Pattrn (AI)

Project Proposal For Theme (1)

Detection and evaluation of visual pollution on street imagery taken from a moving vehicle

Our Objective

To establish a new field of automated visual pollution classification utilizing the technological prowess of the 21st century for environmental management applications.

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Problem Statement

Problem Statement

Detect and classify objects such as graffiti, faded signage, potholes, garbage, construction road, broken signage, bad streetlight, bad billboard, sand on road, clutter sidewalk, and unkept facades.

02
Challenges

Challenges Faced

Class Imbalance

- imbalance in the number of samples for each class.
- leading to poor performance on under-represented classes.

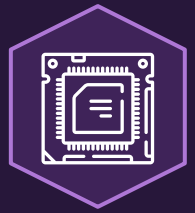
Miss Labels

- issues with incorrect labels.
- leading to the model learning wrong associations between images and labels.

Challenges Faced

Few Samples per Class

- limited number of samples per class
- leading to overfitting and poor generalization



Inaccurate bounding Boxes

- bounding boxes are not accurate.
- leading to poor object detection performance.

Challenges Faced

Inconsistent labeling

- Inconsistency in the labeling of the images
- leading to confusion and poor performance

Low Compute Power

- Trade off between mAP and compute
- leading to low performance.

03
Methodology

Methdology

- We experimented with different state-of-the-art solutions for the object detection problem.
- We specifically investigated models from the YOLO and R-CNN families.
- The R-CNN framework involves two stages:
- 1. Region Proposal**,** in which the model generates a large number of bounding box proposals.
- 2. Proposal scoring, in which the best-scoring bounding boxes are selected.

Methdology

- The YOLO family includes single-stage models that do not require the region proposal step.
- The models we tried exhibited a tradeoff between scalability and performance, and they range from lightweight to large-scale models.
- At the end, we found YOLOv5 with the following hyperparameters to work well on this dataset, while not requiring a large computational cost.

04
Results

Selected Experiments

Model	mAP on Test	Comment
Yolov5s	21.53	The results shown is based on the best selected hyperparameters and type of data augmentation.
Yolov5l	32	
Yolov5x	60.66	
Yolov5x6	57.69	

Sample Outputs

Graffiti | **Faded Signage** | **Potholes**

Sample Outputs

Garbage	Unkept Facades	Broken Signage

Sample Outputs

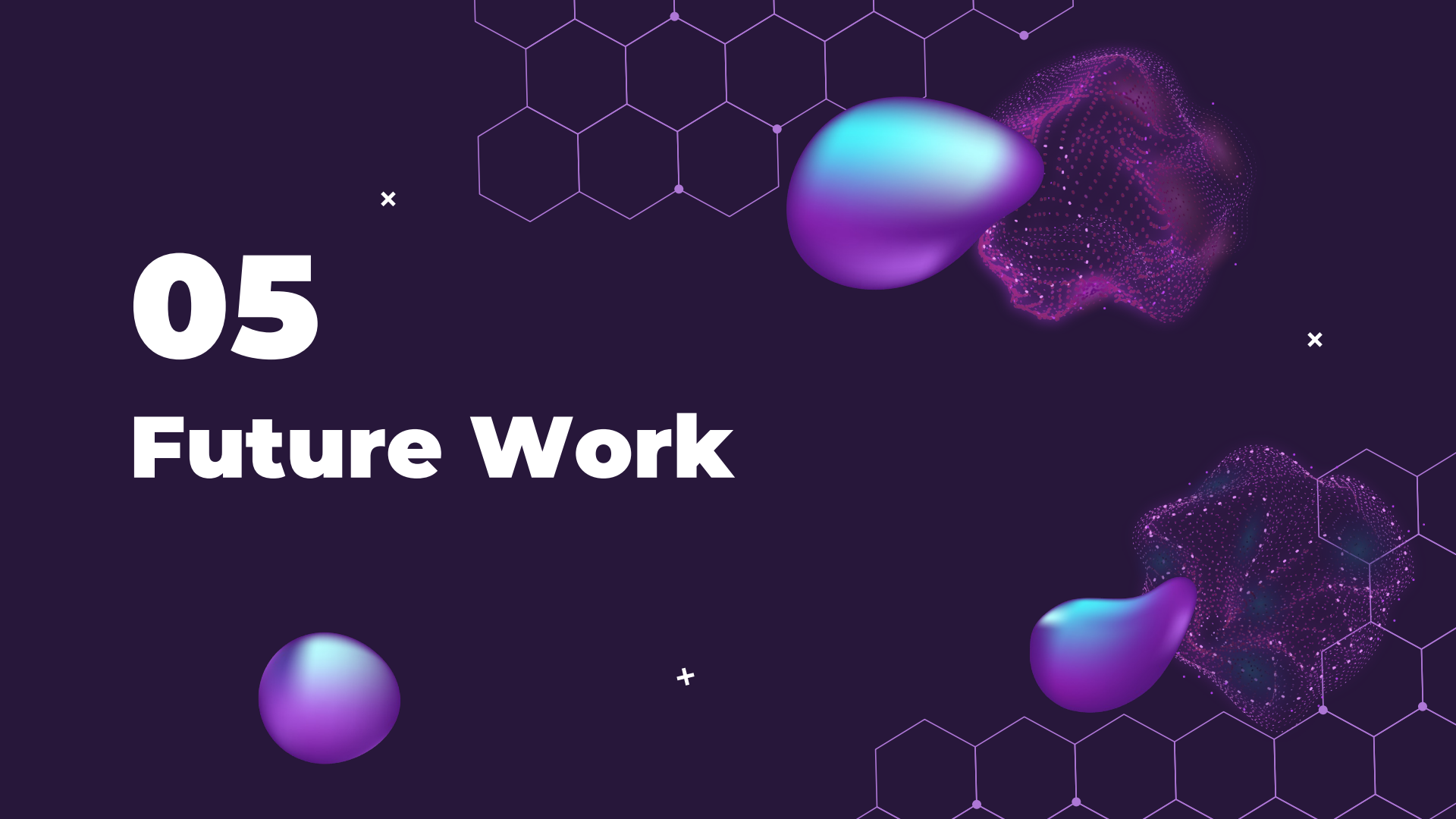
Bad Billboard

Sand on Road

Sample Outputs

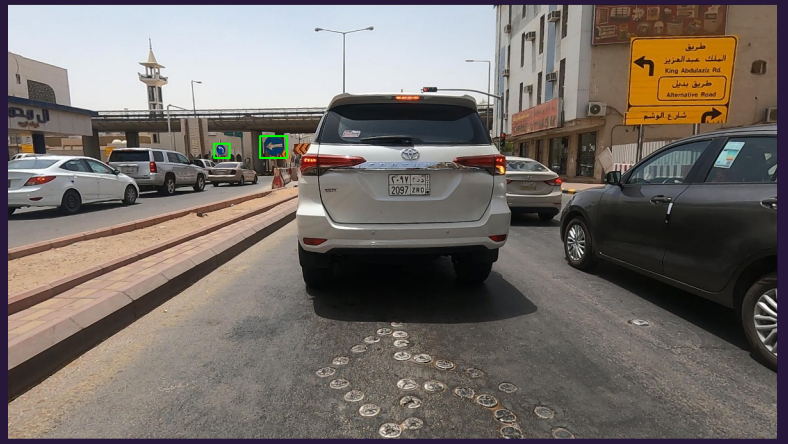
Clutter Sidewalk

Construction Road


05
Future Work

Future Work

- Splitting the task to object detection and classification can result in higher accuracy compared to doing both using the same model.
- SOTA object detection models such as YOLOv8, Fast R-CNN, and RetinalNet **will be trained on detecting the object regardless whether the object is a visual pollution or not**. For example, the model will return the bounding boxes of any traffic SIGN detected in the image without determining if it is faded or not.
- A **dedicated classifier** will be trained to identify if the given object is **a visual pollution or not.**
- This approach can help reduce false positives and false negatives, resulting in improved accuracy.

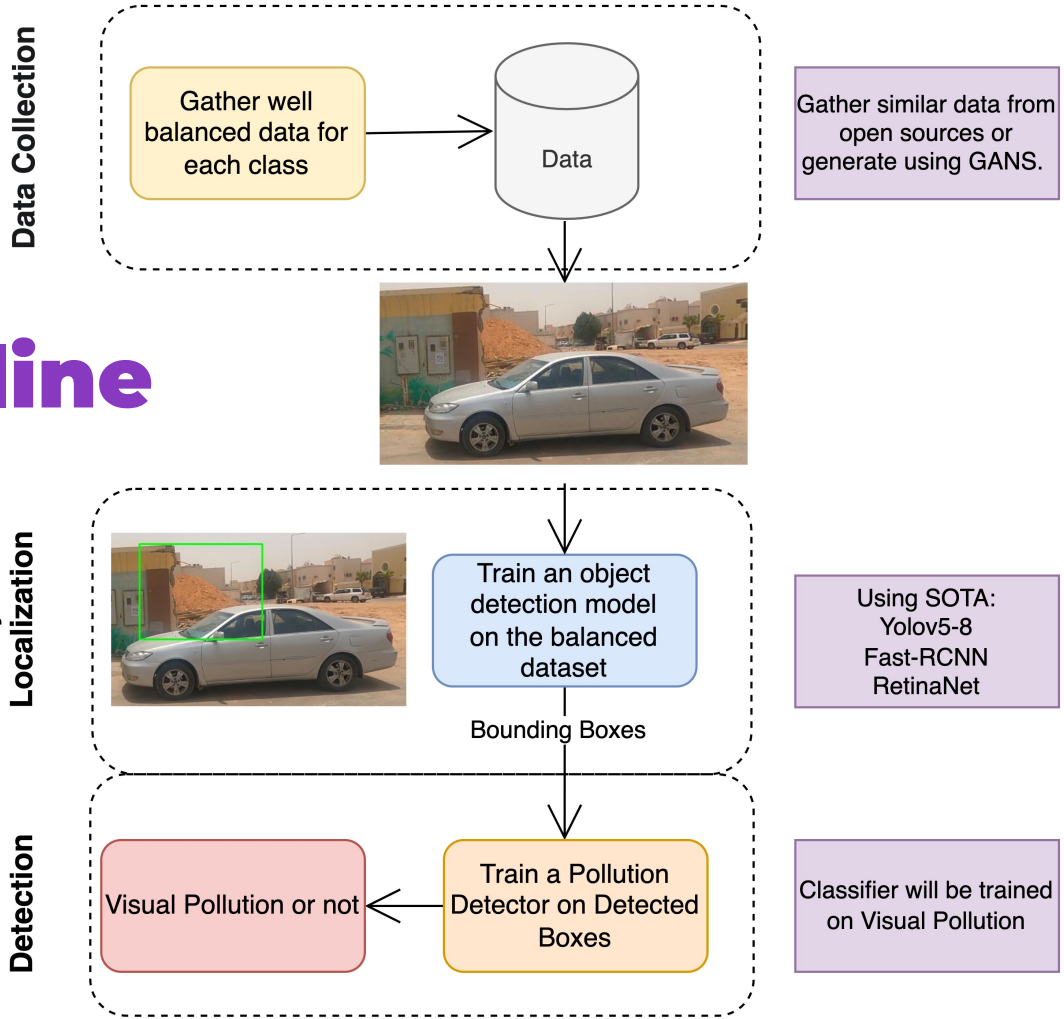


Output of the object detection model

Classifier output:
NOT_FADED

Classifier output:
FADED

Pipeline


Explanation
Data Collection
Gather well balanced data for each class
Data
Gather similar data from open sources or generate using GANS.
Object Localization
Train an object detection model on the balanced dataset
Bounding Boxes
Using SOTA:
Yolov5-8
Fast-RCNN
RetinaNet
Pollution Detection
Visual Pollution or not
Train a Pollution Detector on Detected Boxes
Classifier will be trained on Visual Pollution

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