ZEHAM MANAGEMENT BOOTCAMP

VEHICLE DETECTION AND CLASSIFICATION USING YOLO

PRESENTED BY:

EBTSAM ASIRI
FATIMAH ALSAEEDI
SHAHAD ALHOMUD
NOUF ALOMARI

AGENDA

- Introduction
- Objectives of the Project
- Importance of Object Detection in Traffic Management
- Tools and Methodology
- YOLO Training Process and Custom Dataset
- Implementation and Model Testing
- Results and Evaluation
- Conclusion and Q&A

INTRODUCTION:

Object detection and classification are essential technologies in modern traffic management systems. They enable real-time analysis of traffic flow, vehicle detection, and vehicle categorization (e.g., cars, buses, trucks).

PROJECT OBJECTIVES:

- To develop a system for real-time detection and classification of vehicles (e.g., cars, buses, trucks) using the YOLO object detection model.
- To fine-tune YOLO’s pre-trained weights on the COCO dataset using a custom dataset containing vehicles.
- To apply the trained model to detect and classify vehicles in video sequences and images, with bounding boxes and confidence scores.

IMPORTANCE OF OBJECT DETECTION IN TRAFFIC MANAGEMENT

Object detection plays a crucial role in automating traffic monitoring systems, enabling traffic management systems to detect vehicles, assess traffic density, and identify vehicle types.

KEY APPLICATIONS INCLUDE:

Traffic flow analysis and congestion detection, vehicle counting and classification, enabling intelligent traffic light systems for efficient vehicle management.

TOOLS AND METHODOLOGY

Tools Used:

- YOLO (You Only Look Once): Used for real-time object detection.
- Python and OpenCV: Used for video processing and bounding box visualization.
- Custom Dataset: Composed of vehicle images for training the model.

Methodology:

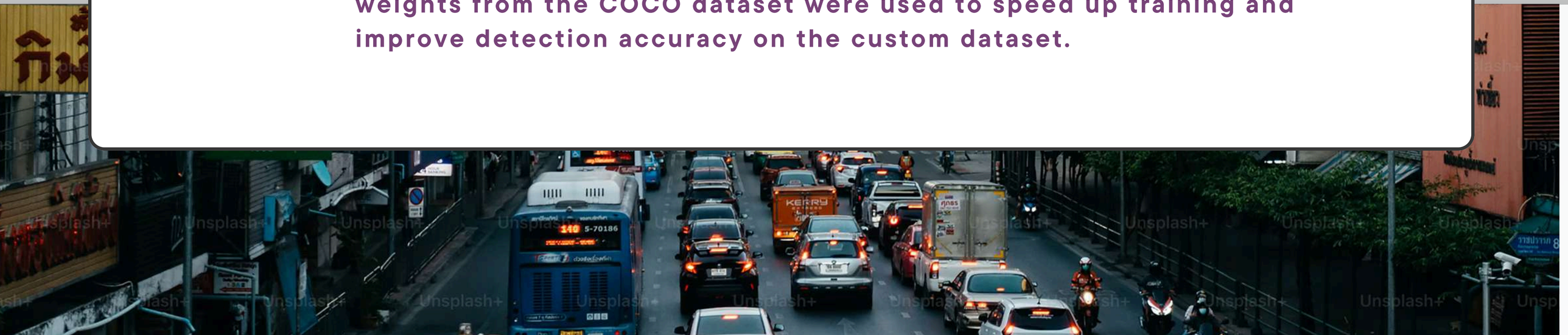
Collect and preprocess a custom dataset with vehicle images.

Fine-tune YOLO pre-trained weights on this dataset using transfer learning.

Apply the trained model to detect and classify vehicles in videos and images.

YOLO TRAINING PROCESS

- YOLO was initially trained on the COCO dataset, which contains 80 classes, including vehicle types (e.g., cars, buses, trucks). This pre-trained model was then fine-tuned with a custom dataset of vehicles.
- The custom dataset included labeled images of vehicles, such as cars and buses.
- The transfer learning approach was applied, where the pre-trained weights from the COCO dataset were used to speed up training and improve detection accuracy on the custom dataset.



IMPLEMENTATION AND MODEL TESTING

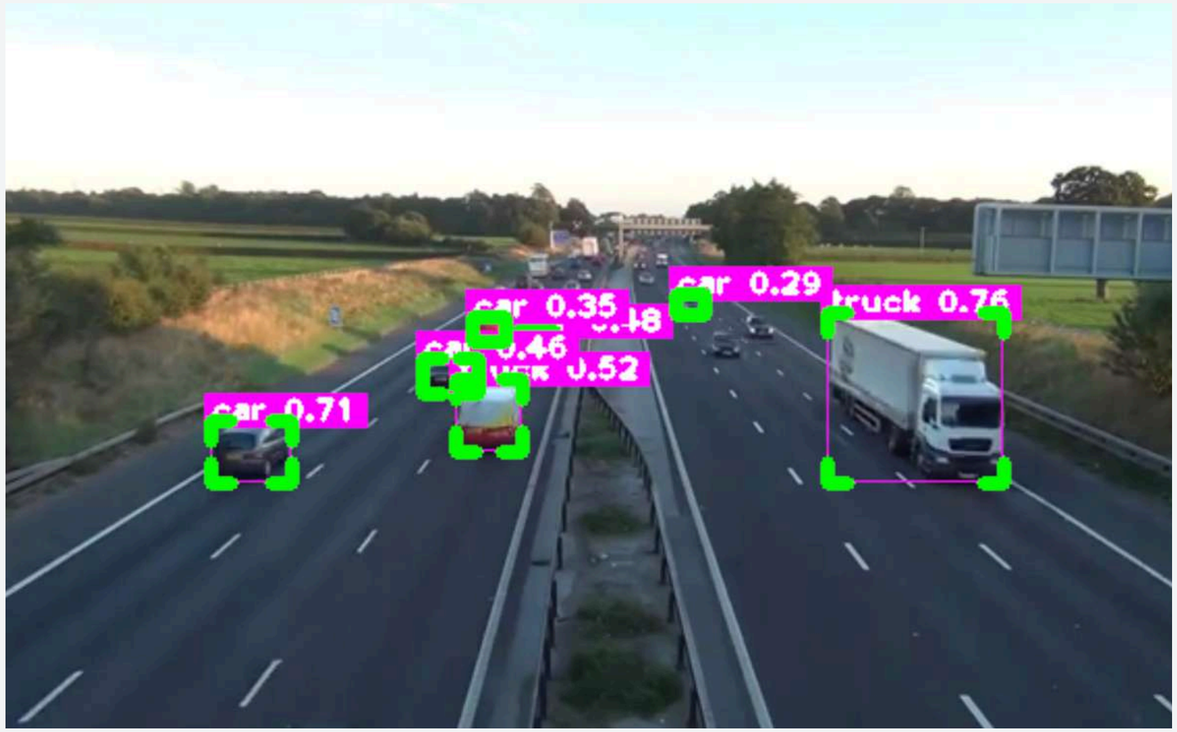
- After training the model, the resulting weight file was used in the `OD2.py` file to process videos and images.
- The model was integrated with OpenCV to capture frames from video, perform detection, and display the detected objects with bounding boxes and class labels.
- Each detected vehicle is assigned a confidence score and a bounding box, indicating the likelihood of correct classification.

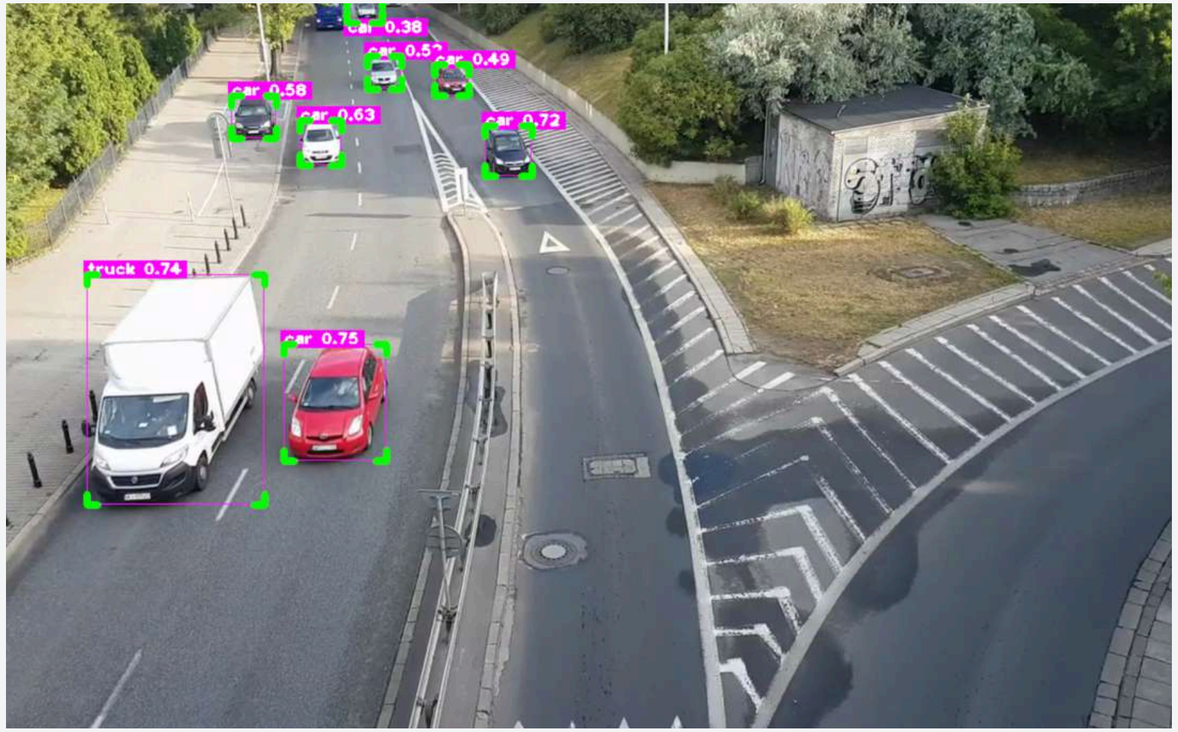
RESULTS AND EVALUATION

The model was tested on various video sequences and images. It successfully detected and classified vehicles such as cars and buses with high accuracy.

The model’s performance was evaluated using metrics such as precision, recall, and F1-score.

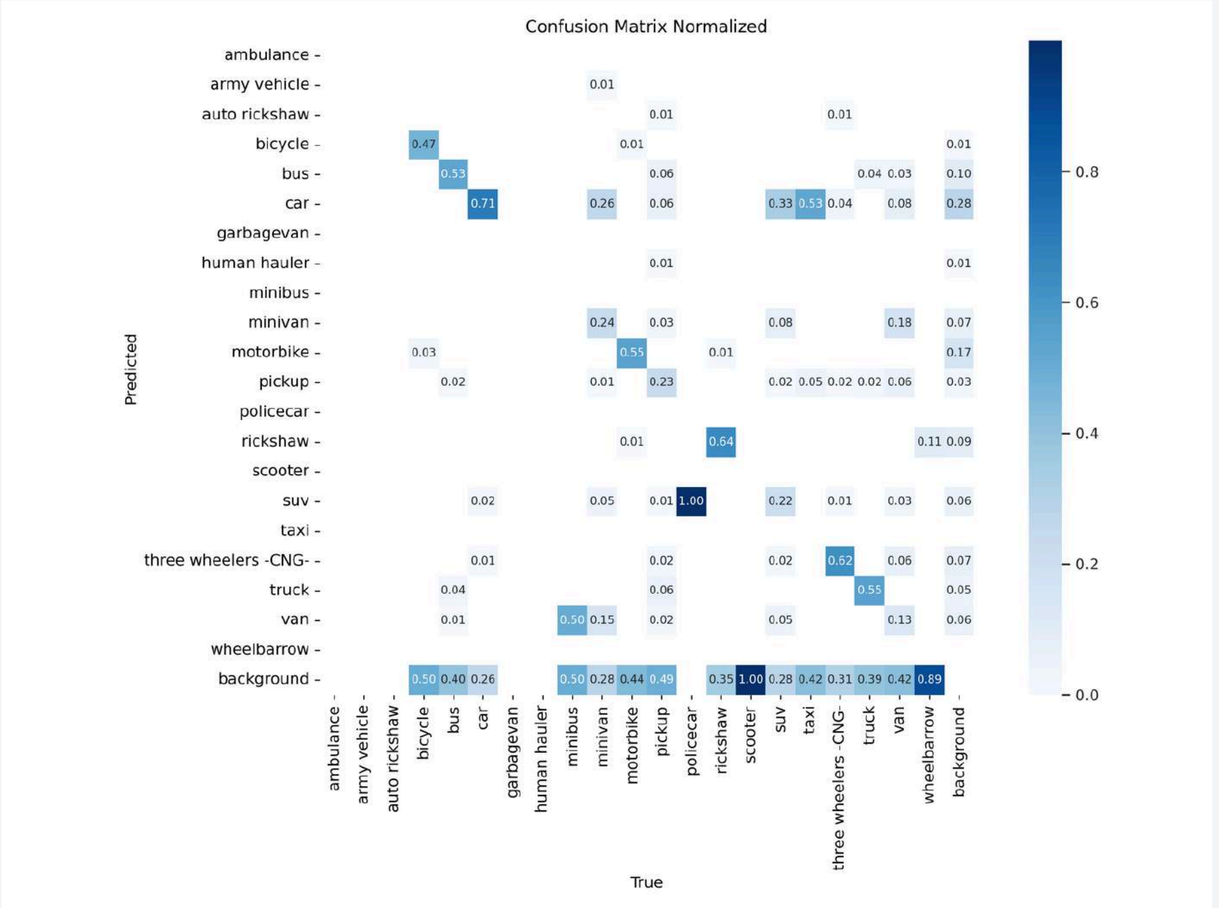
Results:


car 0.71
car 0.35
car 0.29
truck 0.76


car 0.38
car 0.49
car 0.58
car 0.63
car 0.72
truck 0.74
car 0.75

Evaluation

Confusion Matrix: Showed the classification accuracy of different vehicle types.



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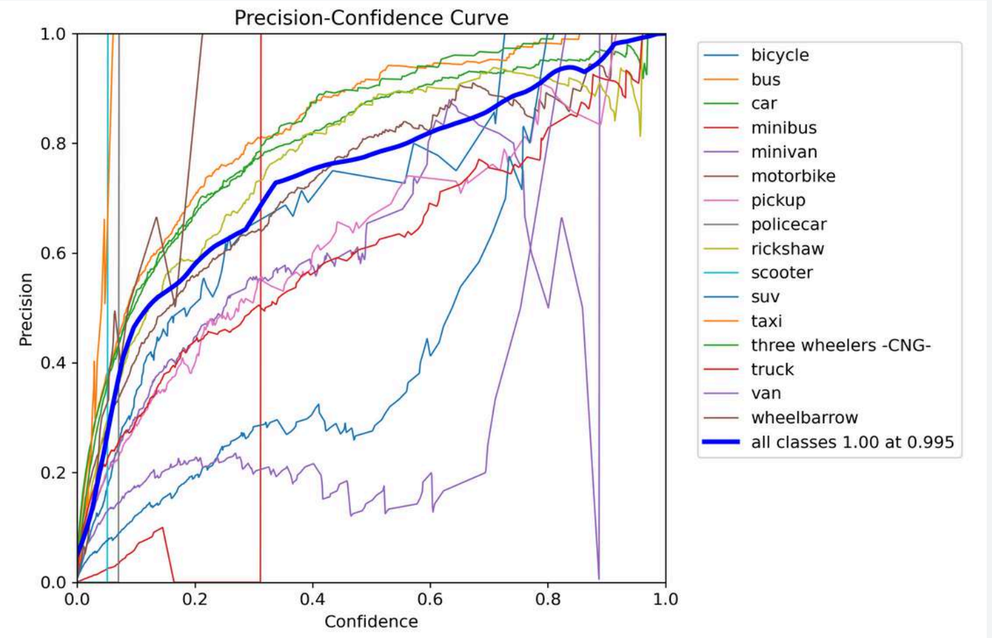
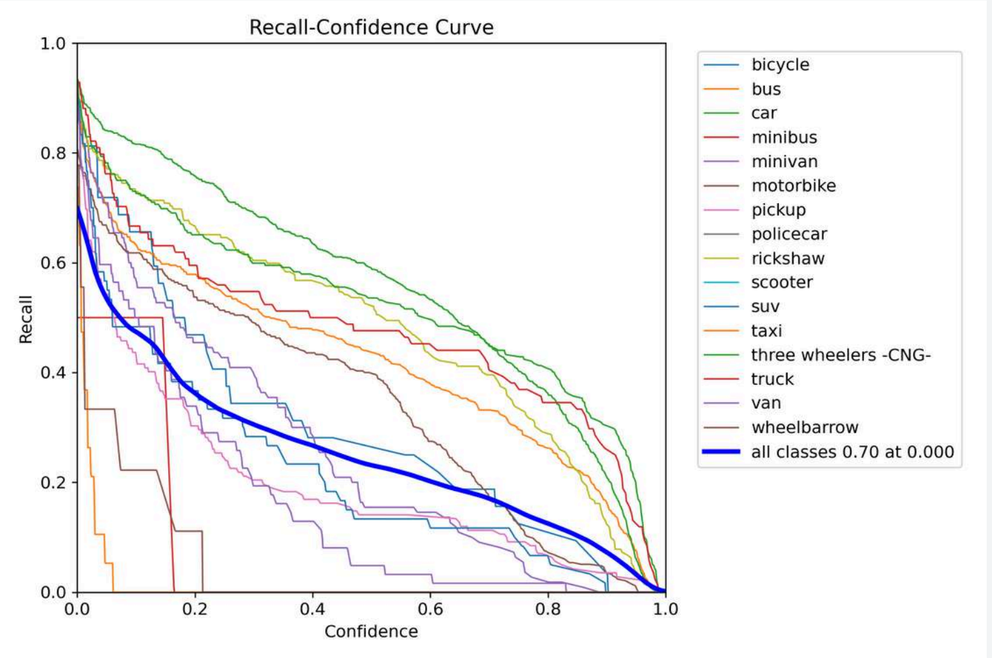
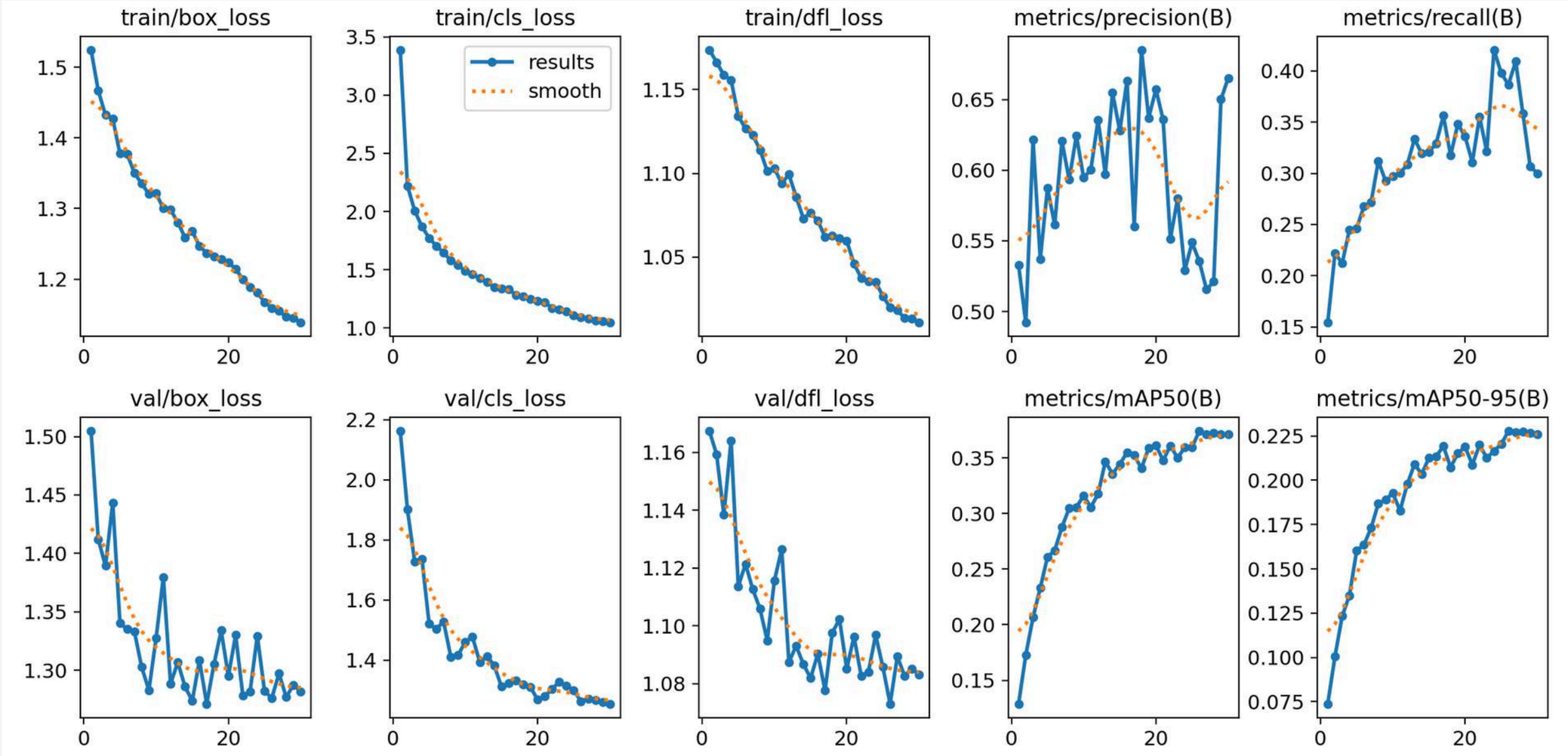
Evaluation

Precision and Recall: The model demonstrated high precision and recall for common vehicle types, with some limitations in detecting smaller or occluded vehicles.






train/box_loss
train/cls_loss
results
smooth
train/dfl_loss
metrics/precision(B)
metrics/recall(B)
val/box_loss
val/cls_loss
val/dfl_loss
metrics/mAP50(B)
metrics/mAP50-95(B)

Conclusion

- The project successfully developed a real-time vehicle detection and classification system using YOLO, achieving high accuracy in detecting cars, buses, and other vehicles.

- This system demonstrates potential for use in traffic management applications, such as real-time monitoring, traffic flow analysis, and autonomous driving support.

THANKYOU