

# Smart Traffic Light Control using Real-Time Density Analysis

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# The Problem: Inefficient Traffic Flow

## Fixed-Time Lights

Cause unnecessary delays and congestion in traffic.

## Resource Waste

Wasted time, fuel consumption, and increased pollution.

## Need for Adaptation

Calls for intelligent, responsive traffic signal systems.

# Our Solution: Adaptive Control

## Vehicle Detection

Uses YOLOv8 to detect vehicles via webcam feed.

## Real-Time Density

Calculates lane density using regions of interest (ROIs).

## Dynamic Timing

Adjusts green light duration based on actual traffic.

## Dashboard Monitoring

Live status available with a user-friendly web dashboard.



# System Workflow



# Technology Stack



## Core Technologies

Python, OpenCV, Ultralytics YOLOv8 for detection



## Backend

Flask to handle API and processing loop



## Frontend

HTML, Tailwind CSS, JavaScript for dashboard UI



## Libraries

NumPy for efficient data calculations



# Finding Vehicles & Measuring Density

## Detection

YOLOv8 identifies vehicles within the video stream.

## Regions of Interest (ROIs)

Defined zones isolate lanes for focused analysis.

## Density Calculation

Based on vehicle area within each ROI for accuracy.

# Smart Decision Making 🧠

## 1 Input Data

Real-time density values for all lanes.

## 2 Decision Logic

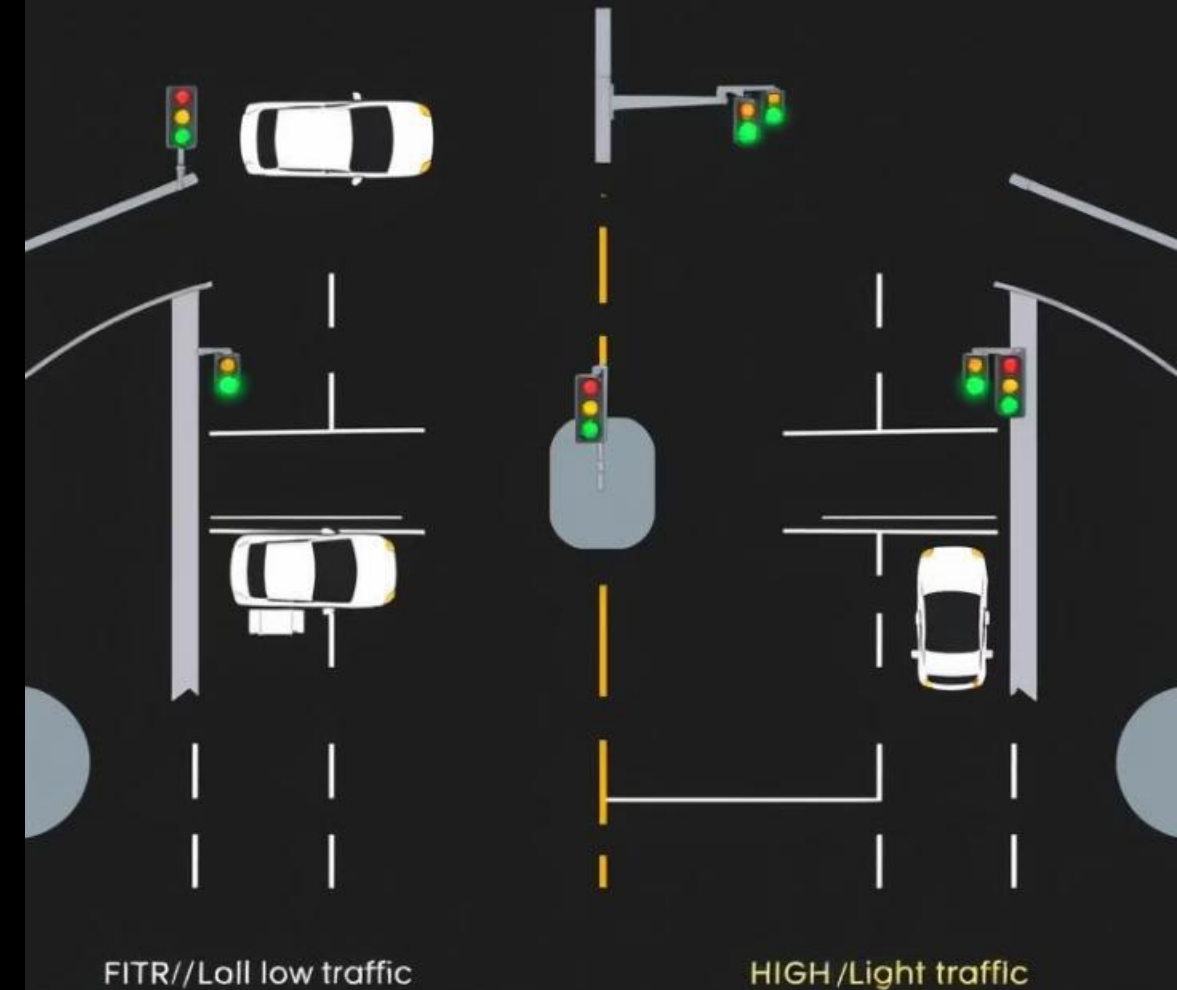
Finds lanes with highest traffic; ignores empty lanes.

## 3 Timing Allocation

Green light duration proportional to traffic density.

## 4 Stagnation Prevention

Switches green signal if others accumulate traffic.



# Web Dashboard Interface

## Backend

Flask API runs traffic data processing and serves JSON endpoint.

## Frontend

Fetches API data, displays live lane density and signals.

## User Interface

Shows lane status visually with green/red lights and timers.



# Demonstration / Results



## Real-Time Monitoring

Dashboard updates lane densities and signal states live.

## Adaptive Timing

Signal durations shift dynamically based on traffic flow.

## Effective Control

Reduces wait times and manages lane congestion efficiently.



# Conclusion & Future Steps



## Prototype Success

Demonstrated adaptive control using real-time vision.

## Future Enhancements

Integrate live video feeds on dashboard and improve logic.

## Deployment

Increase robustness for real-world use and scale up.

