideal

- Proposed framework uses two combined Neural Networks

- Up to 70% of average precision in waste detection

- Around 75% of waste classification accuracy

- It can be applied for automation, monitoring and waste management

- Project was executed by the team of volunteers

- Open source code at GitHub repository