

Vehicle Detection in Various Weather and Lighting Conditions Using YOLO Algorithm

Rajdeep Khaskel, Anuska Roy, Taniska Roy

1 Problem Statement

The project aims to develop a robust vehicle detection system that maintains high accuracy across diverse weather and lighting conditions in real-time scenarios.

2 Methodology

The code and additional details for this project are available on GitHub. Please refer to the following link: [link](#)

2.1 Dataset Overview

The AVD-Dataset contains 3,200 vehicle images under varied weather conditions: 2,600 for training and 200 for validation. It includes 15 vehicle classes, with annotations in YOLO format.

2.2 Observations

1. YOLOv8n:

- mAP@50: **0.41**, F1: **0.49**, Precision: **0.59**

2. YOLOv10n:

- mAP@50: **0.49**, F1: **0.53**, Precision: **0.65**

3. YOLOv10m:

- mAP@50: **0.51**, F1: **0.57**, Precision: **0.69**
- **Backbone Changes:**
 - ResNet50, EfficientNetB4, B5: **0.53**, F1: **0.55**, Precision: **0.67**
 - MobileNetV2: **0.51**, F1: **0.54**, Precision: **0.66**
- **Backbone and Head Changes:**
 - EfficientNetB4 as Both: **0.49**, F1: **0.53**, Precision: **0.65**
 - MobileNetV2 as Both: **0.43**, F1: **0.51**, Precision: **0.62**
 - EfficientNetB4 as Backbone, ResNet50 as Head: **0.49**, F1: **0.53**, Precision: **0.65**
- **Head Changes:**
 - EfficientNetB4 as Head: Accuracy fell below initial result.

4. YOLOv10x:

- No Backbone: mAP@50: **0.598**, F1: **0.60**, Precision: **0.70**
- With Backbone (EfficientNetB4, ResNet50, ResNet152, Swin Transformer): **0.598**, F1: **0.60**, Precision: **0.70**
- Training and Validation: Consistent at **0.598**, F1: **0.60**, Precision: **0.70**

3 Conclusions

1. YOLOv10n and earlier versions did not show significant improvements.
2. YOLOv10m achieved **0.53** mAP@50 with medium-weight backbones, while MobileNetV2 scored **0.51**.
3. YOLOv10x consistently achieved **0.598** mAP@50 for both training and validation.
4. Training for 50 epochs was optimal; beyond 50 epochs led to overfitting, with increased false negatives and decreased recall.
5. Backbones with fewer parameters did not show significant improvements, while larger models performed better but did not benefit from epochs beyond 50, suggesting the data was not well-suited for heavier models.