# CS525/ECE459 - A Lightweight IoT Speed Camera Solution
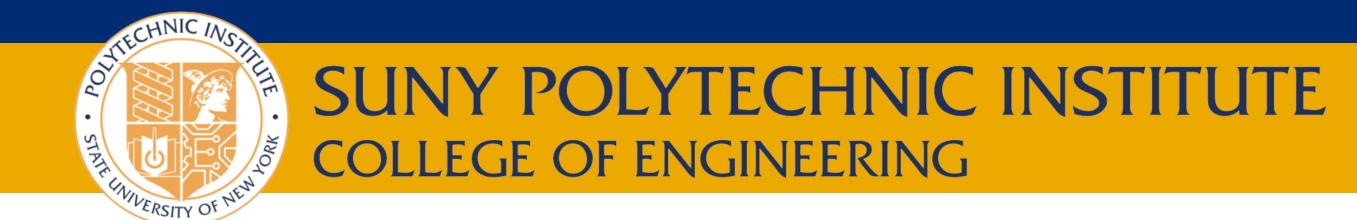
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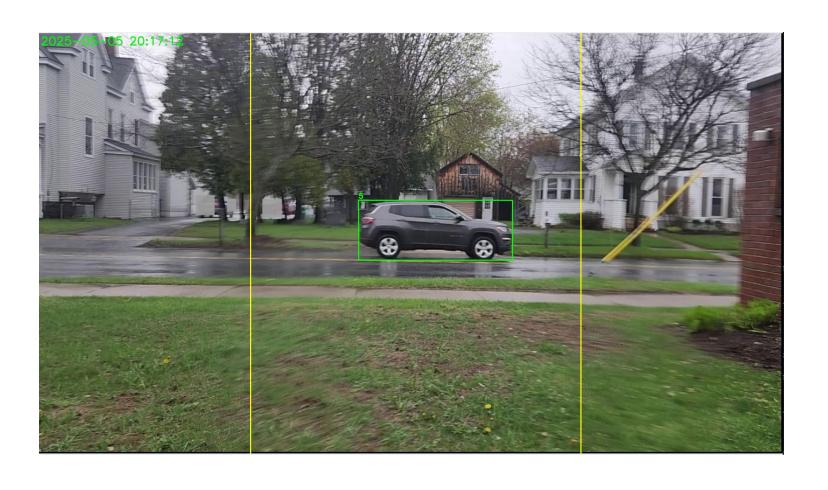**COLLEGE OF ENGINEERING**

## MOTIVATION

Traditional speed-monitoring systems are expensive, infrastructure-heavy, and often limited in adaptability. This project aims to explore how low-cost IoT hardware combined with real-time AI processing can provide an intelligent, scalable alternative to enhance road safety

- **Rising concerns about speeding in urban and residential areas.**
- **Existing speed cameras are costly and require significant infrastructure.**
- **Desire for a low-cost, scalabale, and intelligent alternative using IoT and AI.**

## PROBLEM STATEMENT

We address the challenge of detecting vehicles, measuring their speed, and classifying them using affordable, off-the-shelf components. The system is designed to notify drivers if they are speeding, promoting safer driving habits in areas like campuses, residential roads, and private lanes.

- **The goal:**
  - Detect vehicles,
  - Measure their speed between two virtual boundaries
  - Identify vehicle color
  - And provide real-time alerts if speeding occurs.



## APPROACH

- **Video Capture & Streaming:** A Raspberry Pi captures video from a camera and streams video frames over a TCP connection.
- **Object Detection & Tracking:** The server runs YOLOv8 to detect vehicles, tracks them across two virtual boundaries, and measures time taken to compute speed.
- **Color Classification:** Once detected, the dominant color of the vehicle is determined via HSV analysis, serving as an identifier on the driver's dashboard.
- **Alert System & Data Logging:** Speeds are logged locally in a database, and if a vehicle exceeds the predefined speed-limit, a UDP broadcast alert is issued to connected clients.
- **Preview & Calibration:** The system supports a live visual window for manual calibration and debugging.

## RESULTS

The system reliably detects and tracks moving vehicles in real time, correctly estimating speed with high accuracy for single-lane use cases. Vehicles that exceed the defined speed threshold trigger alerts, and driver dashboards reflect changes almost instantly.

- **Successfully detects and classifies vehicles in real-time.**
- **Accurately calculates vehicle speed with minimal latency.**
- **Real-time web dashboard updates every second.**
- **Alert messages generated for vehicles exceeding speed limits.**

## FUTURE DEVELOPMENTS

- Add a license plate recognition for more precise tracking.
- Integrate GPS data for location-aware monitoring.
- Expand to multi-lane traffic scenarios.