🚦 Object Detection with YOLOv8

This project implements a **custom multi-class object detection system** using **YOLOv8**, trained on a manually annotated dataset to detect:

> 🚗 **Cars,** 🚌 **Buses,** 🚚 **Trucks,** 🧍 **People, and** 🔢 **Number Plates**

Built with Ultralytics' YOLOv8 Nano, this model is optimized for **low-VRAM GPUs** and runs smoothly on both **CPU and GPU environments**.

📁 Project Overview

- ✅ Custom multi-class dataset annotated using **Label Studio**
- 🔧 Trained using YOLOv8 Nano (`yolov8n.pt`)
- 🧠 Inference results are generated and saved to a folder
- 🎯 Optimized for performance on entry-level GPUs (like RTX 2050)

🚀 Features

- 📦 Multi-class detection: **number plates, cars, buses, trucks, people**
- 🧠 Powered by Ultralytics YOLOv8
- ⚙️ Supports both **CPU and GPU** execution
- 📁 Auto-saves predictions to `predicted_results/`
- 🧠 Optimized image size and batch size to prevent CUDA errors

🛠️ Installation

Install YOLOv8 and dependencies using pip:

```
pip install ultralytics
```

🏗️ Workflow Summary

1. 📸 Dataset Annotation

- Annotated using **Label Studio**
- Exported in YOLOv8-compatible format

2. 🧠 Model Training

Parameter	Value
Model	`yolov8n.pt`
Epochs	150
Image Size	640
Batch Size	4
Optimizer	Adam
Learning Rate	0.001 (cosine decay)
Augmentations	HSV, RandAugment

> Trained using both CPU and GPU fallback to suit low-resource environments.

3. 🔍 Inference

Run predictions on random images and save results using:

```
results = model("your_image.jpg")
results[0].save()
```

🗒️ Classes Used

Listed in `classes.txt` :

```
0: number_plate
1: car
2: bus
3: truck
4: person
```

🖼️ Sample Outputs

Detected object bounding boxes are stored under:

```
predicted_results/
```

Use `results[0].show()` or `.save()` for visualization.

📁 Folder Structure

```
object_detection_project/
├── images/
├── labels/
├── weights/
│   └── best.pt
├── predicted_results/
├── number_plate_dataset.yaml
├── numberplateprediction.ipynb
├── classes.txt
└── README.md
```

🔮 Future Improvements

- 📊 Improve dataset quality, balance class distribution
- 🚀 Upgrade to `yolov8s.pt` for higher accuracy
- 🎗️ Integrate license plate cropping + OCR module
- 🌐 Deploy with Flask or Streamlit for live inference

👤 Author

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