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POSTER DCP91291
CONTACT NAME Kedar Potdar: kedarp@nyu.edu

NVIDIA GTC GPU TECHNOLOGY CONFERENCE

Modelling Spatio-Temporal Patterns in Pedestrian Behavior at the Edge with Jetson SOMs

Kedar Potdar (kedarp@nyu.edu), Dr. Paul M. Torrens (torrens@nyu.edu)
NYU Center for Urban Science and Progress

NYU | Center for Urban Science + Progress

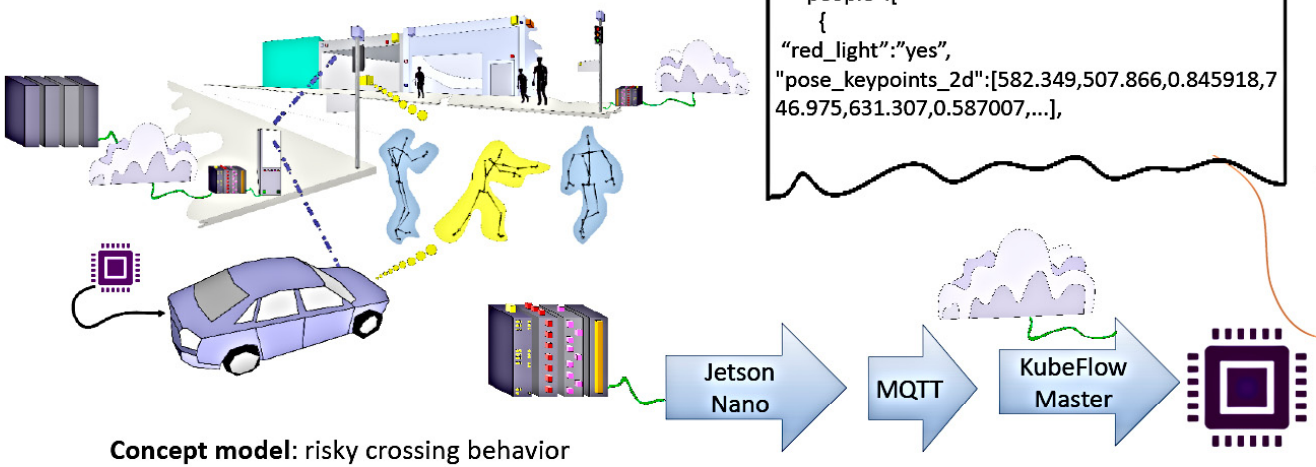
Abstract: As machine intelligence and human activity mix with increasing interactivity on streets, collection and interpretation of pedestrian behavior data is becoming a critical component of many cyber-physical systems (CPS). Vision-based sensorimotor control of Autonomous Vehicles (AVs) and input to Advanced Driver Assistance Systems (ADAS) are two systems that can immediately benefit from higher fidelity pedestrian behavior models. Here, we show a system that leverages the agility of edge computing alongside socio-behavioral science of pedestrian behavior to build on-the-fly machine response to complex scenes of busy human environments in cities. Specifically, we show how edge computing enables on-prem computer vision-based analysis of human movement behavior, using a novel distributed edge architecture to ally detailed pedestrian data with a cloud backend for modeling spatio-temporal pedestrian behavior for varying contextual locations across New York City.

What? Modelling Crowd Behavior in a city for improved pedestrian knowledge in AVs and ADAS, with potential applications to social robots and assistive technologies.

How? NVIDIA Jetson Nano powered Edge Nodes capture pedestrian data across various locations. Theses nodes use GPU techniques for pedestrian tracking and pose estimation to perform real-time identification of pre-trained behavior patterns. Thus, each node generates a time-series of observed behavior, which it reports to the cloud. The cloud backend performs Deep Spatio-Temporal Analysis on the obtained data to model frequency and density of crowd and associated behavior. We use PyTorch GPU on the Edge Nodes with KubeFlow for large scale ML-serving container management.

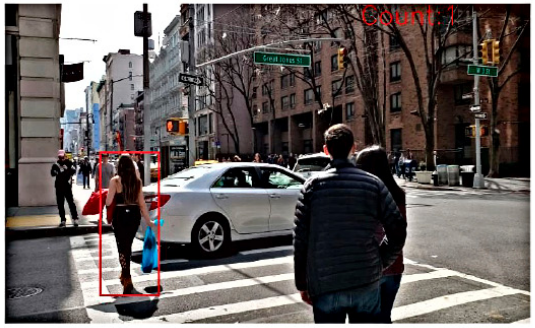
Our Contribution:

- Development of Deep Learning LSTM Models for Pedestrian Activity Recognition using Pose Estimation.
- GPU model for recognizing Red Light crossing with accuracy of over 96% in complex urban scenes.
- Creation of NVIDIA Docker containers for deploying the models on Jetson Nano.
- Training Deep ST Residual Networks for macro-crowd behavior analysis.



Concept model: risky crossing behavior

Proof-of-concept: Red-light crossing detection in-scene



Pedestrian isolation and body-language graph