

Real-Time Object Detection

FOR AUTONOMOUS VEHICLES

DEPI Graduation Project

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December 2025

Project Concept



The Problem

Autonomous systems lack reliable environmental perception in adverse conditions (low light, fog), creating safety risks.



The Solution

A real-time YOLO detection model optimized for edge deployment, to identify pedestrians & vehicles with low latency.



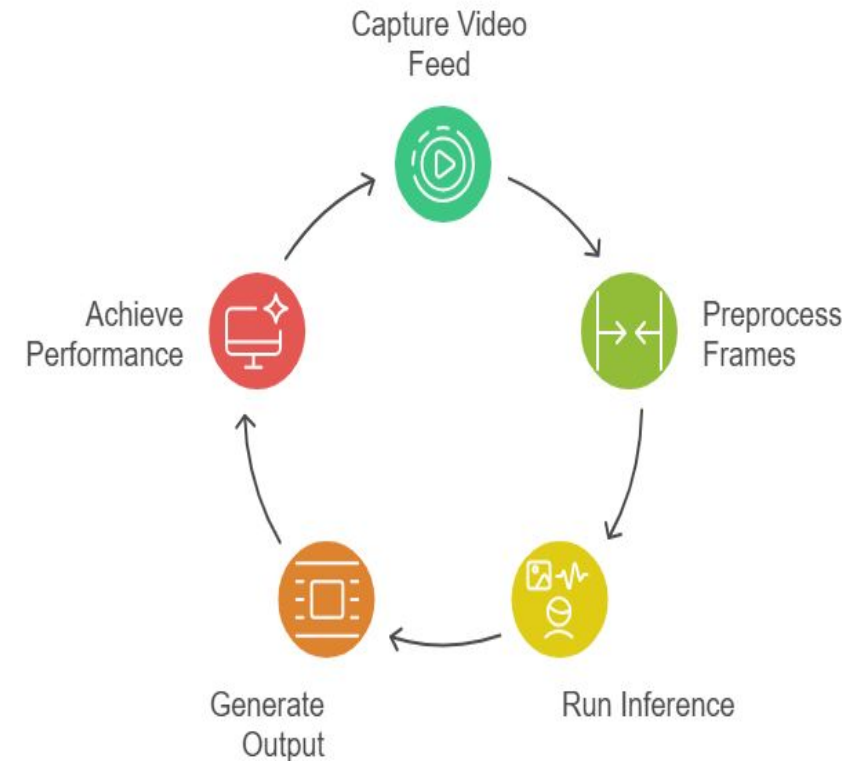
Unique Value

High-speed detection optimized for real-time driving environments
Engineered for < 200ms latency,

Model Architecture & Data Flow

Inference Pipeline (Core Focus)

- ✓ **Input:** Live Video Feed from vehicle cameras.
- ✓ **Preprocessing:** Frame normalization and resizing (640x640).
- ✓ **Detection:** YOLOv8 model runs inference on the frame.
- ✓ **Output:** Structured data (Bounding Boxes and Class Labels).
- ✓ **Performance:** Achieving fast inference for real-time operation.



Target Users & Features



Primary User

The Autonomous Vehicle System:

Requires instantaneous, machine-readable perception data to make life-critical decisions without human intervention.

Key Features

- ✓ **Low Latency:** Optimized to respond in $< 200\text{ms}$.
- ✓ **10-Class ID:** Pedestrians, Cars, Traffic Lights, etc.
- ✓ **High mAP:** Maximizing Mean Average Precision ($>90\%$).
- ✓ **Robustness:** High accuracy in diverse conditions.

Data Strategy & Processing

Dataset: COCO-2017 Subset

We filtered the massive COCO dataset to focus on
10 driving-critical classes.

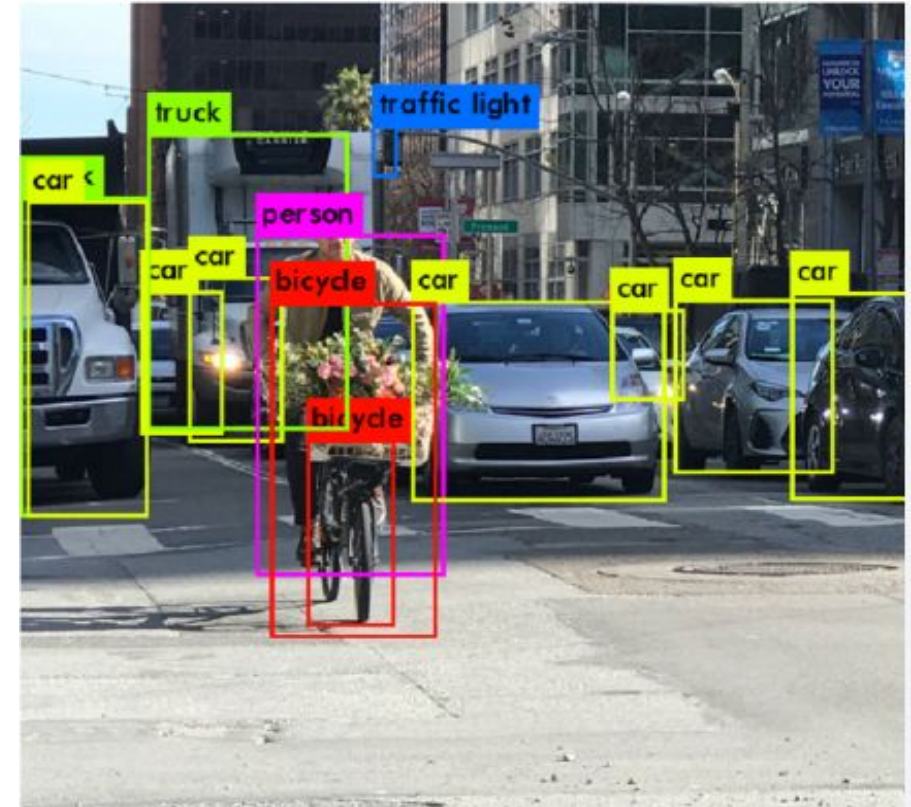
Pipeline Implementation

Filtering: Python script extracts only relevant images.

Normalization: Converts COCO [x,y,w,h] to YOLO format.

Config: Automatically generates data.yaml for training.

Augmentation: Applied during training to simulate weather.



Technology Stack



Core & ML

Python (Main Language)

YOLOv8 (Ultralytics Framework)

PyTorch (Engine)



Data & Tools

Pandas & NumPy (Data Handling)

OpenCV (Image Processing)

Git (Version Control)

Performance KPIs

The model is optimized to meet strict real-time safety metrics.

Metrics achieved on the validation dataset during training.

< 200ms

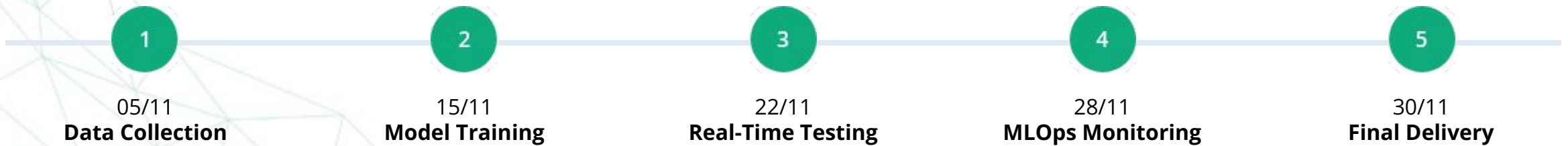
Target
Latency

> 90%

mAP
(Accuracy)

*Training parameters: Image size **640x640**, Batch size 16.*

Milestones & Deliverables



Final deliverables include the working source code, and comprehensive technical documentation.

Project Team

Member	Role	Key Responsibility
Nizar Hussien	Team Lead	Project Management & Data Acquisition & Presentaion
AbdElRahman Ahmed	Data Scientist	Data Filtering & Preprocessing
Ahmed Ashraf	ML Engineer	Model Architecture & Training
Elsayed Aboulila	ML Engineer	System Integration & Documentation
Mohamed Ashraf	MLOps Engineer	Model Optimization & Validation

Thank You

Questions & Discussion

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