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CPS: Medium: Hybrid Twins for Urban Transportation: From Intersections to Citywide Management

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Ultimate Goal

An urban traffic management system driven by public needs for improved safety, mobility, reliability.

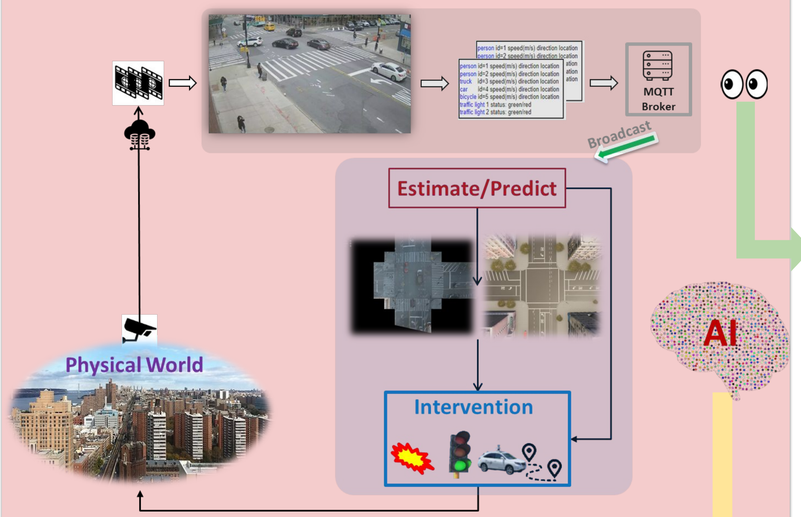
Challenges

- Ensuring safety at intersections is an important engineering problem with value for human drivers, self-driving vehicles and pedestrians.
- The key question: How could traffic managers leverage real-time information collected from IoT devices for adaptive urban traffic management?
- Proposal: Build a digital twin of a street intersection, with which we can explore a number of use cases, from traffic counting and prediction to intersection signal optimization.

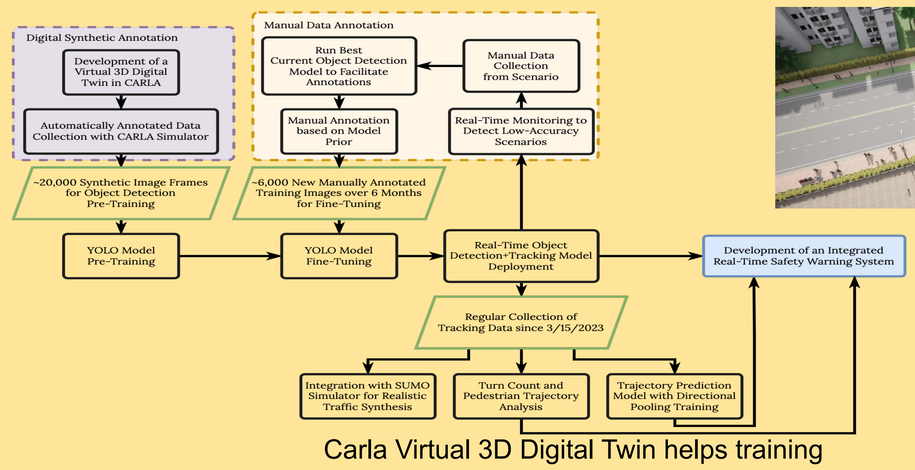
Solution

Novelty: hybrid twin for urban traffic systems.

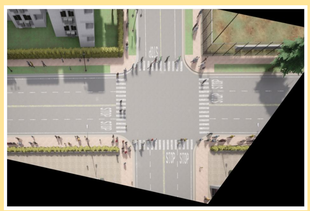
Develop a hierarchical and distributed hybrid twin to support urban traffic management systems while leveraging Artificial Intelligence (AI), edge cloud computing, and next generation communication networks.

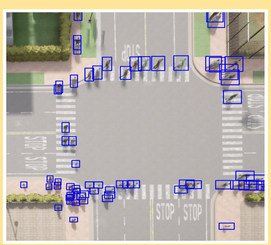


Digital twin architecture



Carla Virtual 3D Digital Twin helps training

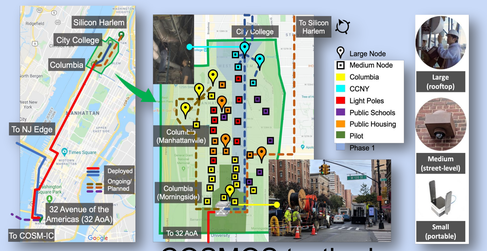




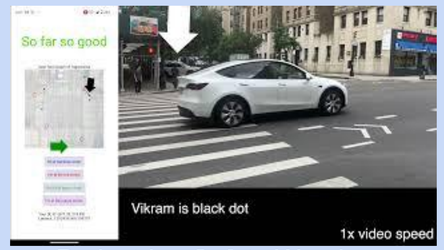
Scientific Impact

Data analytics and ML including real-time learning for control:

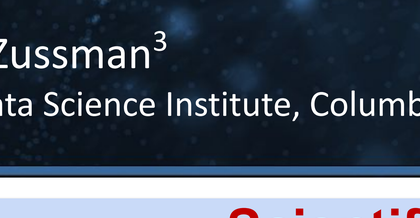
- Physics-informed deep learning.
- Adaptive control with reinforcement learning.
- Develop applications Enhancing the safety of Vulnerable Road Users (VRUs).



COSMOS testbed



Pedestrian Safety Warning



Object detection with two 12th floor cameras

Object detection with 1st floor and 2nd floor cameras

Broader Impact

- Transform the way urban transportation is modeled, simulated, and controlled.
- Advance knowledge of modeling, computation, and simulation
- Benefit society with a safe and efficient urban traffic management system.

Smart Cities Connected program

NSF SURE Summer Program

NSF REM/RET Summer Program