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CONNECTED COMMUNITIES WITH SMART MOBILITY TO EQUITABLY REDUCE CONGESTION

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Vision Zero Research on the Road, Part 6

A-EYE URBAN: EXPLORING THE OPPORTUNITIES OF LOW-COST COMPUTER VISION SOLUTIONS FOR ENHANCING THE URBAN ROADWAY SAFETY

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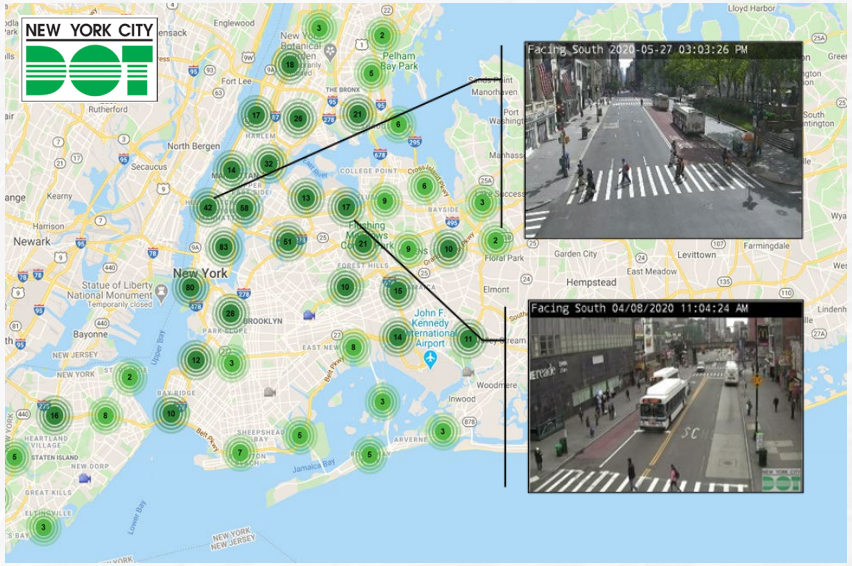
C2SMARTER University Transportation Center Led by New York University

November 29, 2023

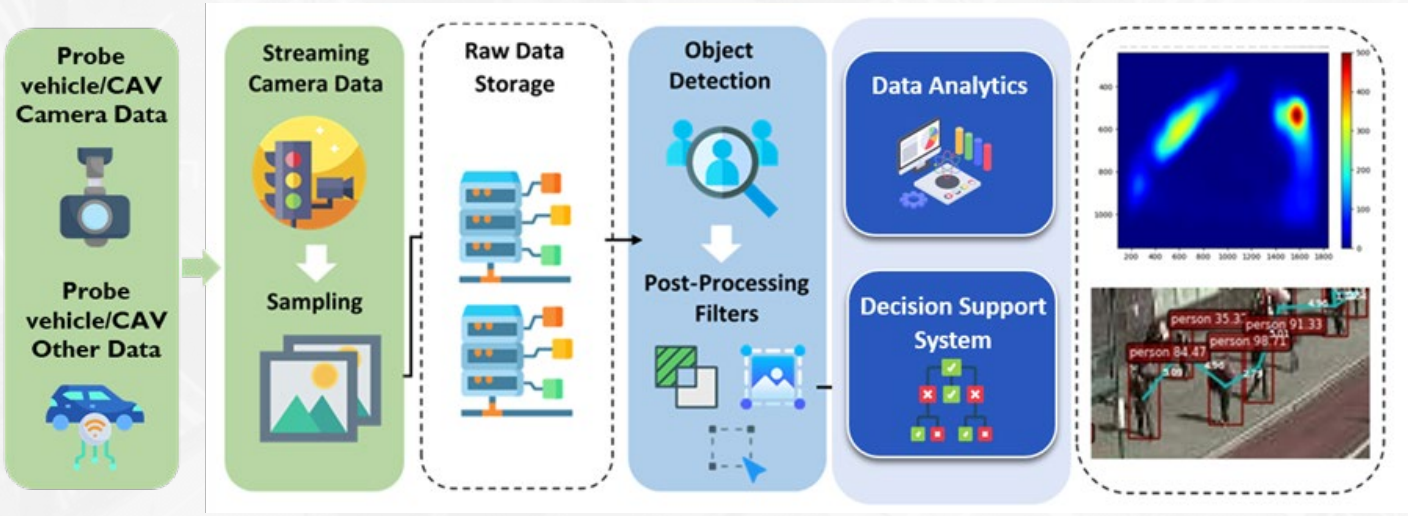
VISION ZERO
Building a Safer City

NYC DDC TOWN +GOWN

Motivations and Objectives



[Public Traffic Cameras: https://nyctmc.org/](https://nyctmc.org/)

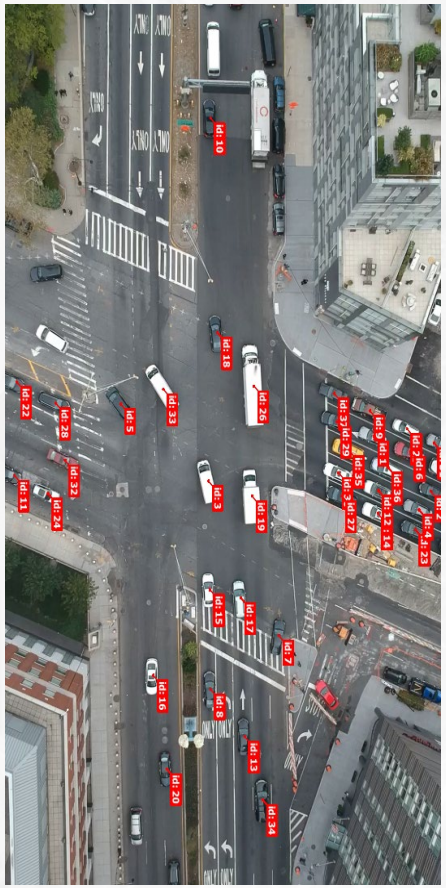


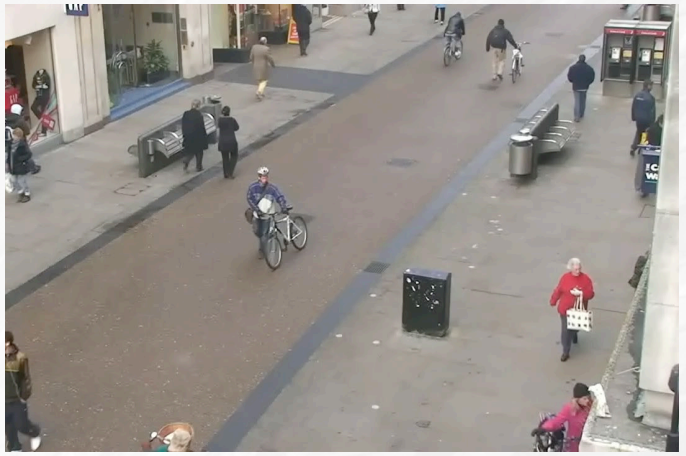
Highlighted Resources:

- 900+ public CCTV traffic cameras
- Real-time deep learning-based object detection model for multiple classes
- Post-processing solutions

Computer Vision-Based Safety Data Extraction

- Multiple image/video source formats available
- Apply for multiple agent types
- Deep learning-based image processing models
- Advanced surrogated safety measurements estimation

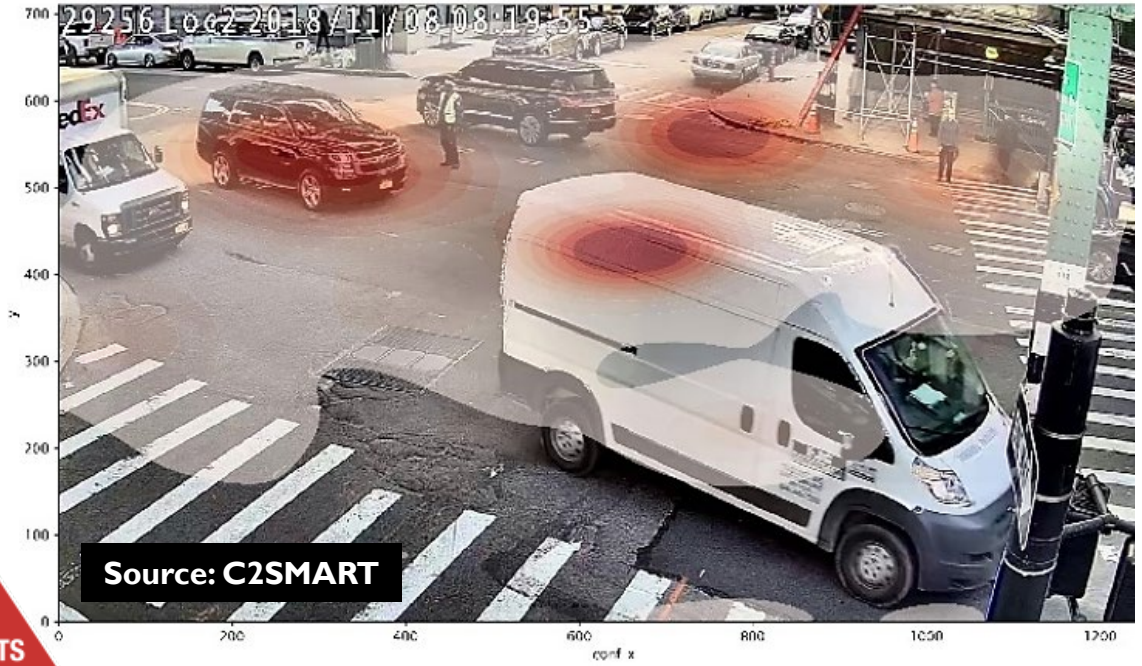


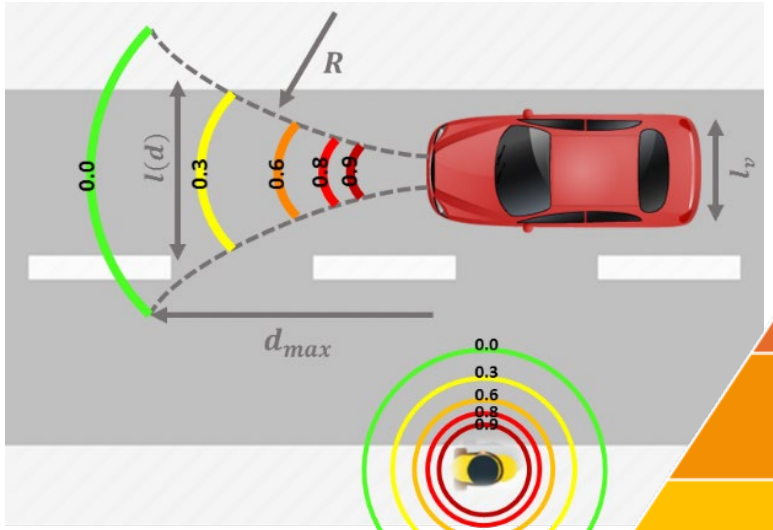


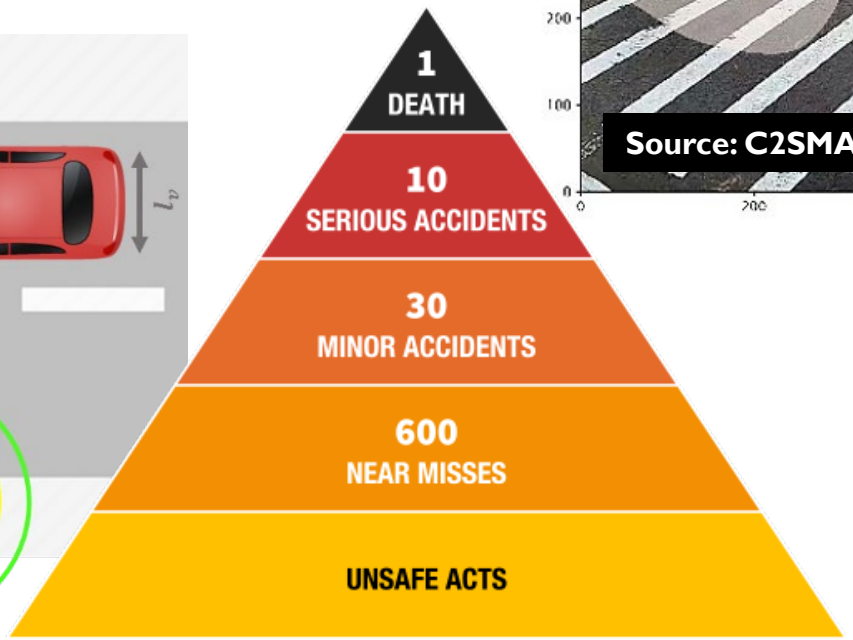
Event Information Extraction – Near Misses

The Occupational Safety and Health Administration (**OSHA**) defines a near miss as:

- *"An incident in which no property was damaged and no personal injury was sustained, but where, given a slight shift in time or position, damage or injury easily could have occurred."*







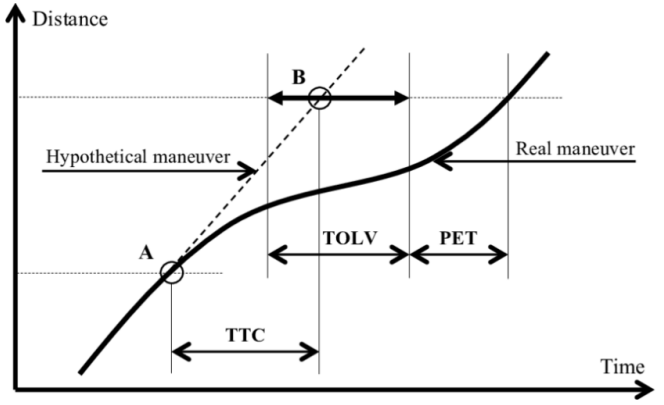


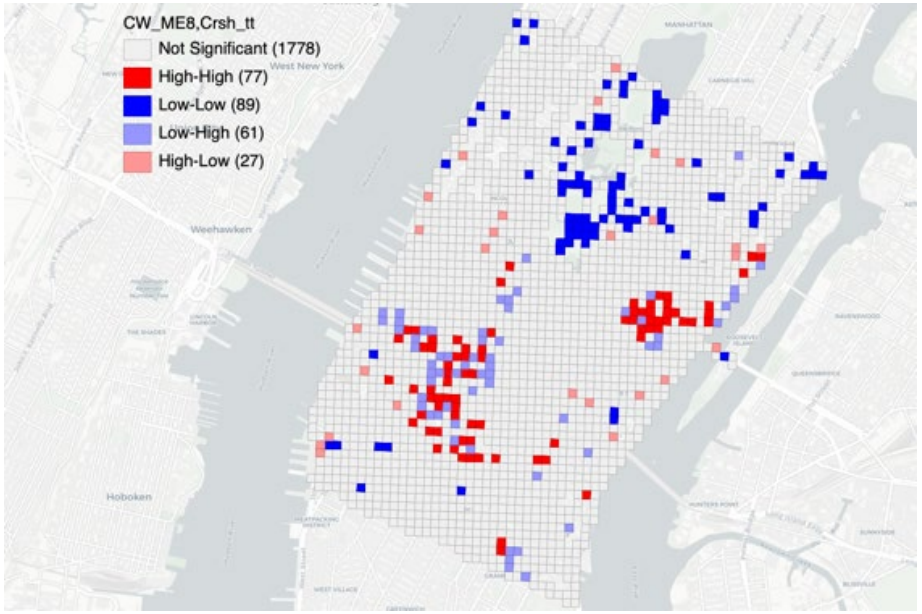
Image Source: https://rombit.com/collision-avoidance/2022/03/01/how-many-near-misses-make-an-accident/

Example: Near miss data extracted using computer vision

Near miss data gathered from in-vehicle cameras via computer vision from industry partner

- **Use Case 1:** Test the **spatial correlation** between **near miss events and crash** to understand if near miss data can be used as an approximation of crash risk.
- The High-High and Low-Low clusters are the areas where near-miss data can be used to signify high and low crash risk.

Near miss data (forward collision warning, VRU Collision Warnings)
Source: Mobileye



Near Miss - Crash Count Spatial Correlation

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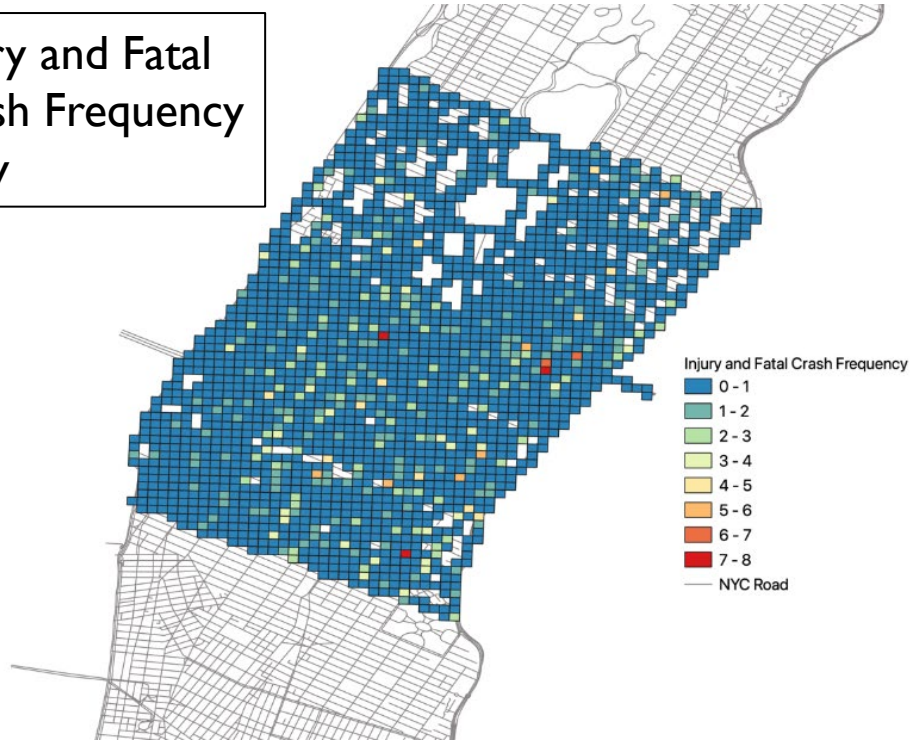
Example: Safety Risk Indicator (Injury and Fatal Crash)

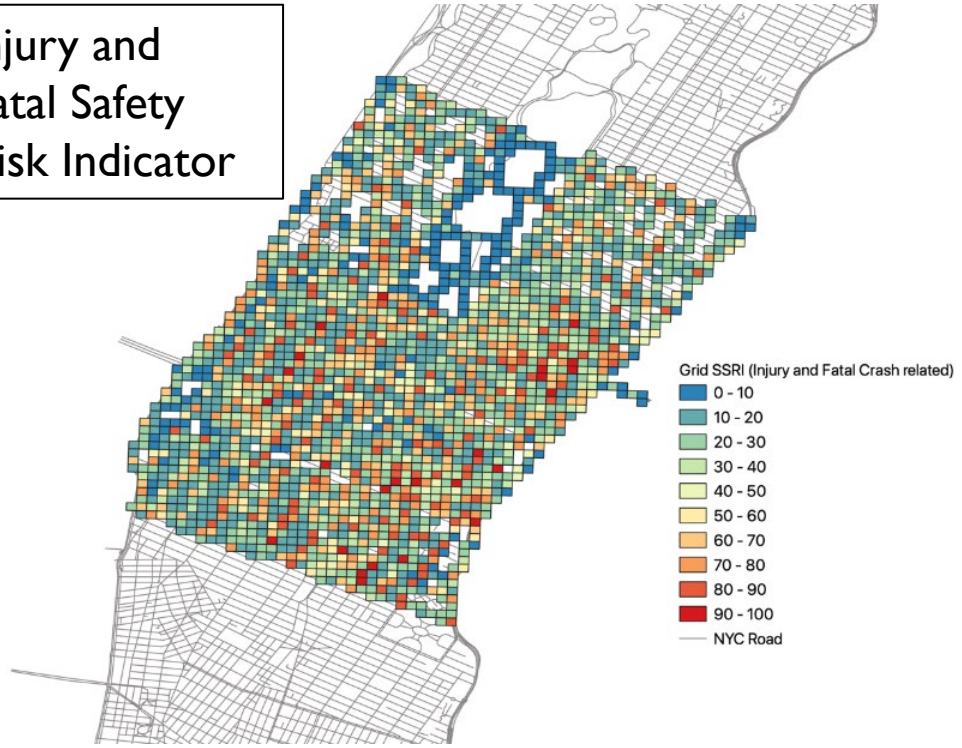
Use Case 2: Utilize **data fusion** to integrate multiple safety-related information (e.g., crashes, near misses, number of intersections, etc.) and develop a **safety risk indicator** for city streets.

The safety risk index map application provides a risk indicator scoring system with a map interface.

Injury and Fatal Crash Frequency Only



Injury and Fatal Safety Risk Indicator



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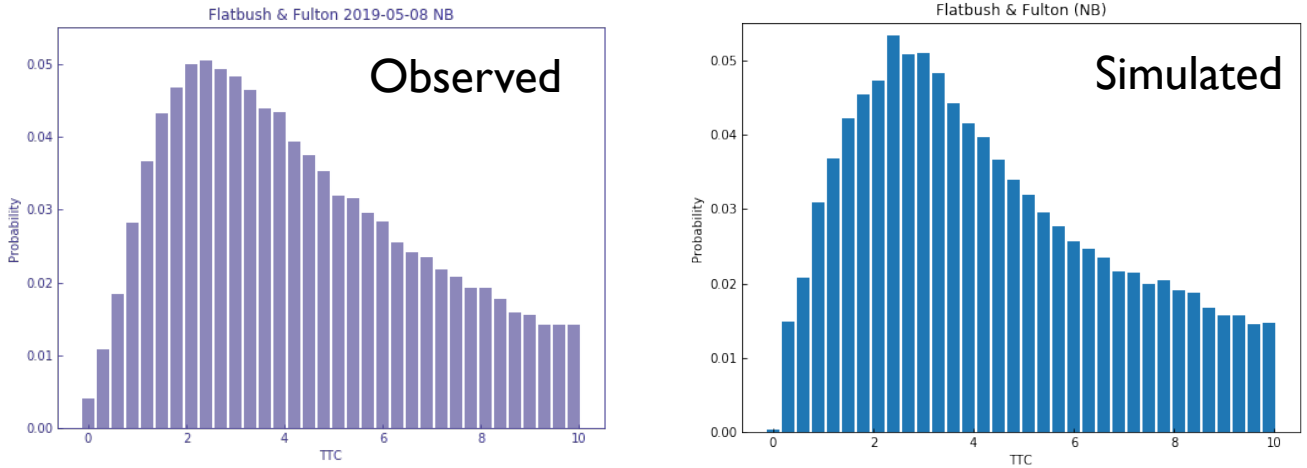
See project report: https://c2smarter.engineering.nyu.edu/exploring-cost-effective-computer-vision-solutions-for-smart-transportation-systems/

Trajectory Extraction – Safety Calibration

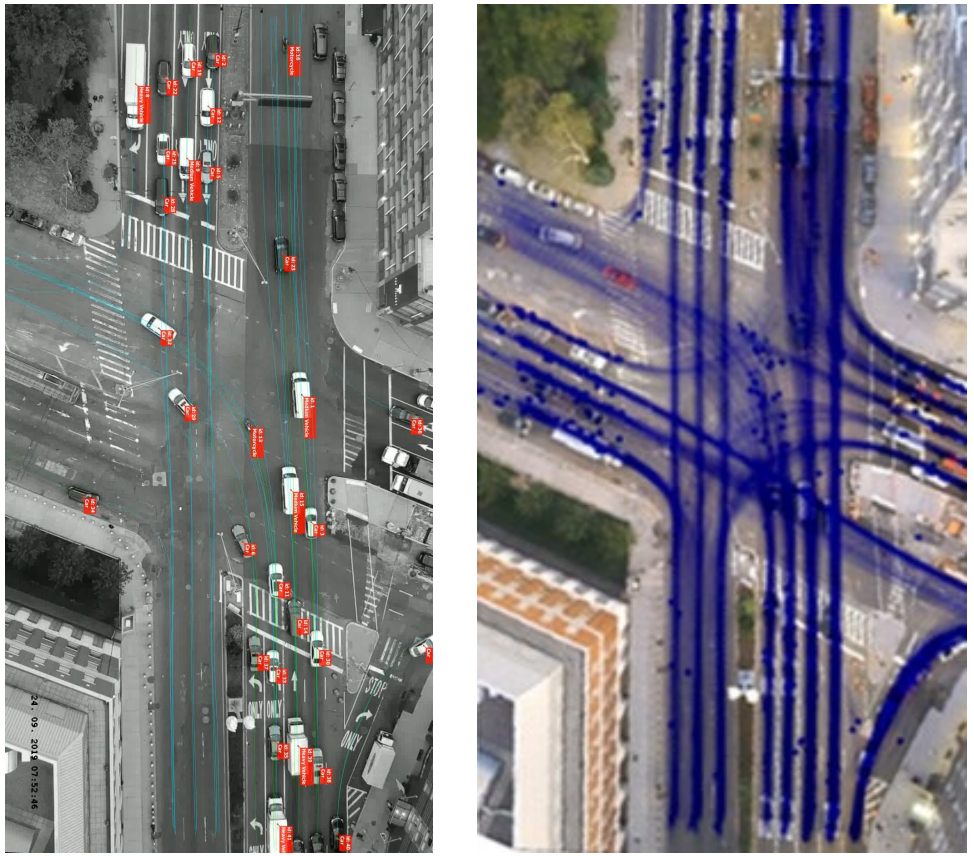
Trajectory →Time to Collision (TTC) → Safety Calibration

A novel calibration framework which combines traffic conflict techniques and multi-objective stochastic optimization was developed so that the operational and safety measures can be calibrated simultaneously.

- Benefit of safety calibration



Conflict distributions after calibration (D_{KL}=0.0047)



This approach was adopted in the USDOT/NYCDOT Connected Vehicle Pilot Deployment: See report **Connected Vehicle Pilot Deployment Program Phase 3 – System Performance Report - New York City**

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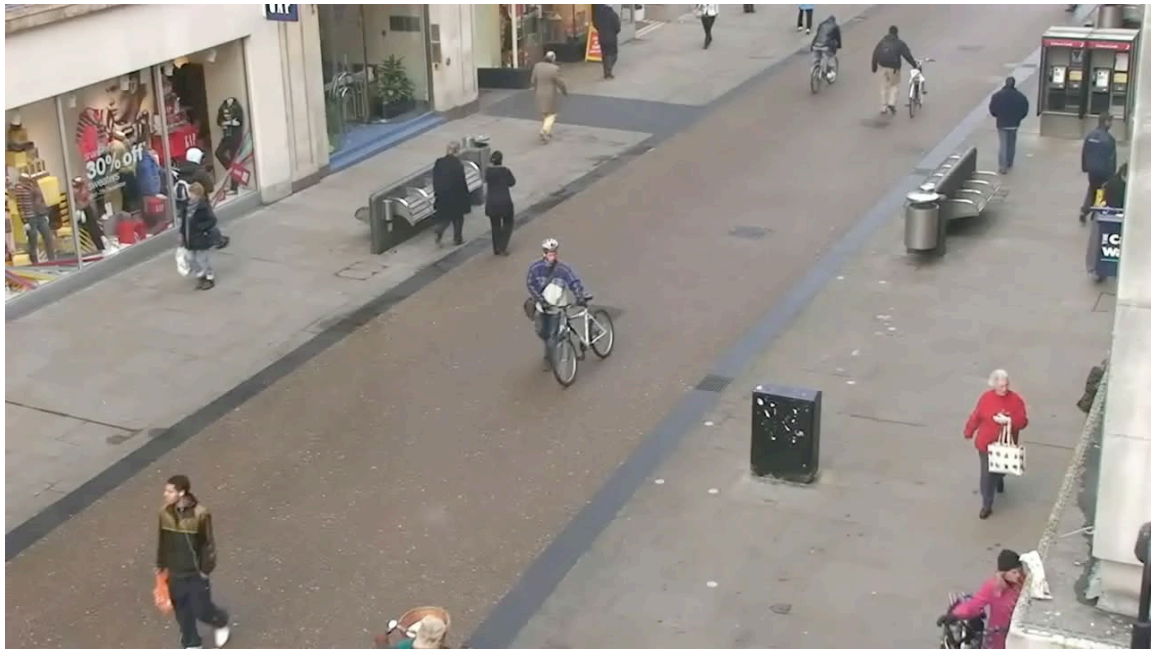
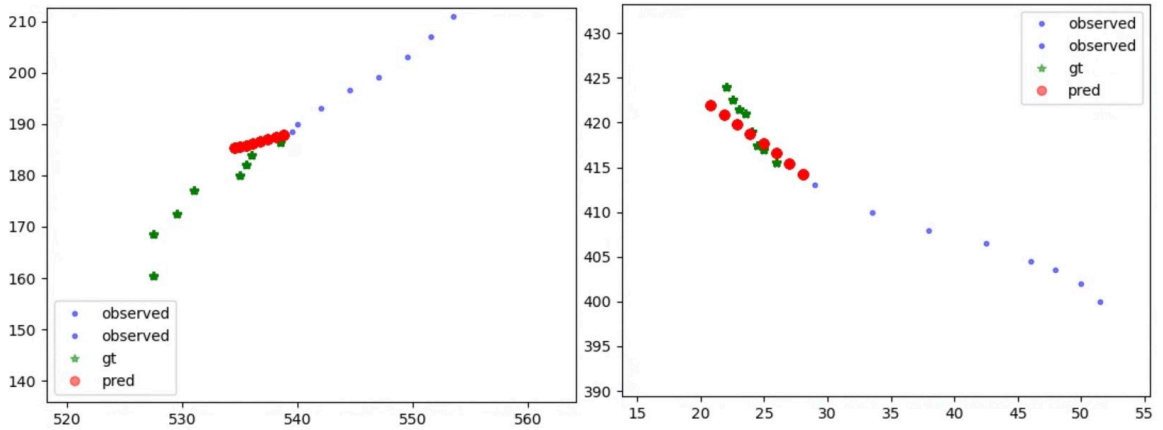
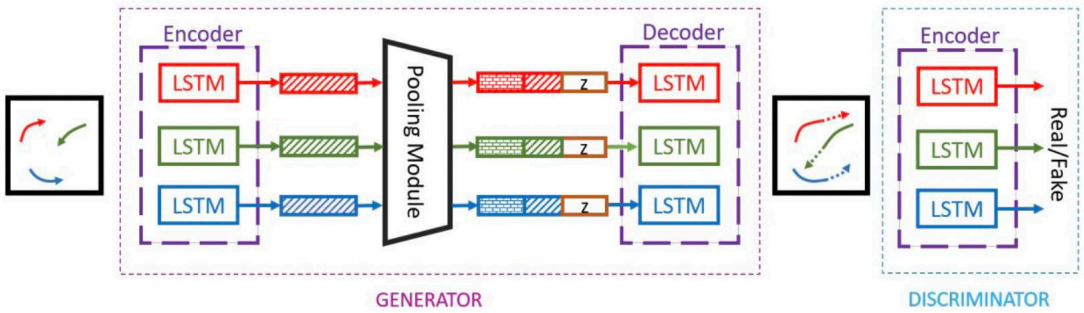
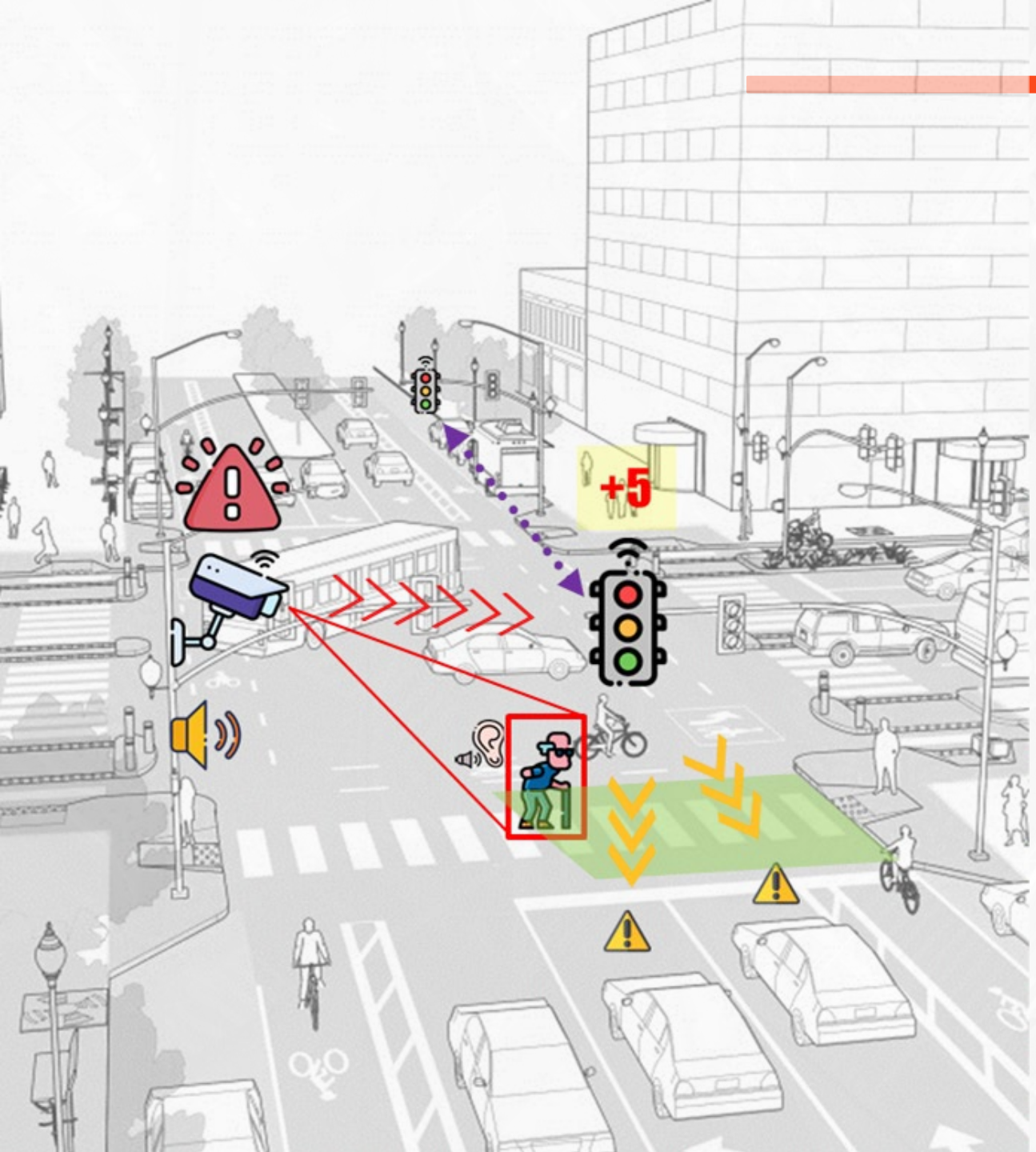
VRU Information Extraction – Intension Prediction







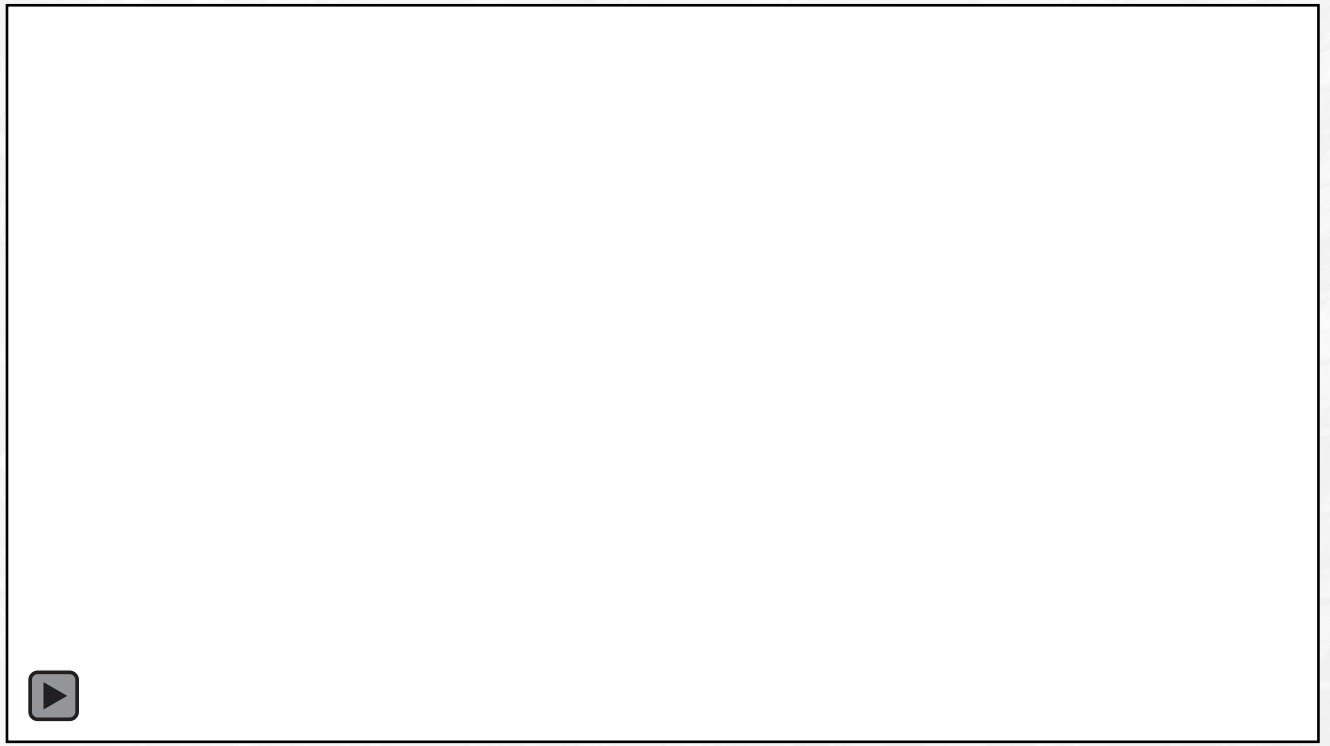


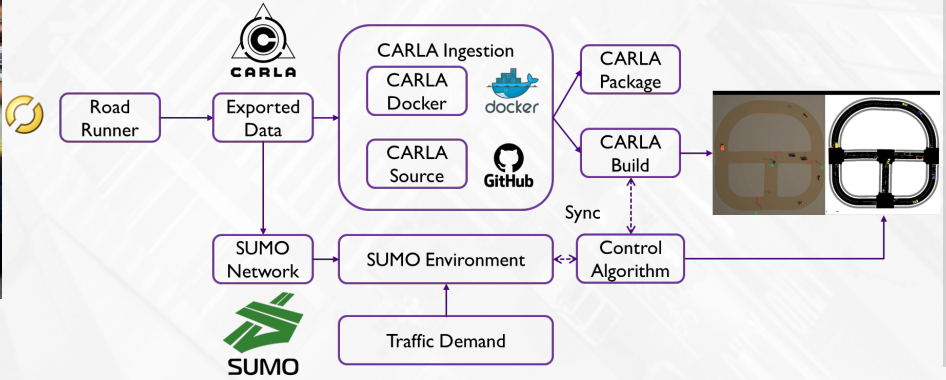
ADAPTIVE SIGNAL SYSTEM TRAINING FOR VRU SAFETY

- Detection module to identify the pedestrian with mobility aid
- Check if extra time is required to cross the road
- If Extra time is required, extend green time for pedestrian with mobility disability
- Keep track of maximum green time
- Deployed in a Traffic Digital Twin (TDT)

Training Environment: SUMO + CARLA

- Using YOLOv8 & StrongSort to detect and track the pedestrians with mobility aids in the region of interest.





- CARLA for 3D visualization of real world.
- SUMO for vehicles/pedestrian generation and control + traffic light control

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Work Zone Detection for Worker Safety

Work Zone Detection for Worker Safety

Legend

A camera with no work zone detected

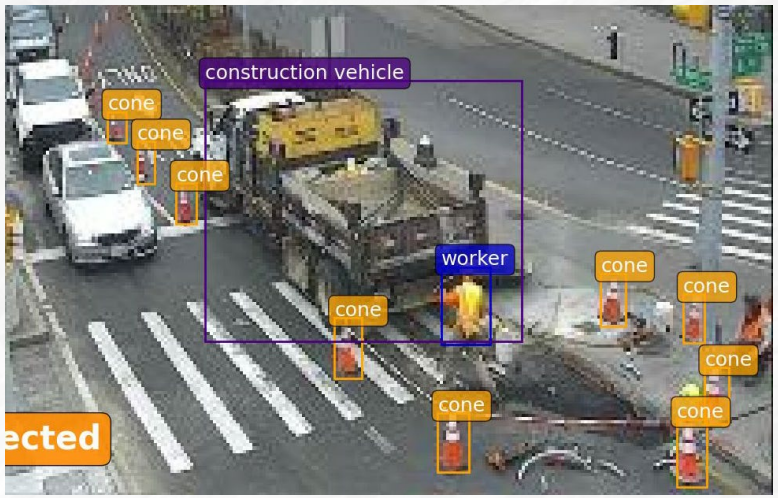
A camera with a work zone detected

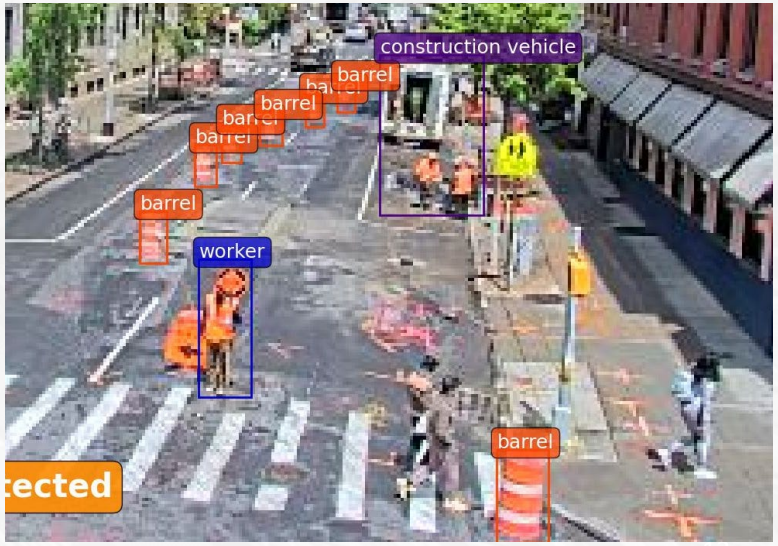
A camera with a work zone and a worker detected

A cluster containing only cameras with no work zone detected

A cluster containing only cameras with a work zone detected

A cluster containing both camera(s) with no work zone detected and camera(s) with a work zone detected





Detecting construction workers for active work zones

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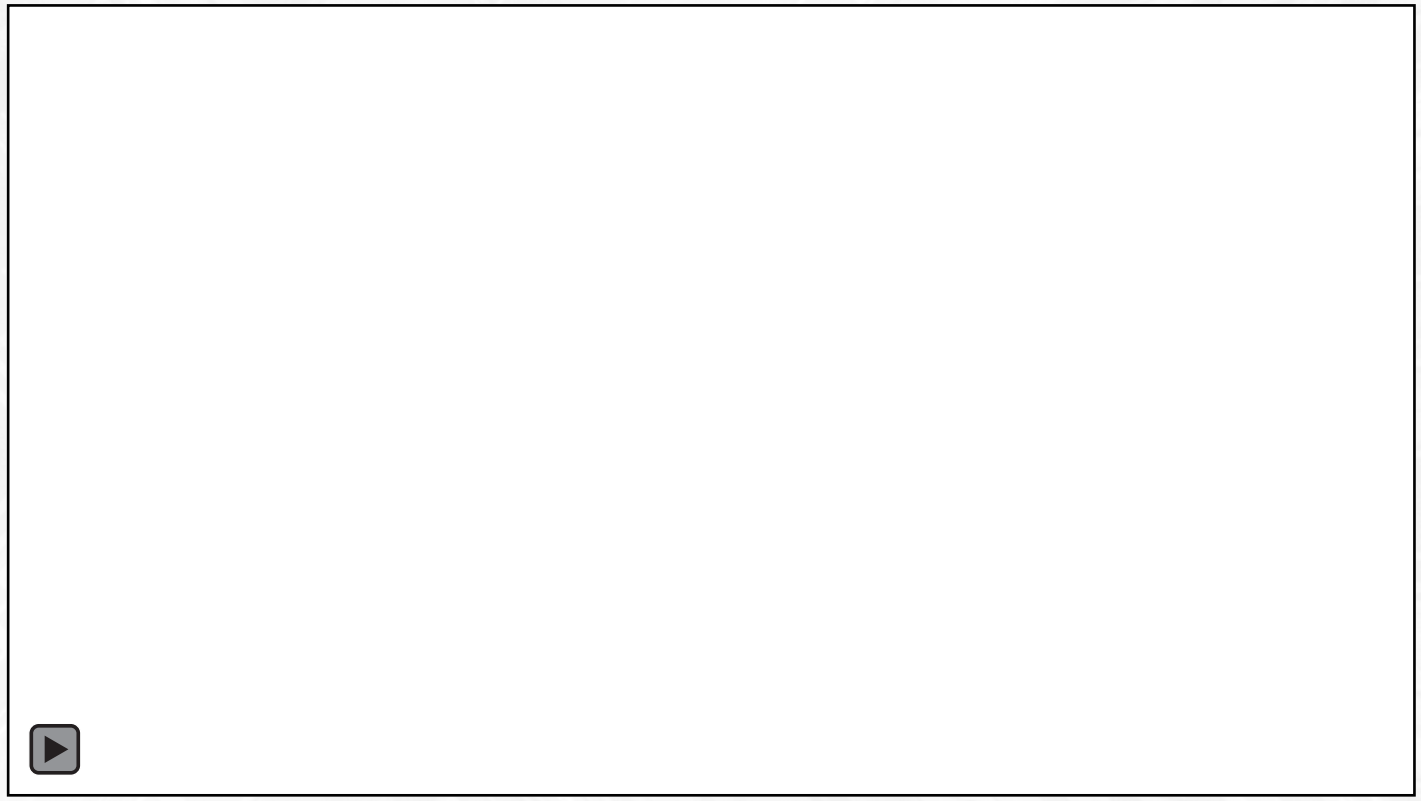
Web-based application

Applications are embedded into a web-based tool which employs a microservices architecture, separating functions to simplify development, testing, and maintenance.

View demonstration video at: https://shorturl.at/abtHM

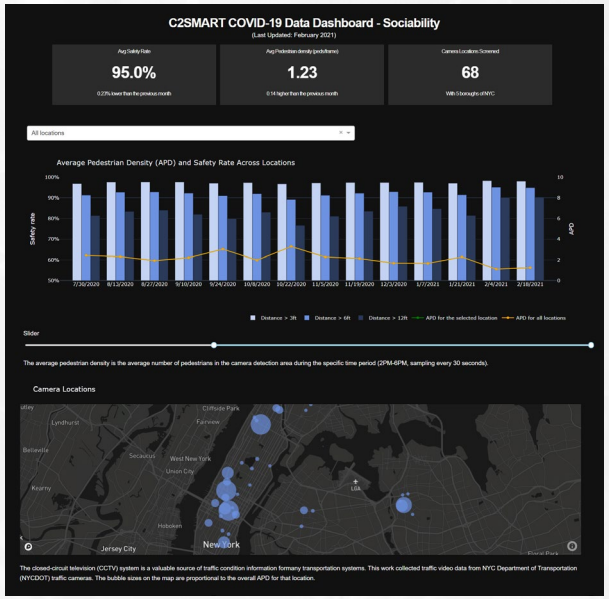
Web-based app main functionalities:

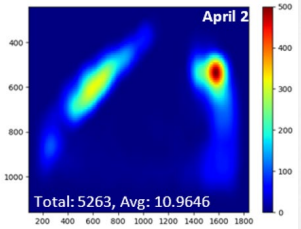
- Map-based app & Dashboard
- Detecting work zones
- Detecting surrounding traffic density
- Detecting active work zones with construction workers
- Record work zone durations (active/non-active)
- Record work zone numbers

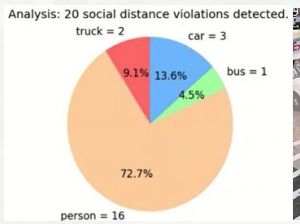


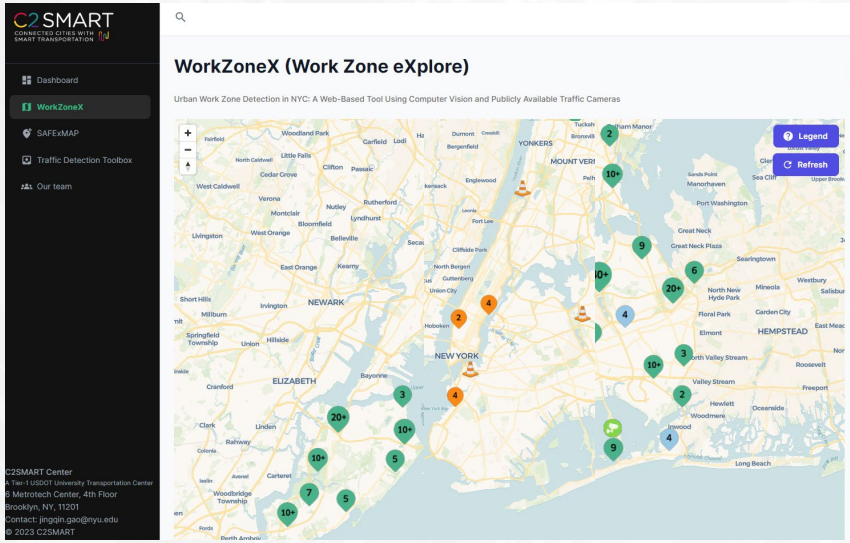
A-EYE Urban Platform

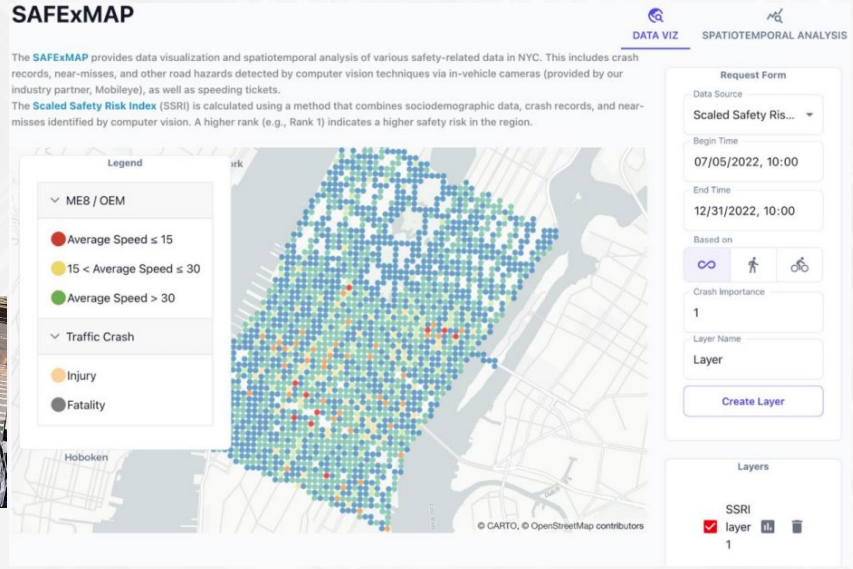
All-in-One Web-based Toolkit

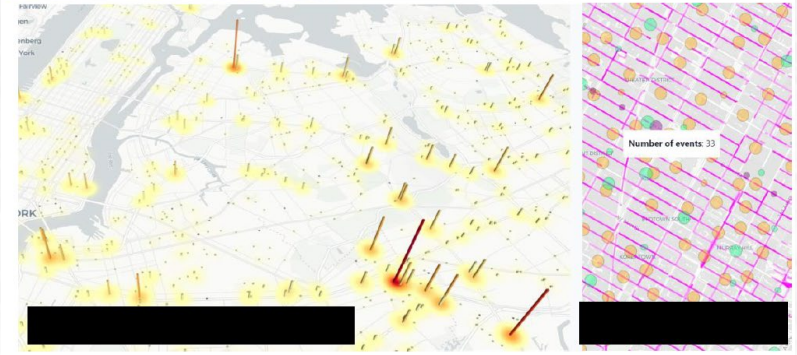












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Ongoing Collaboration

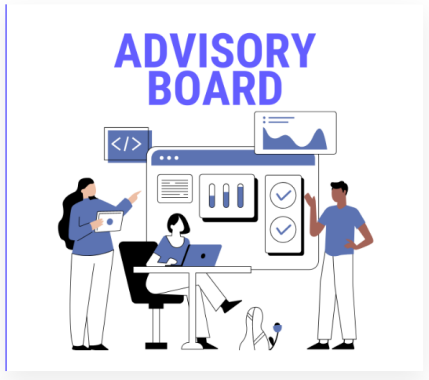
Town+Gown: NYC

PRELIMINARY EXPLORATION OF VIDEO TRAFFIC DATA ANALYTICS

USDOT University Transportation Center Research

EXPLORING COST-EFFECTIVE COMPUTER VISION SOLUTIONS FOR SMART TRANSPORTATION SYSTEMS

PARTNER WITH US TO ADVANCE VISION-BASED TECHNOLOGY IN THE REAL WORLD!



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THANK YOU

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