

Development and implementation of real-time alert system for cyclists using deep learning and computer vision

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Question & Answer





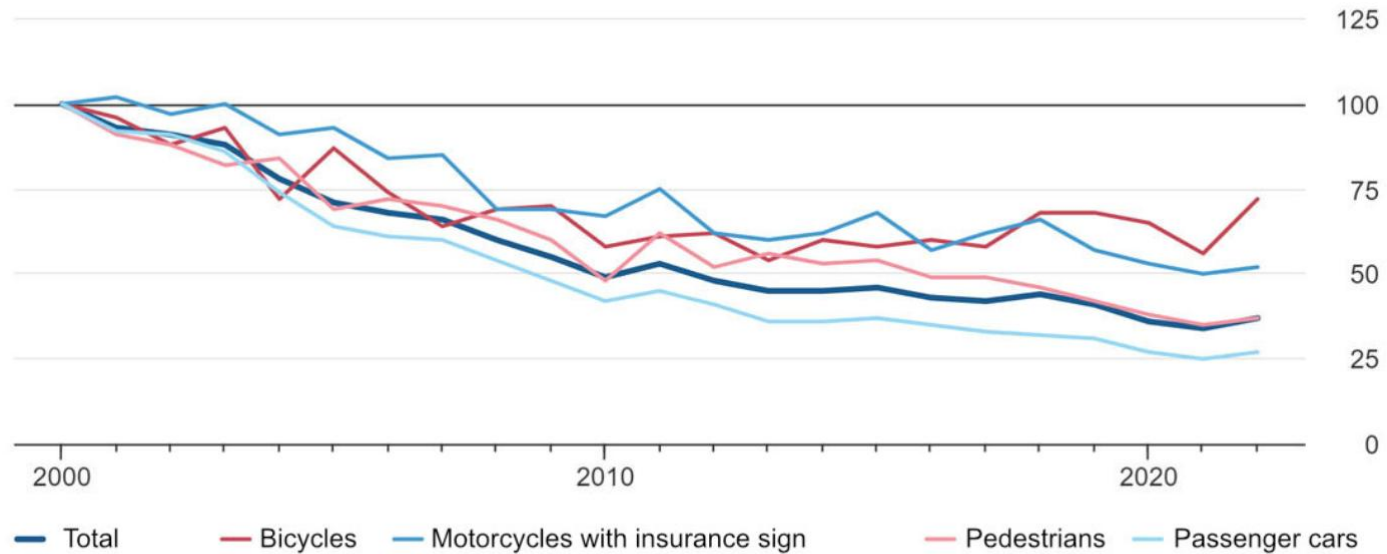
Motivation

- Limited visibility and awareness.
- Growing urban traffic density.
- Risk increases with vehicles.
- Inconsistent cycling infrastructure.

Traffic Accident Fatalities In Germany

Trend of traffic accident fatalities according to selected traffic participations

Index, 2000 = 100



Objectives

01

Design and implement a real-time hazard detection safety system using deep learning and computer vision.

02

Develop an integrated alert mechanism for immediate cyclist notification.

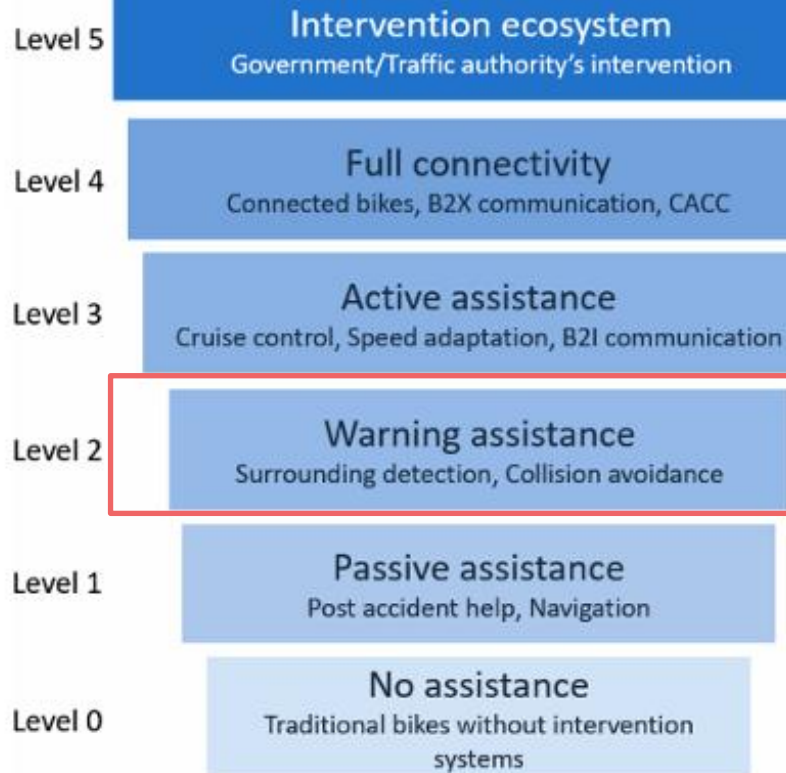
03

Create an affordable solution using readily available components.

04

Achieve accuracy in tracking vehicles exceeding 90 percent in various conditions.

Proposed Topology Illustrating Smartness Levels in Bicycle Assistance Systems.

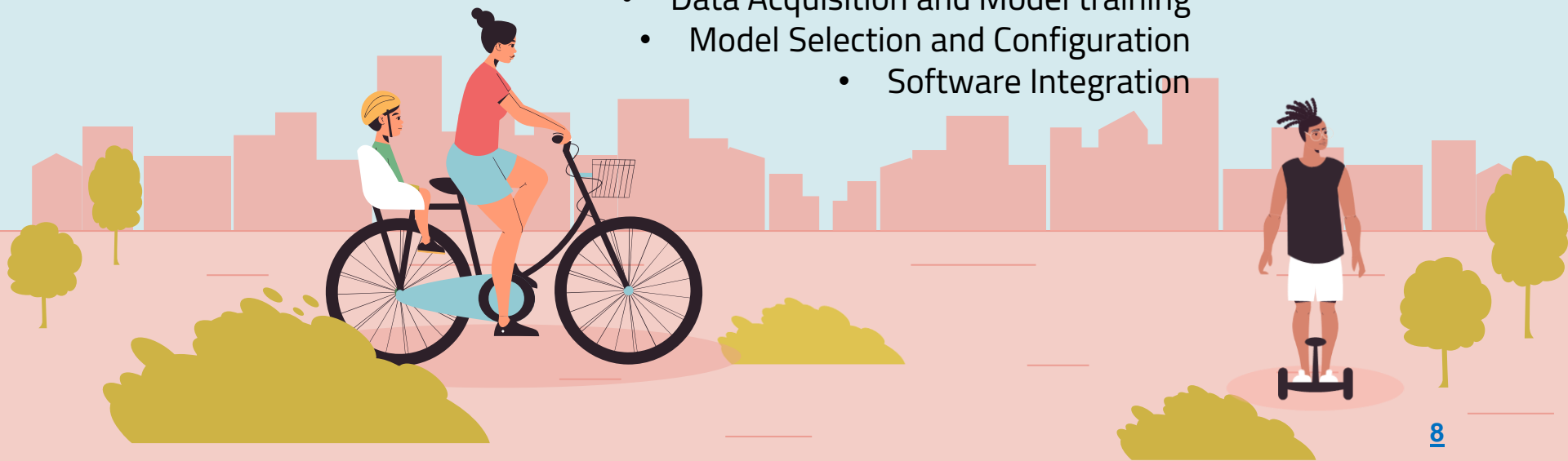


Methodology



Methodology

- System Architecture
- Data Acquisition and Model training
- Model Selection and Configuration
- Software Integration



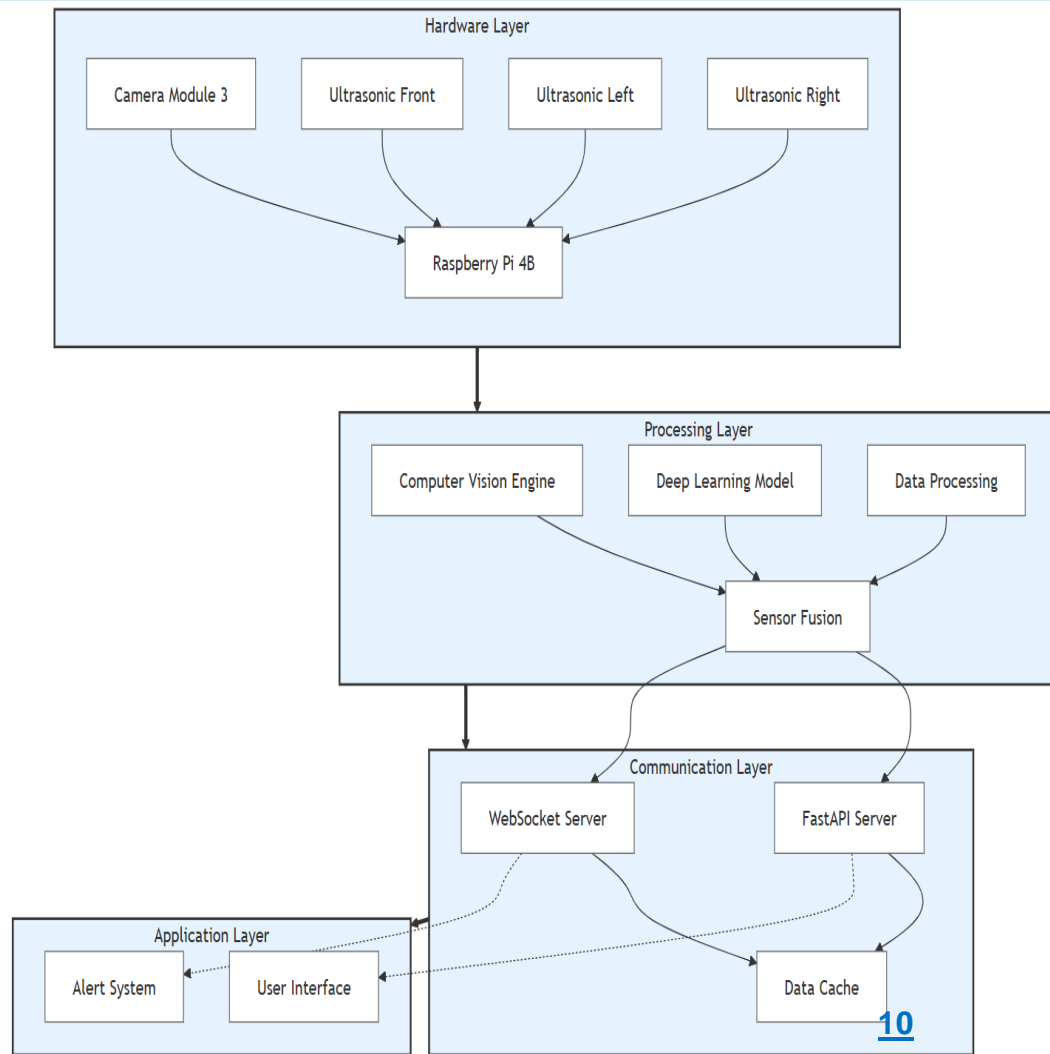
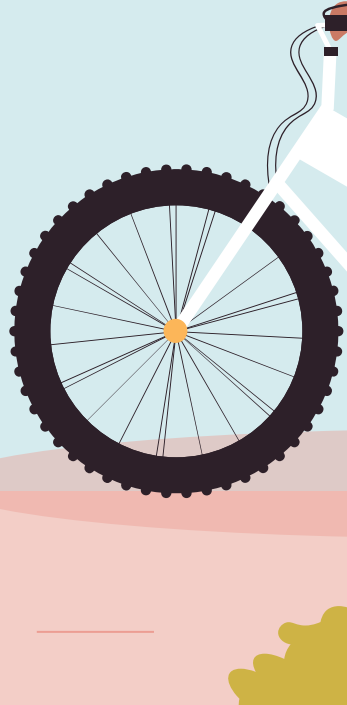
System Architecture

1. System-Workflow
2. Mechanical Housing Design
3. Speed and Alert Detection Mechanism
4. Vehicle Detection Integration



System-Workflow

- Data Collection
- Processing
- Data Fusion
- Communication

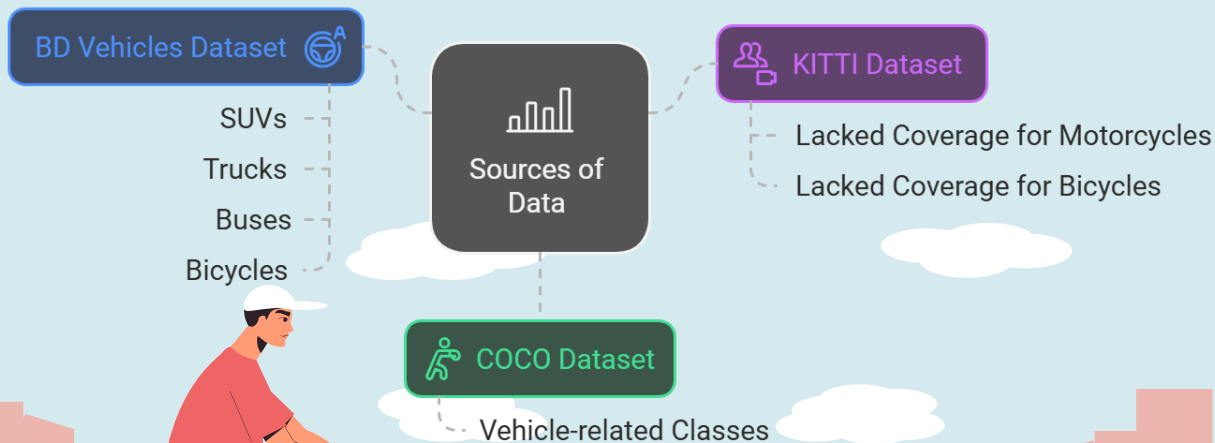


Data Acquisition and **Model training**

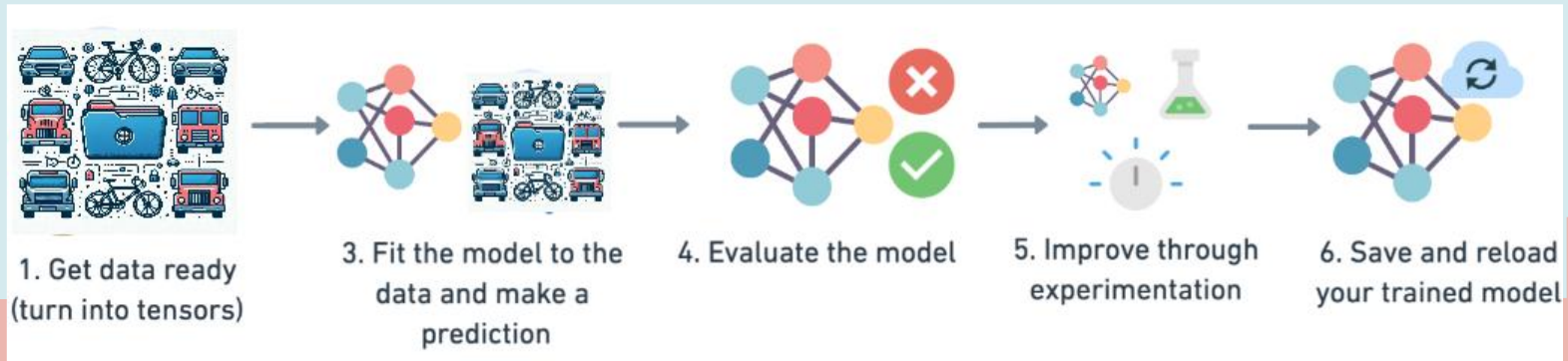
- Dataset Selection
- Model Training



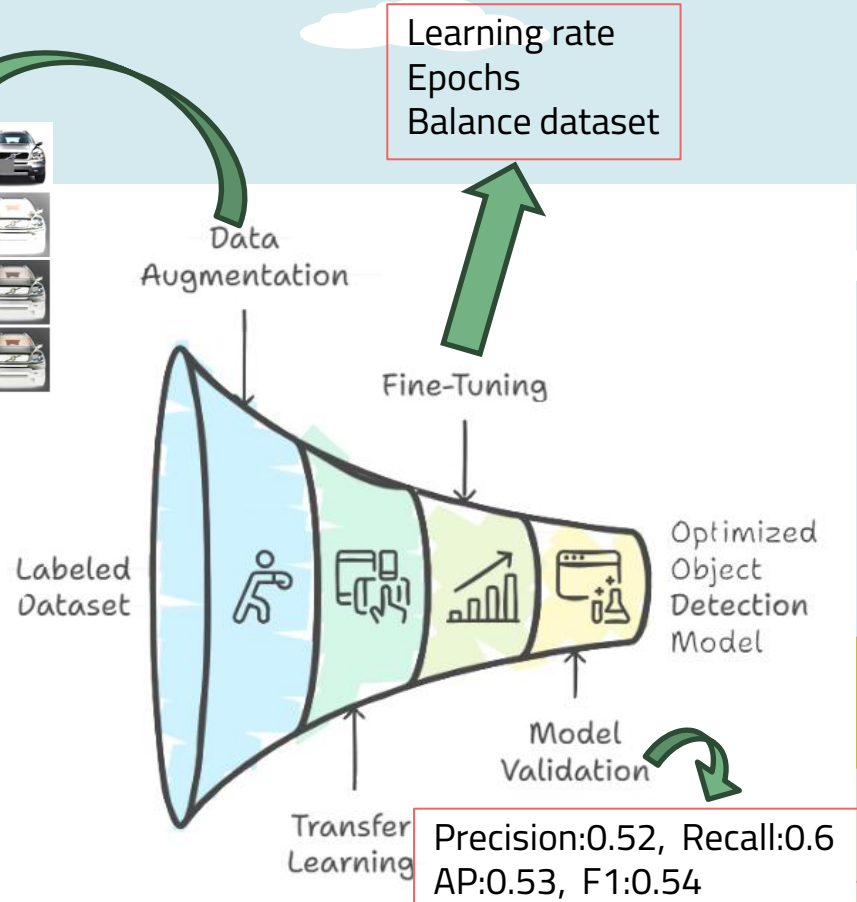
Dataset Selection



Model Training Pipeline **for Custom Data**



Model Training Pipeline for Custom Data



An illustration of a person with dark skin riding a white bicycle with large black tires. The person is wearing a white t-shirt, yellow shorts, a white cap, and green sneakers. They are riding on a pink path with green bushes in the foreground. In the background, there is a pink city skyline and a light blue sky with white clouds.

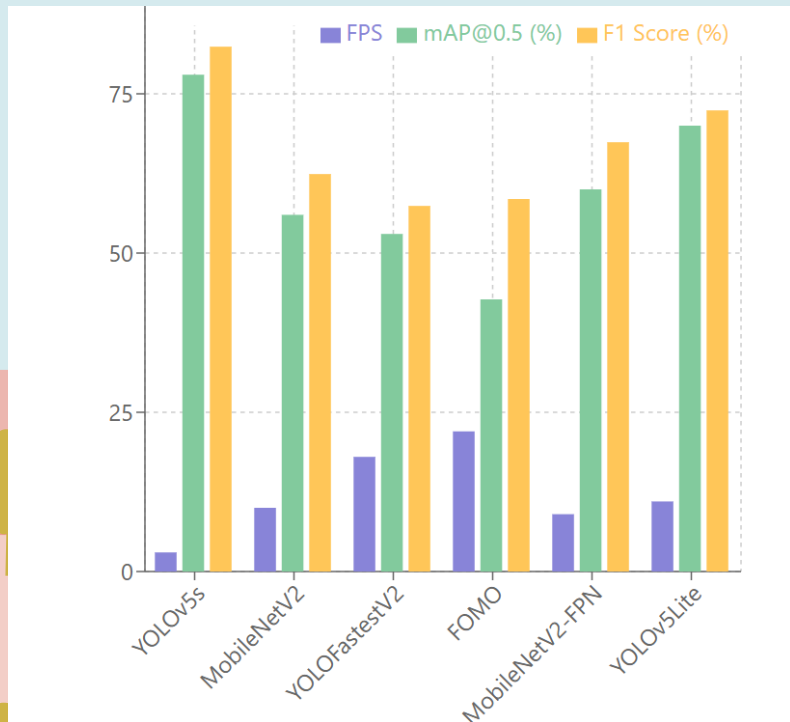
Model Selection and Configuration

- YOLOV5s
- MobileNetV2
- YOLOFastestV2
 - FOMO
- MobileNetV2-FPN
 - YOLOv5Lite

Model Selection and Configuration

Model	Epochs	Batch Size	Learning Rate	Optimizer
YOLOv5s	100	16	0.0100	SGD (Stochastic Gradient Descent)
MobileNetV2	100	30	0.0001	SGD (Stochastic Gradient Descent)
YOLOFastestV2	100	128	0.0010	SGD (Stochastic Gradient Descent)
FOMO	100	16	0.0100	SGD (Stochastic Gradient Descent)
MobileNetV2-FPN	100	30	0.0010	SGD (Stochastic Gradient Descent)

Object Detection Model Comparison

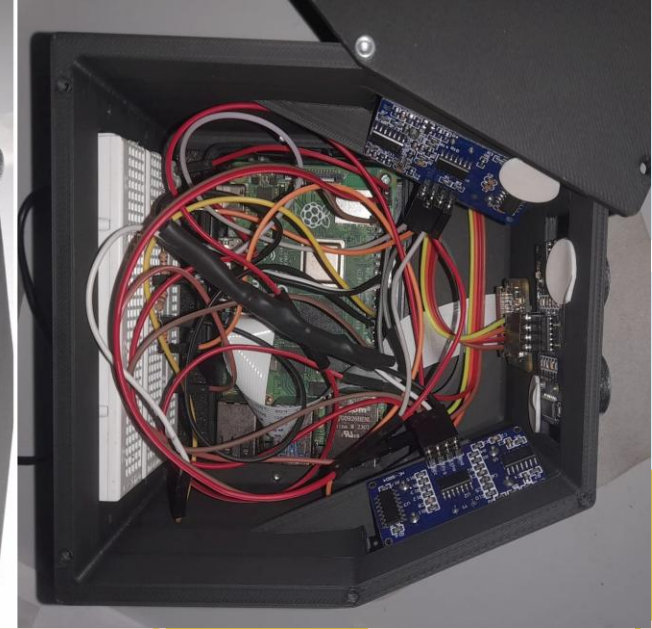


DL Model	Speed (FPS)	Accuracy (%)	Hardware Requirement	Suitability for Cyclist Safety
YOLOFastestV2	High	Moderate	Low	Excellent
YOLOv5sLite	Moderate	High	Moderate	Very Good
MobileNetV2	Moderate	High	Moderate	Good
MobileNet FPN	Moderate	High	High	Limited

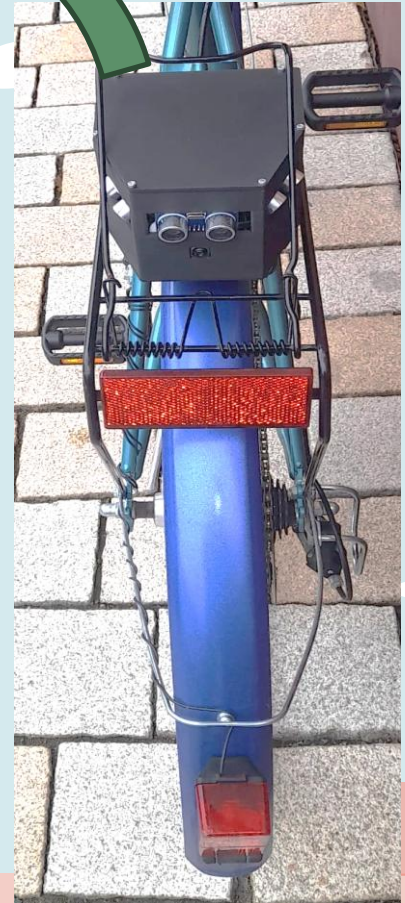
Mechanical Housing Design

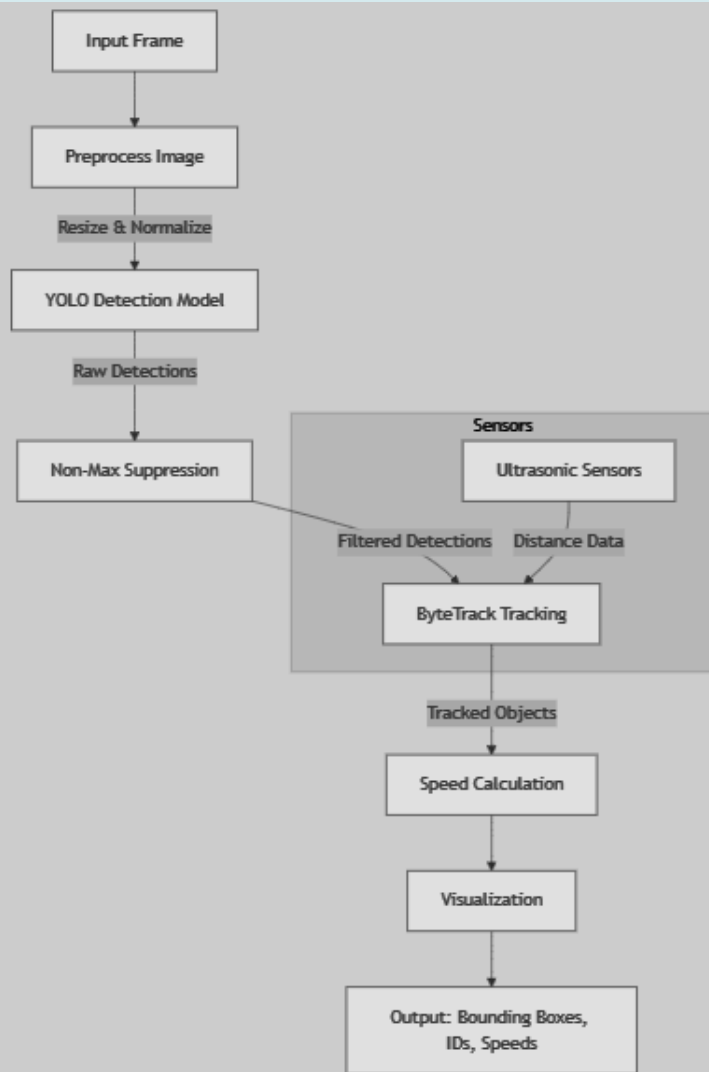


Integrated System Overview



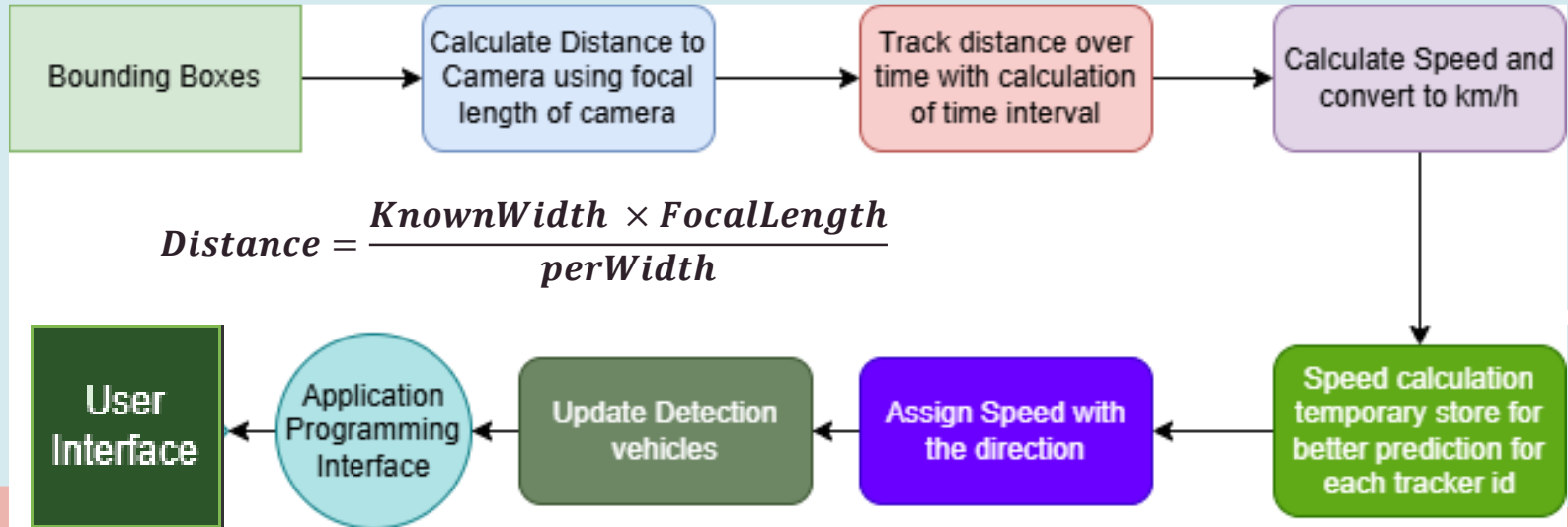
Integrated System Overview





Software Integration

Speed Detection Mechanism



Results

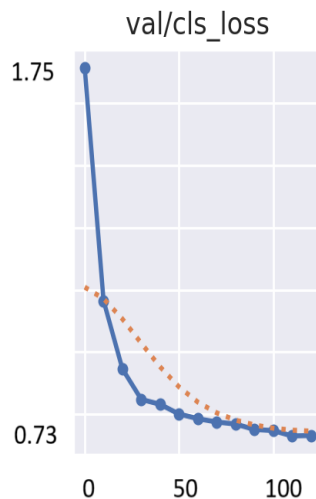
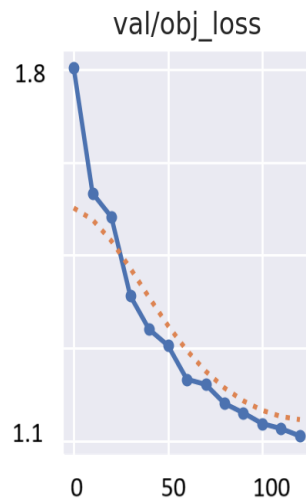
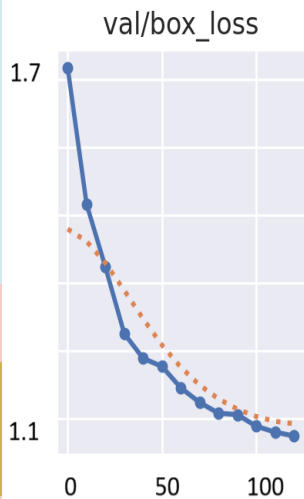
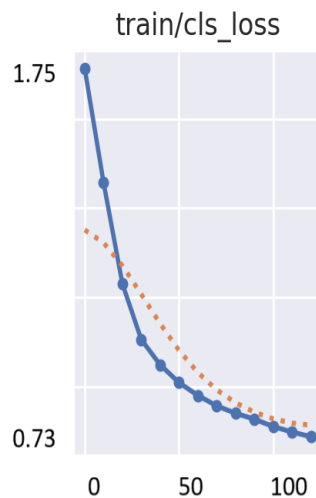
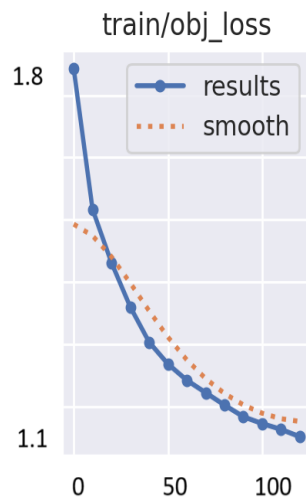
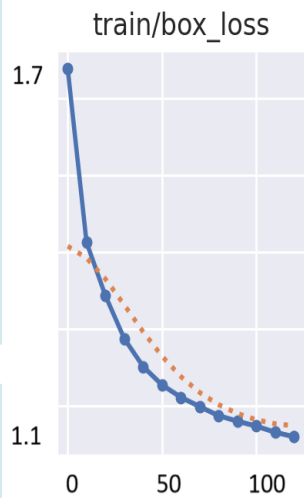


Results

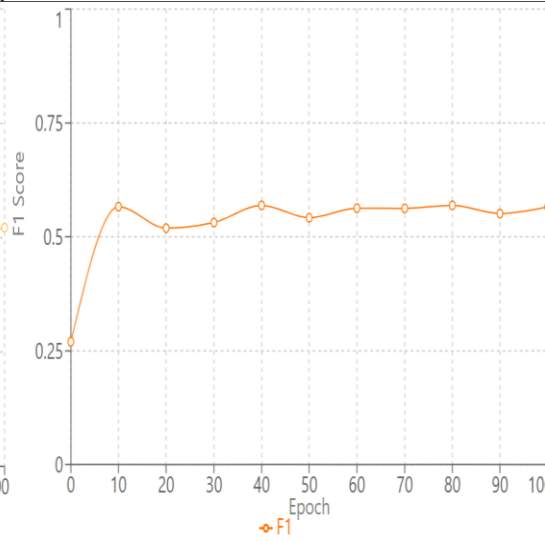
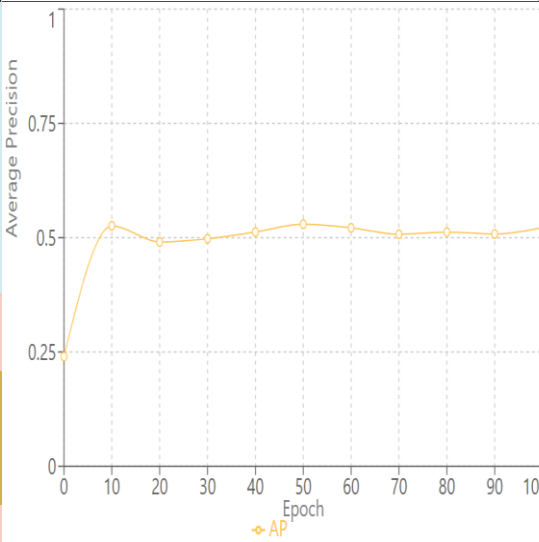
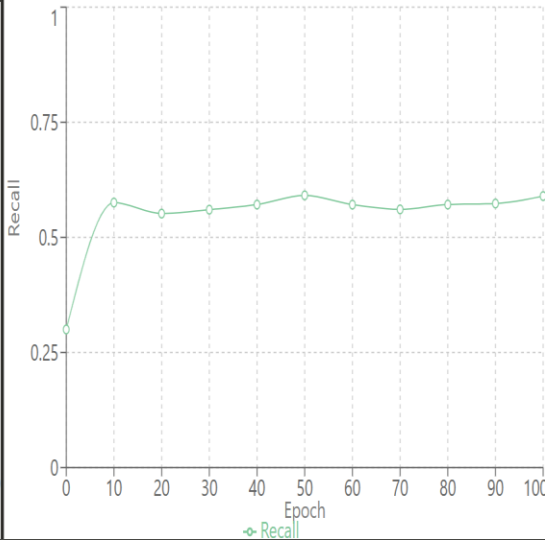
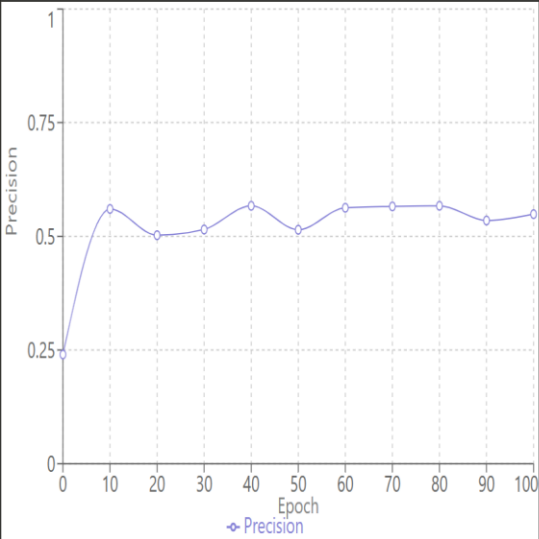
- Model Training Results
 - System Validation
 - GUI Overview



Results of YOLOfastest V2



Results of YOLOfastest v2



Single Vehicle Detection Test

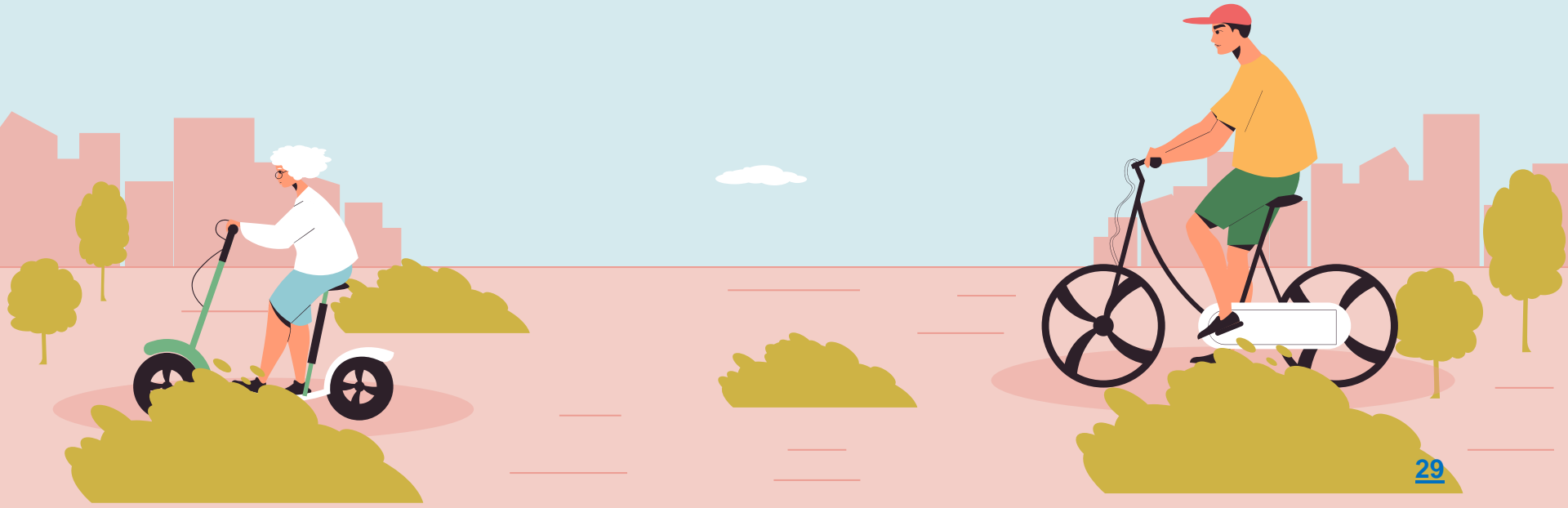
0.35 confidence accuracy is good for vehicle detection

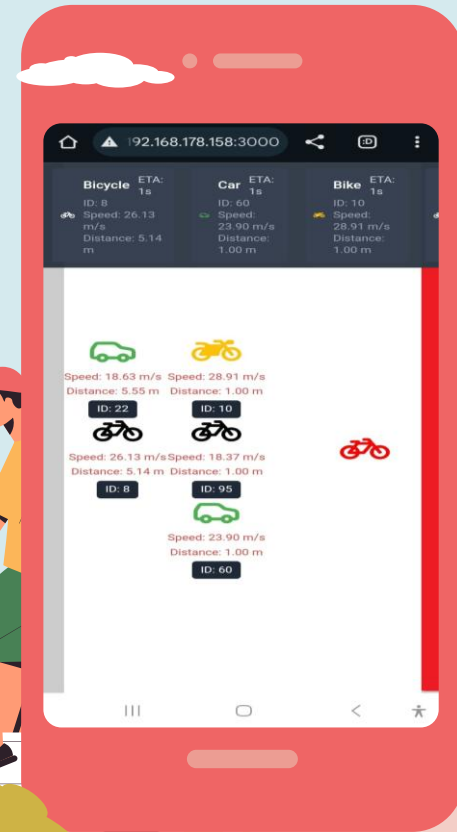
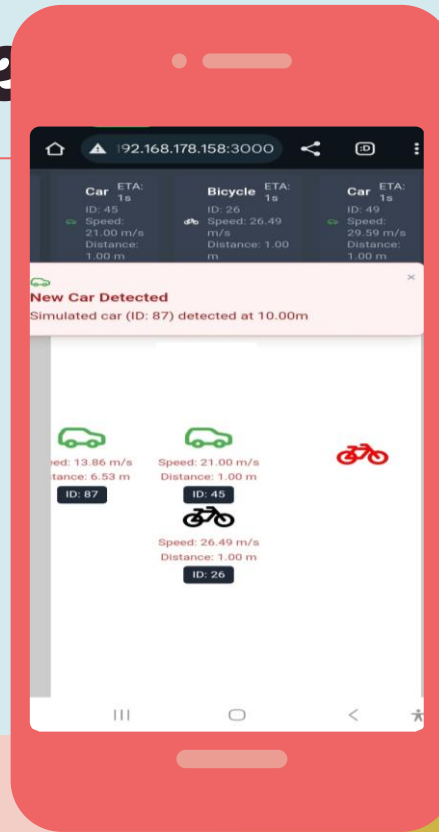
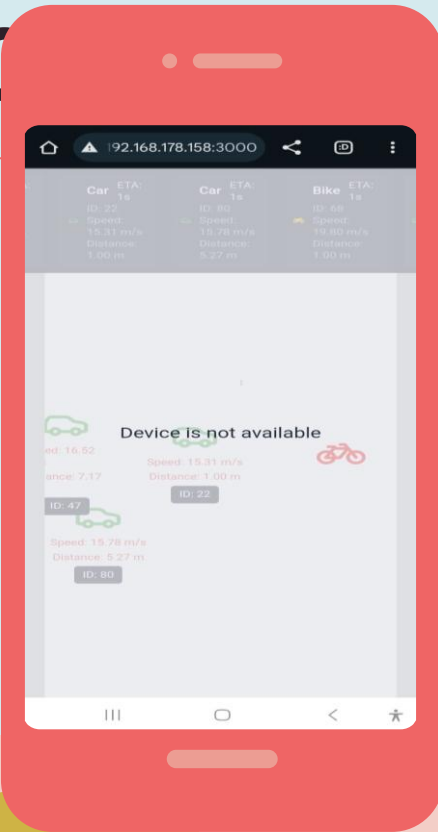


Real time Detection Test

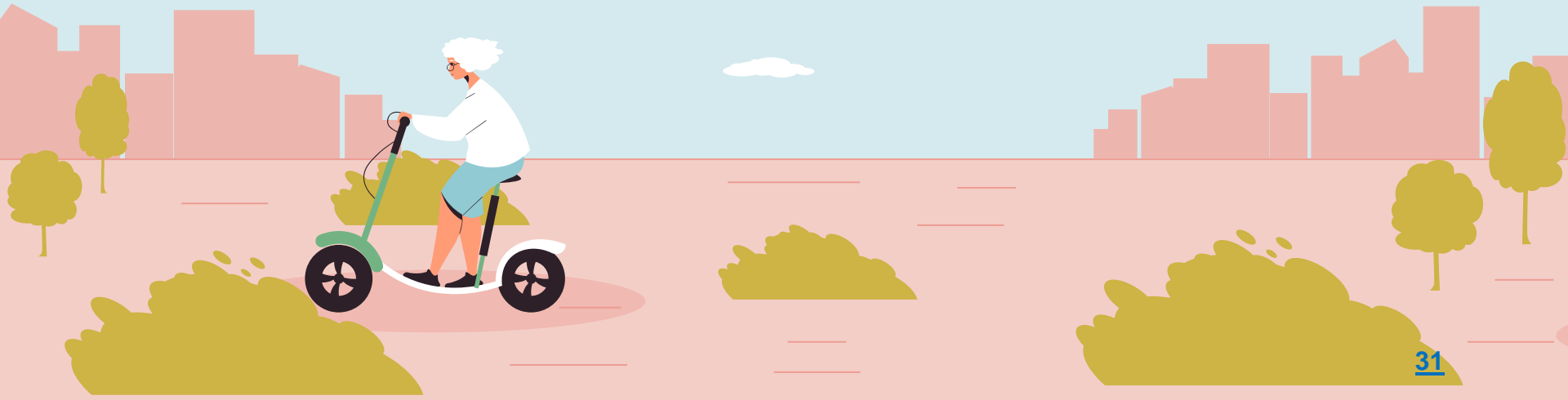


GUI Overview





Contributions



Contributions

- 🚀 Advancing Cyclist Safety
- 🚀 Integration of Affordable Technologies – 170 euro
- 🚀 Practical System Design
- 🚀 Impact on Road Safety
- 🚀 Potential for Scalability



Risk, Challenge and future scope



Risk, Challenge

- **Technical Challenges:**

- Resource-Intensive Models
 - Architecture Complexity

- **Data Challenges:**

- Class Imbalance
 - Dataset Limitations

- **Operational Challenges:**

- Model Update and Retraining
 - User Adaptability



Future-Scope

- 🚀 Integrate more advanced deep learning models
- 🚀 Additional Sensors
- 🚀 Smart Alerts
- 🚀 Integration with mobile apps for route safety and logging incidents.
- 🚀 Speed up computation and Battery Optimisation.
- 🚀 Reducing system size.

Conclusion



Conclusion

- Conducted a comparative analysis of various models for development purposes.
- Integrated YOLOFastestV2 for efficient and accurate vehicle detection with low computational requirements.
- Seamlessly combined ultrasonic sensors and the camera module into a compact, reliable unit.
- Designed a robust mechanical housing to ensure durability and ease of maintenance during cycling.

THANKS!

Do you have any questions?

