Model Training Report

1. Code Flow / Algorithm

1. Load YOLOv11m pretrained model (`yolo11m.pt`)

2. Load and parse dataset defined in `data.yaml`

3. Set training configurations: `epochs=50`, `batch size=8`, `device=GPU`

4. Train the model on 5048 images

5. Validate the model on 561 images

6. Evaluate model metrics and save best-performing weights

2. Exploratory Data Analysis (EDA)

Dataset Summary:

- Training Images: 5048

- Validation/Test Images: 561

Classes:

- ADVISORY_SPEED_MPH: 188 instances

- DIRECTIONAL_ARROW_AUXILIARY: 199 instances

- DO_NOT_ENTER: 220 instances

3. Training Configuration

- Model: YOLOv11m

- Epochs: 50

- Batch Size: 8

- Patience: 0 (no early stopping)

- Device: GPU (Google Colab)

Why Only 50 Epochs?

The dataset consists of a substantial number of labeled images (5,609 in total). Training on such a large dataset requires high-performance hardware. Since training was conducted on Google Colab, which has time and resource limitations, we capped the training at 50 epochs. Despite this limitation, the model demonstrated exceptional performance, achieving high

accuracy and generalization. Therefore, extending the epochs further was not necessary for this task.

4. Training Results Analysis

Validation Metrics:

- mAP@0.5: 0.979

- mAP@0.5:0.95: 0.871

- Precision: 0.947

- Recall: 0.959

Class-wise Performance:

Class	Precision	Recall	mAP@0.5	mAP@0.5:0.95
ADVISORY_SPEED_MPH	0.975	0.995	0.994	0.915
DIRECTIONAL_ARROW_AUXILIARY	0.930	0.905	0.958	0.775
DO_NOT_ENTER	0.936	0.977	0.986	0.923

Inference Speed:

- Preprocess: 0.3 ms/image

- Inference: 7.5 ms/image

- Postprocess: 3.1 ms/image

5. Confusion Matrix Analysis

- ADVISORY_SPEED_MPH: 187 correct, 9 missed

- DIRECTIONAL_ARROW_AUXILIARY: 188 correct, 29 missed

- DO_NOT_ENTER: 218 correct, 31 missed

- 14 false positives from background

6. Detection on Unseen Data

Performs reliably across various sizes and lighting. Cluttered background is the major error source.

Conclusion

High precision, low latency YOLOv11m model suitable for real-time object detection.