Road Lane Detection System Using Advanced Computer Vision

A comprehensive approach to enhancing driving safety through real-time video analytics and deep learning.

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Project Overview

Lane Detection

Automated system using image processing techniques

Object Detection

Real-time identification using YOLOv8 model

Enhanced Awareness

Integrated visualization for improved road safety

Scalable Solution

Designed for autonomous vehicles and ADAS

Technologies & Tools

Programming

- Python
- OpenCV
- PyTorch

Deep Learning

- YOLOv8 model
- Ultralytics YOLO

Image Processing

- Gaussian Blur
- Canny Edge Detection
- Perspective Transformation
- HLS Color Space

Image Preprocessing

Color Space Conversion

Convert to HLS color space to enhance lane visibility under different lighting conditions.

Noise Reduction

Apply Gaussian blur to minimize false edge detection.

Edge Detection

Use Canny algorithm to highlight lane boundaries.

Region of Interest Extraction

Masking

Isolate road area and ignore irrelevant regions

Perspective Transformation

Warp to bird's-eye view for better detection

Points Definition

Define source and destination points for alignment

Lane Detection and Tracking

Histogram Analysis

Analyze lower half of image to locate lane lines

Sliding Window

Place windows along lanes to track non-zero pixels

Frame Update

Track and update lane positions across video frames

Polynomial Fitting

Fit smooth curves to detected lane points

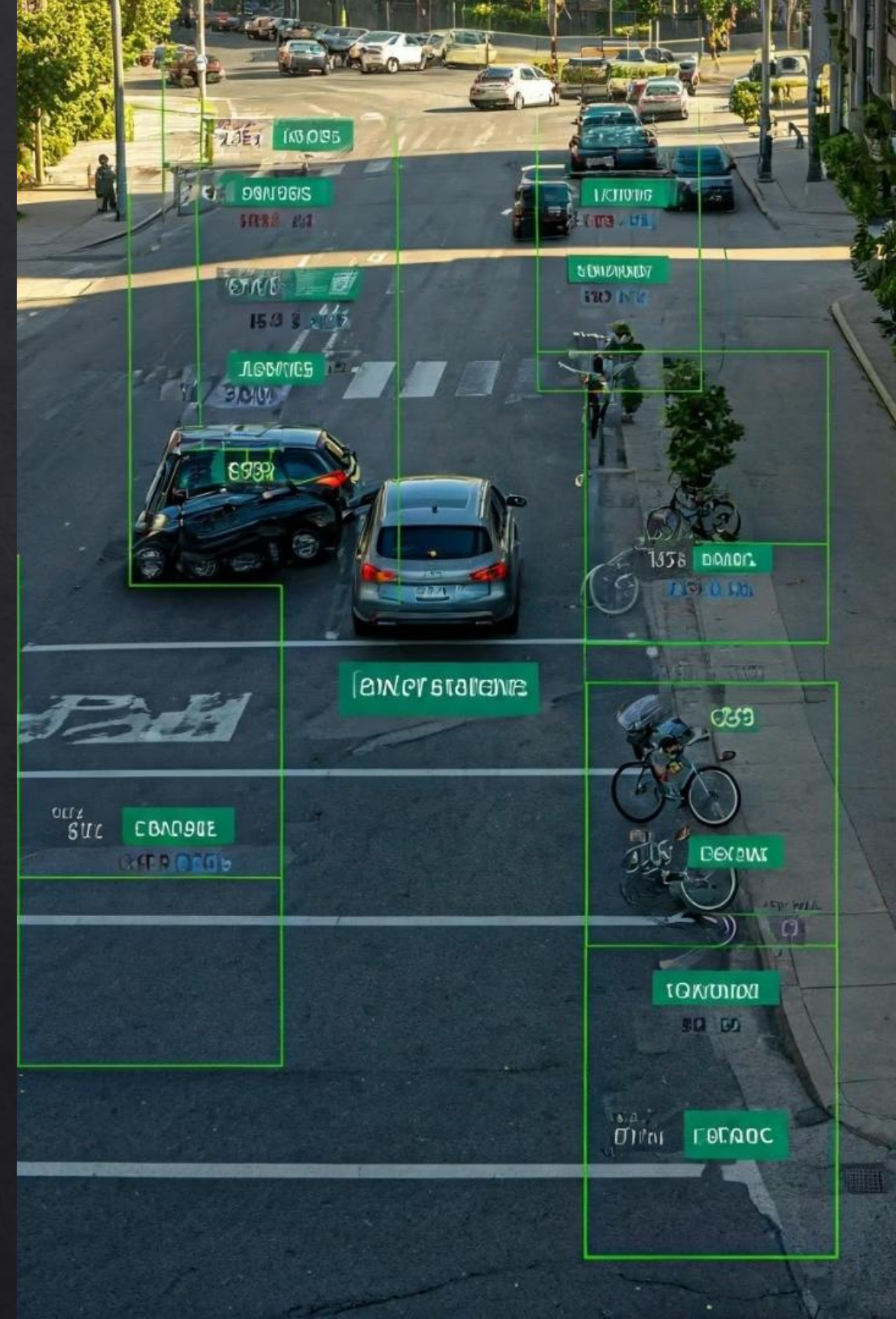# Object Detection System

YOLOv8 Implementation

Load pre-trained model with Ultralytics package for real-time object detection.
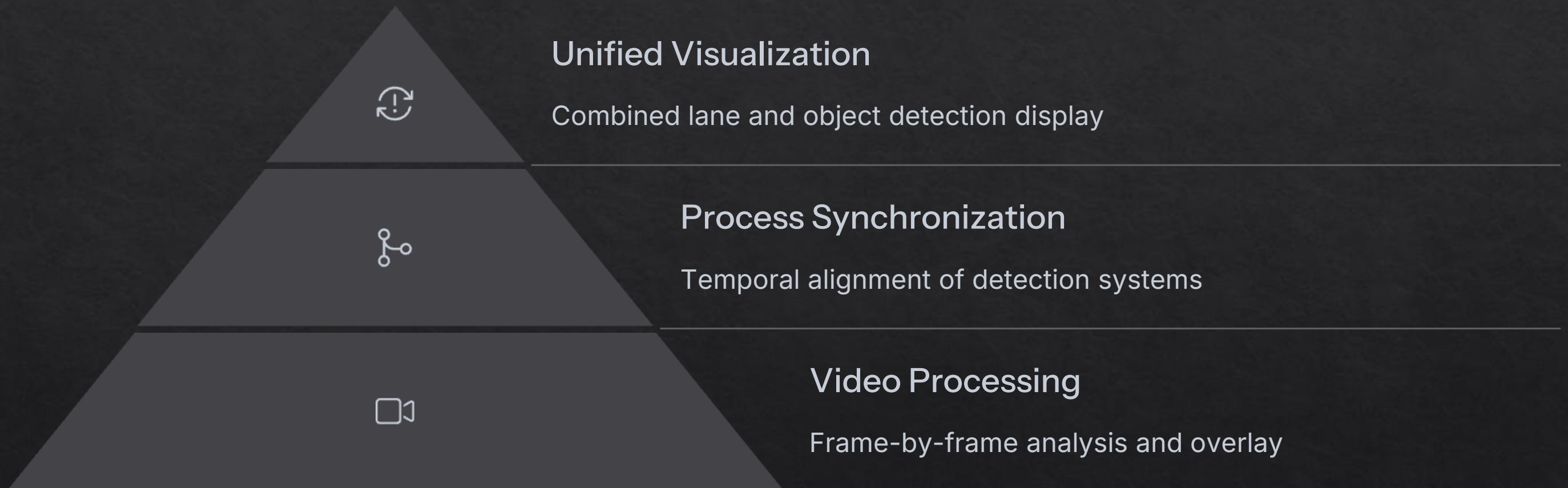
Frame Processing

Pass each video frame through YOLOv8 to detect and classify objects.
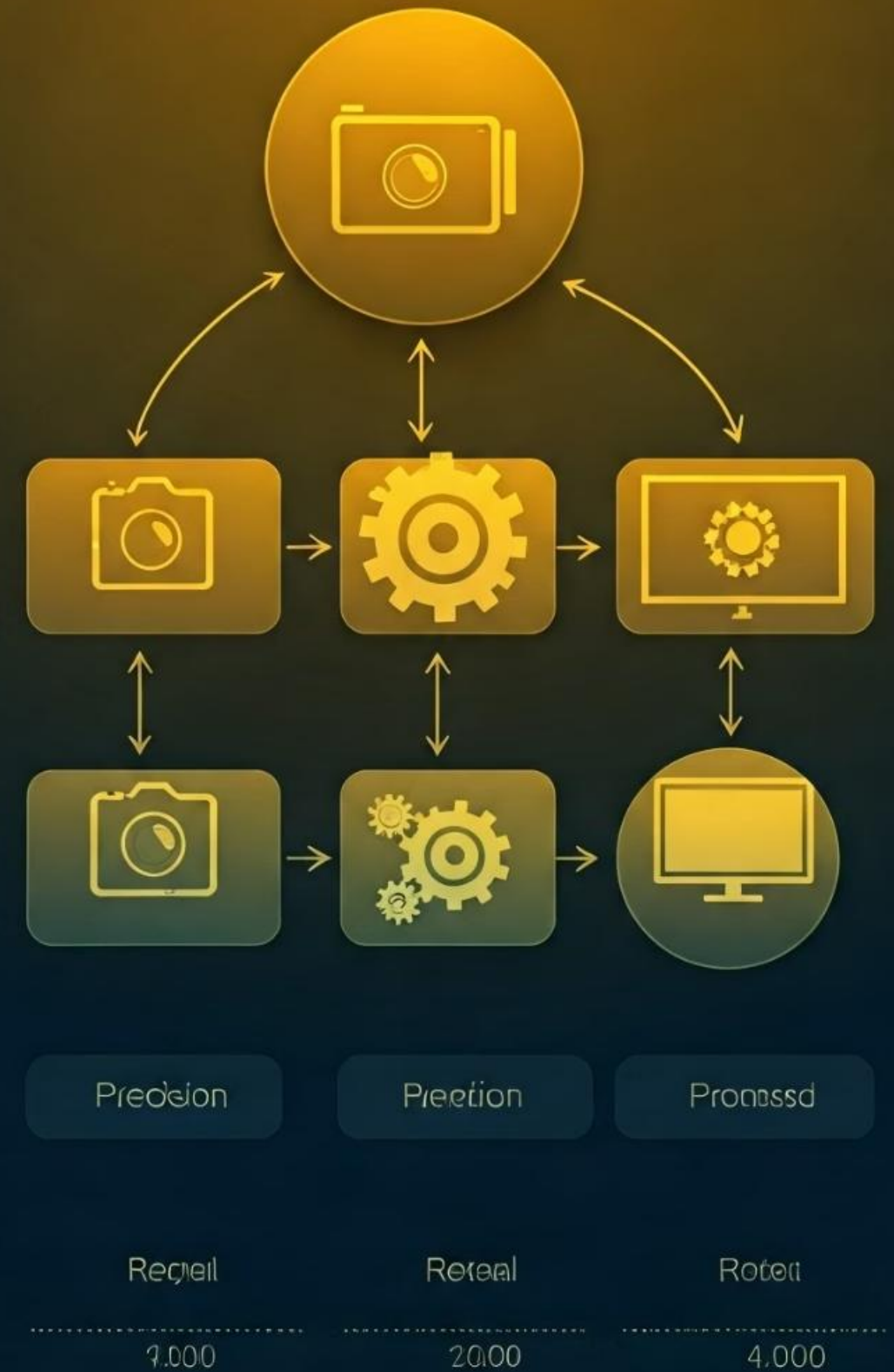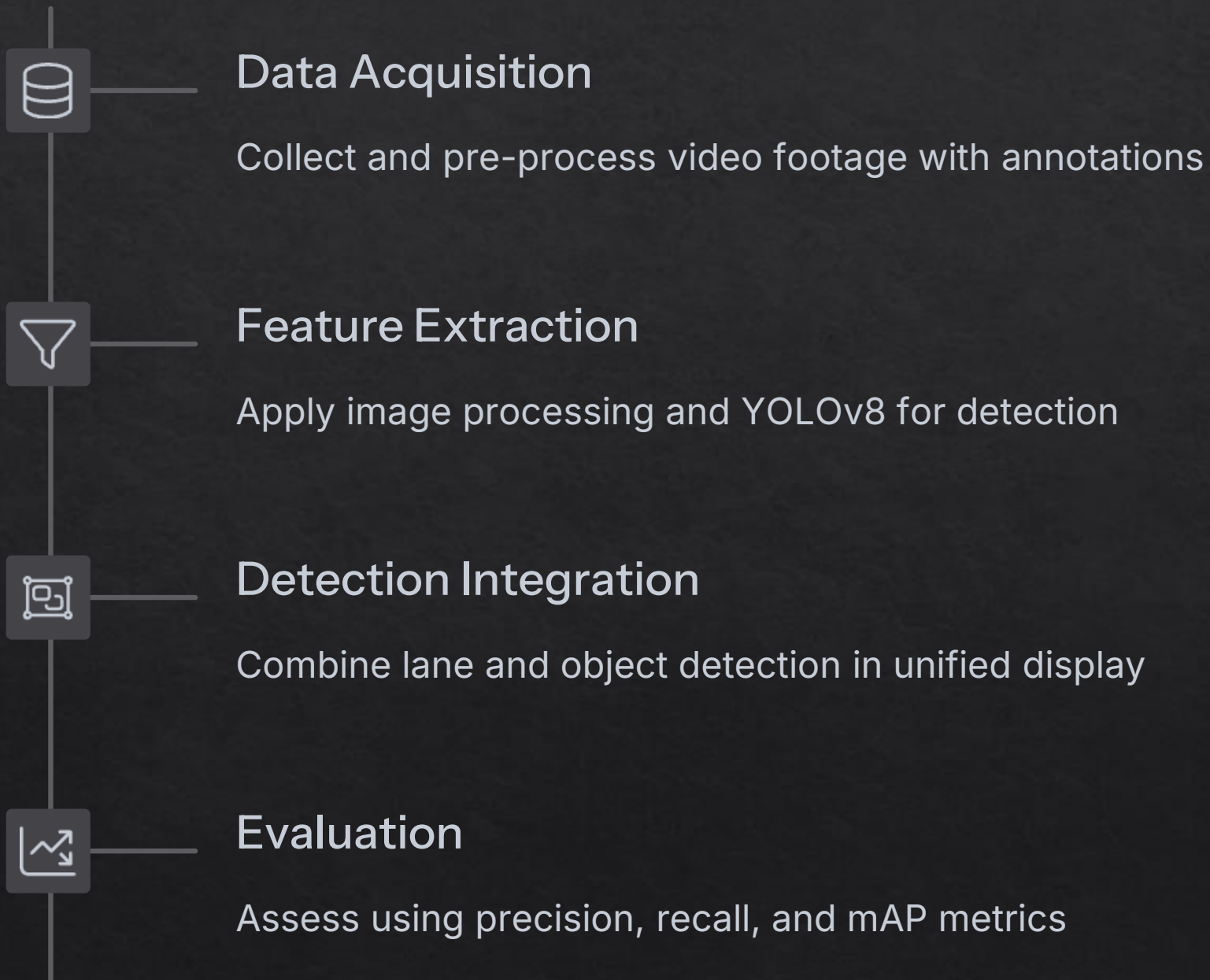
Detection Output

Generate bounding boxes, class labels, and confidence scores for vehicles and pedestrians.

System Integration

Unified Visualization

Combined lane and object detection display

Process Synchronization

Temporal alignment of detection systems

Video Processing

Frame-by-frame analysis and overlay

Solution Approach

Data Acquisition

Collect and pre-process video footage with annotations

Feature Extraction

Apply image processing and YOLOv8 for detection

Detection Integration

Combine lane and object detection in unified display

Evaluation

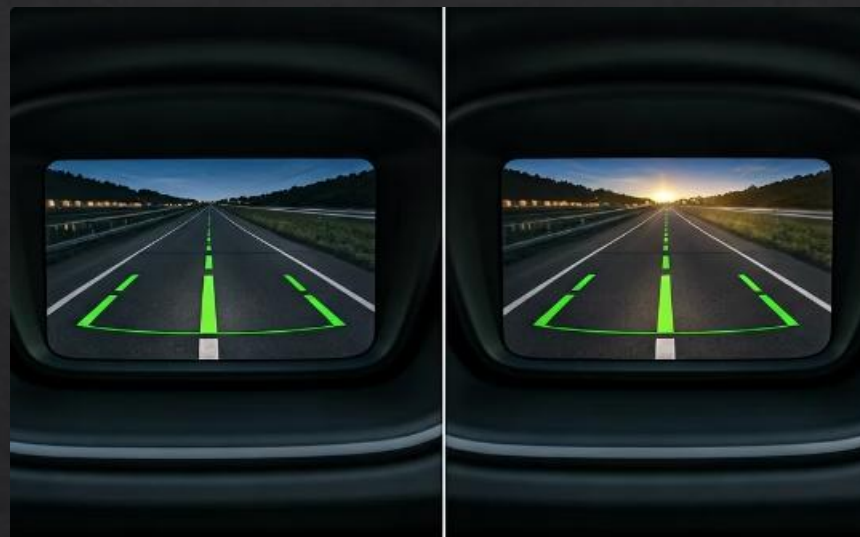Assess using precision, recall, and mAP metrics

Key Findings & Applications

High Accuracy

YOLOv8 achieved excellent real-time object detection performance.

Lighting Adaptability

Image processing techniques enhanced lane visibility across various conditions.

Improved Awareness

Combined system provides comprehensive view of lane boundaries and objects.

THANKYOU