

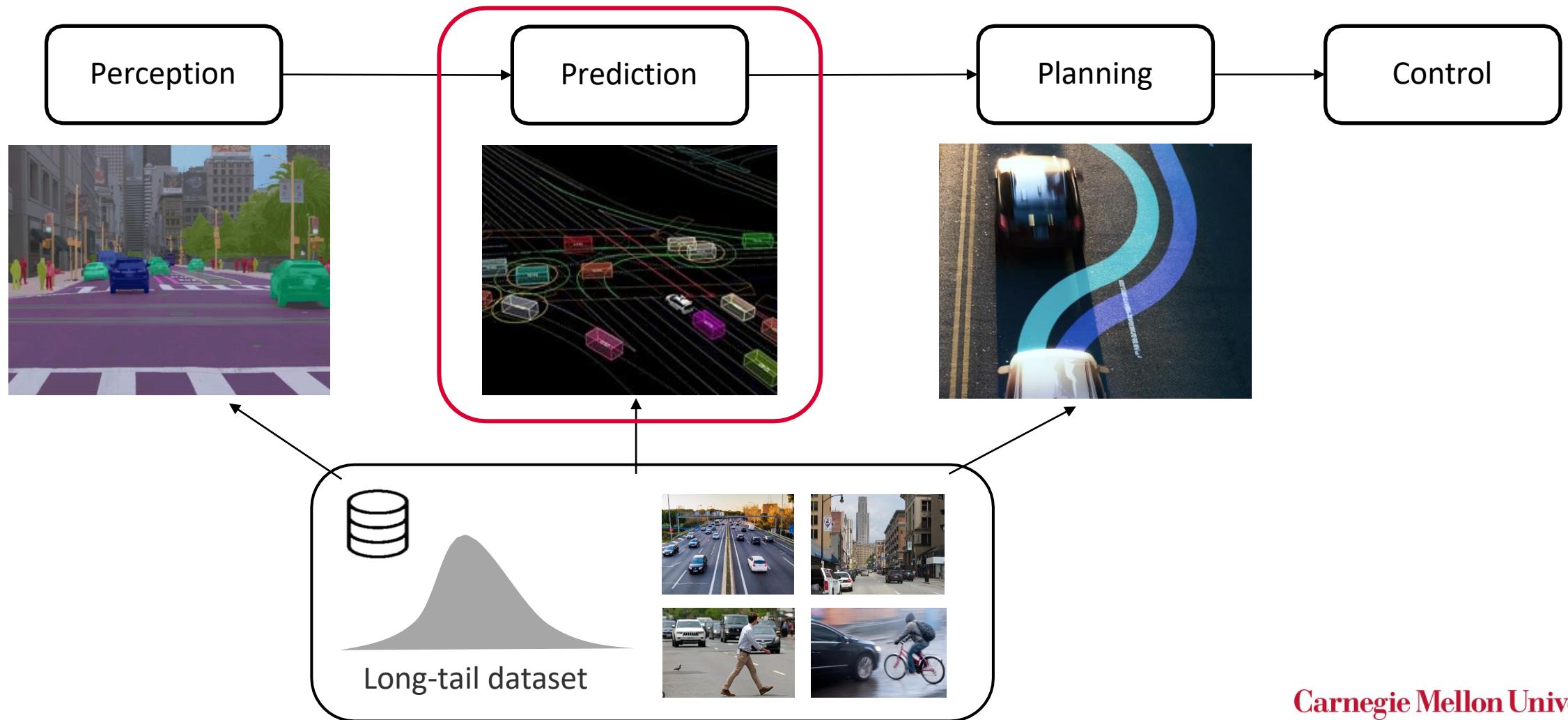
JaywalkerVR: A VR System for Collecting Safety-Critical Pedestrian-Vehicle Interactions

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*Supported in part by DENSO International America, Inc., the Ford Fellowship,
and the NSF Graduate Research Fellowship Program

Background - Autonomous Driving

Safe and reliable autonomous driving algorithm requires large amount of data



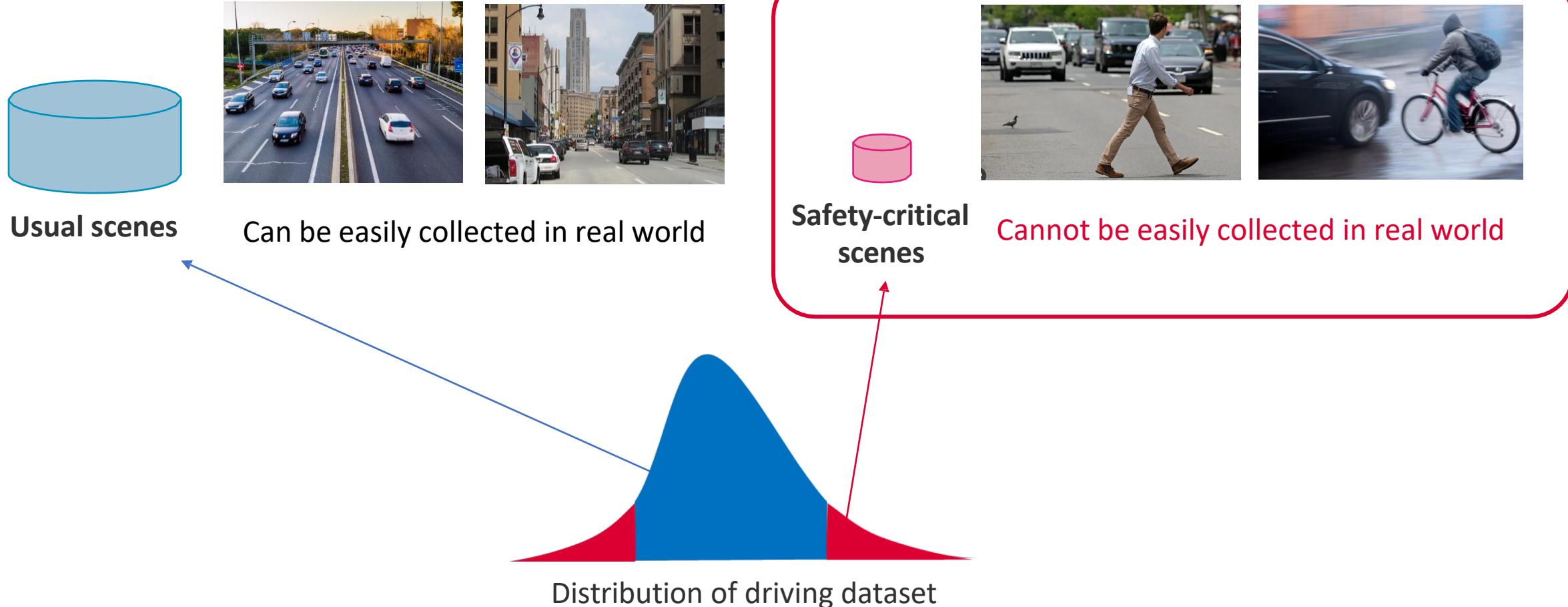
Video



21/10/20
13:56:10

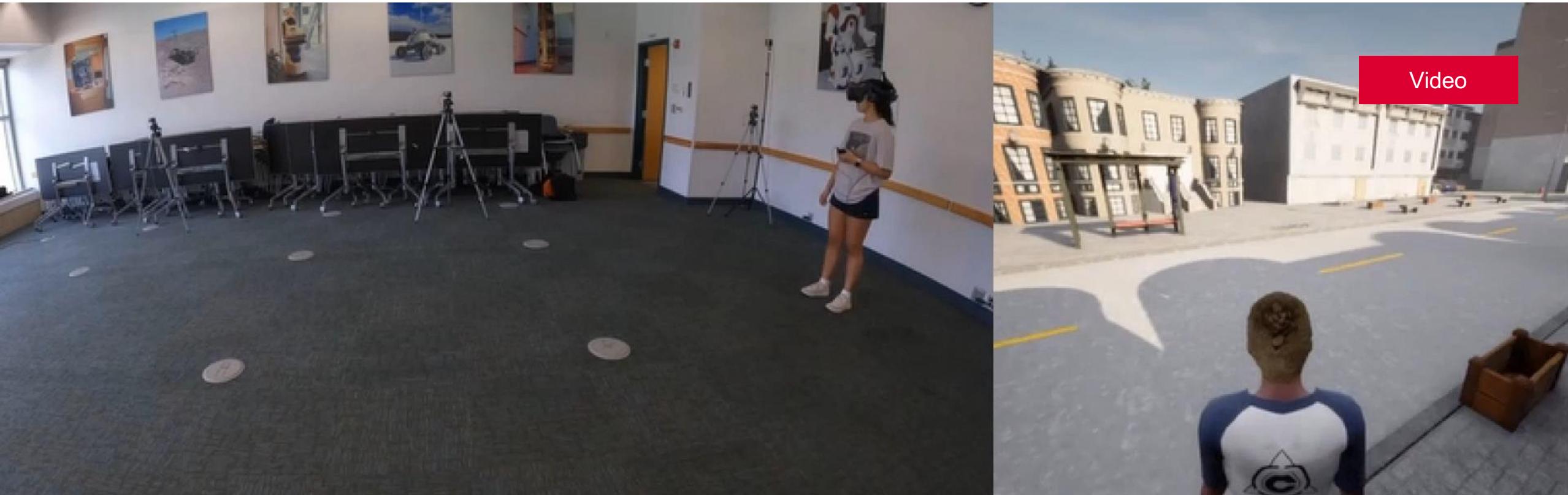
Background - Dataset Issue

Gathering vehicle-pedestrian interaction data can be costly and unsafe in real world



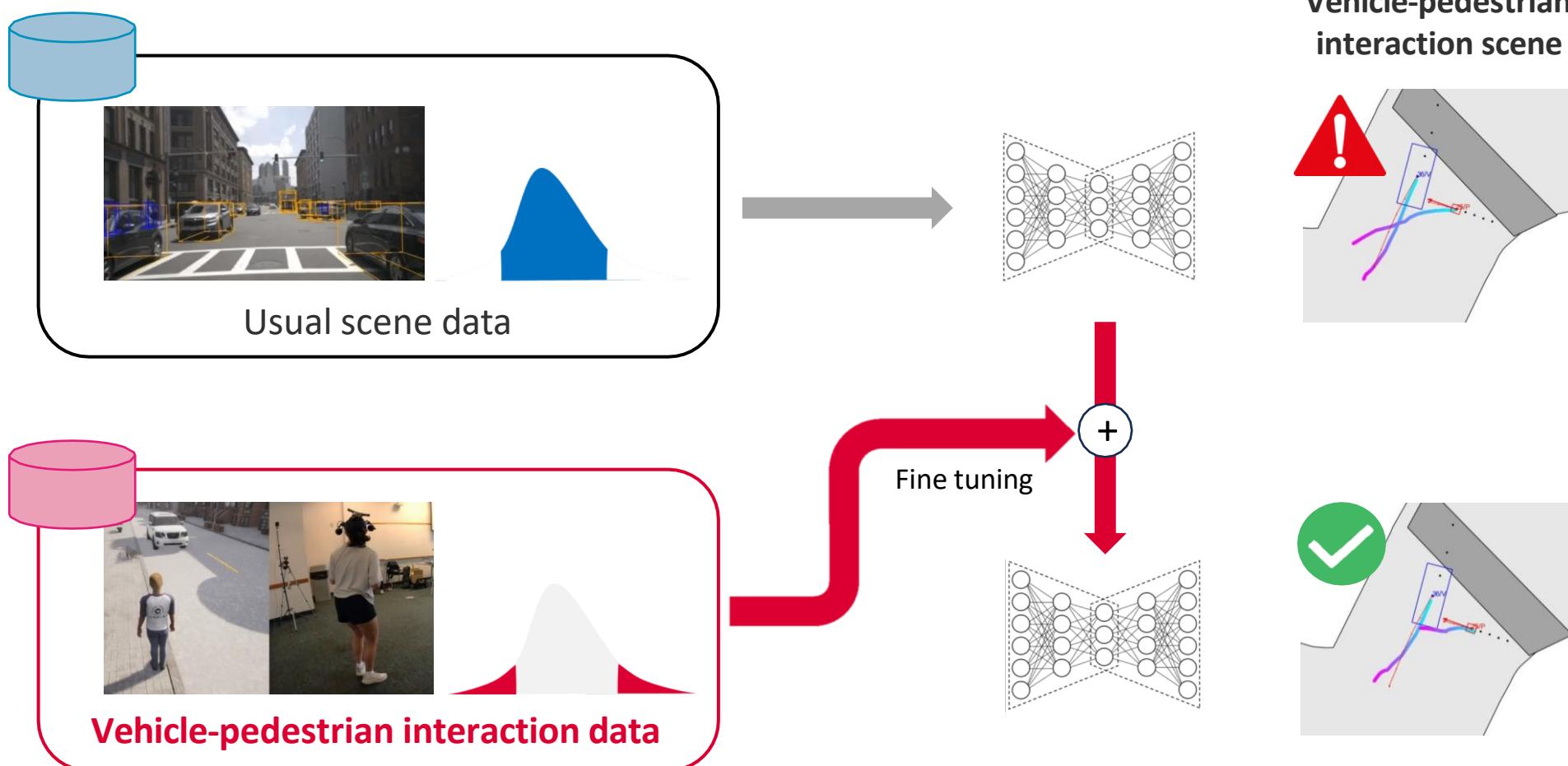
Our Approach - JaywalkerVR

A VR System for Collecting Safety-Critical Pedestrian-Vehicle Interactions

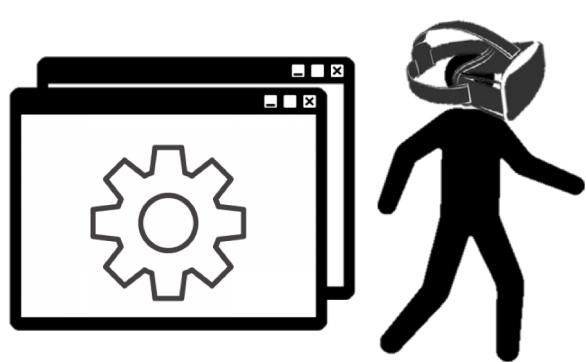


Motivation - Towards Robust AI Model

Goal: Obtain robust trajectory forecasting model in vehicle-pedestrian interaction scene



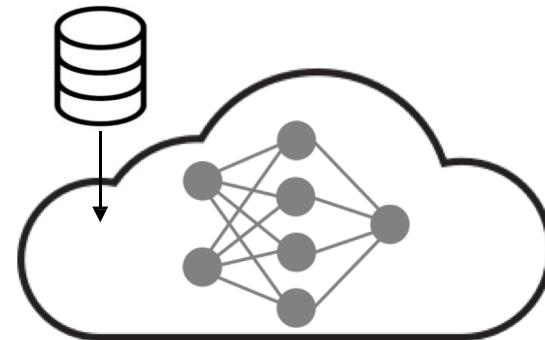
Overview



JaywalkerVR
- How to construct?

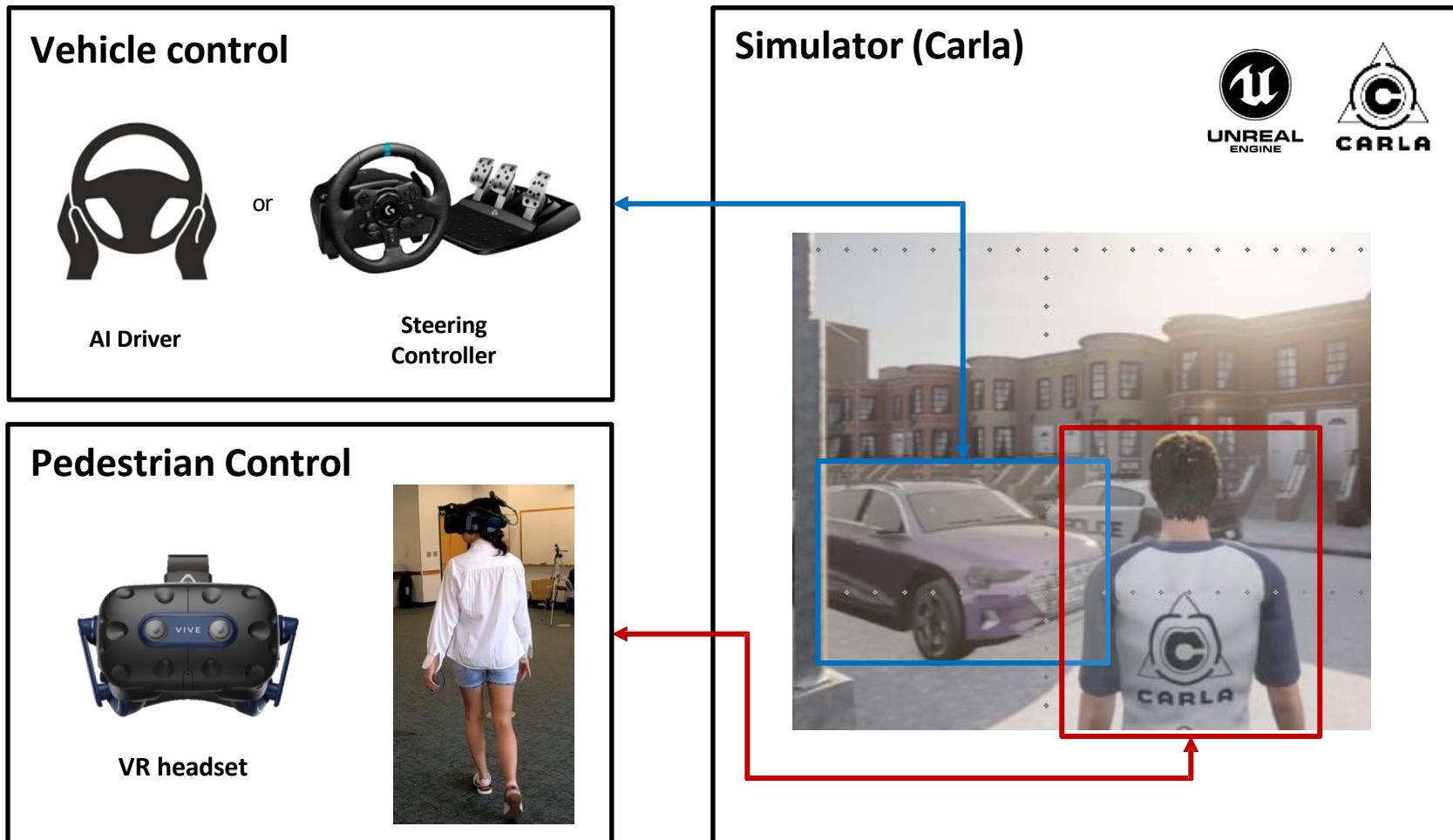


CARLA-VR dataset
- Which scenario?

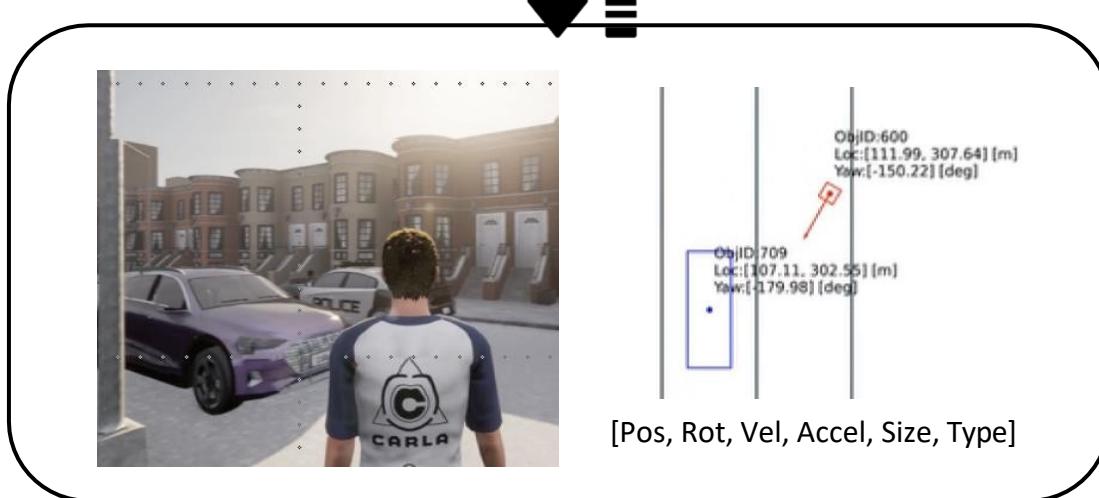
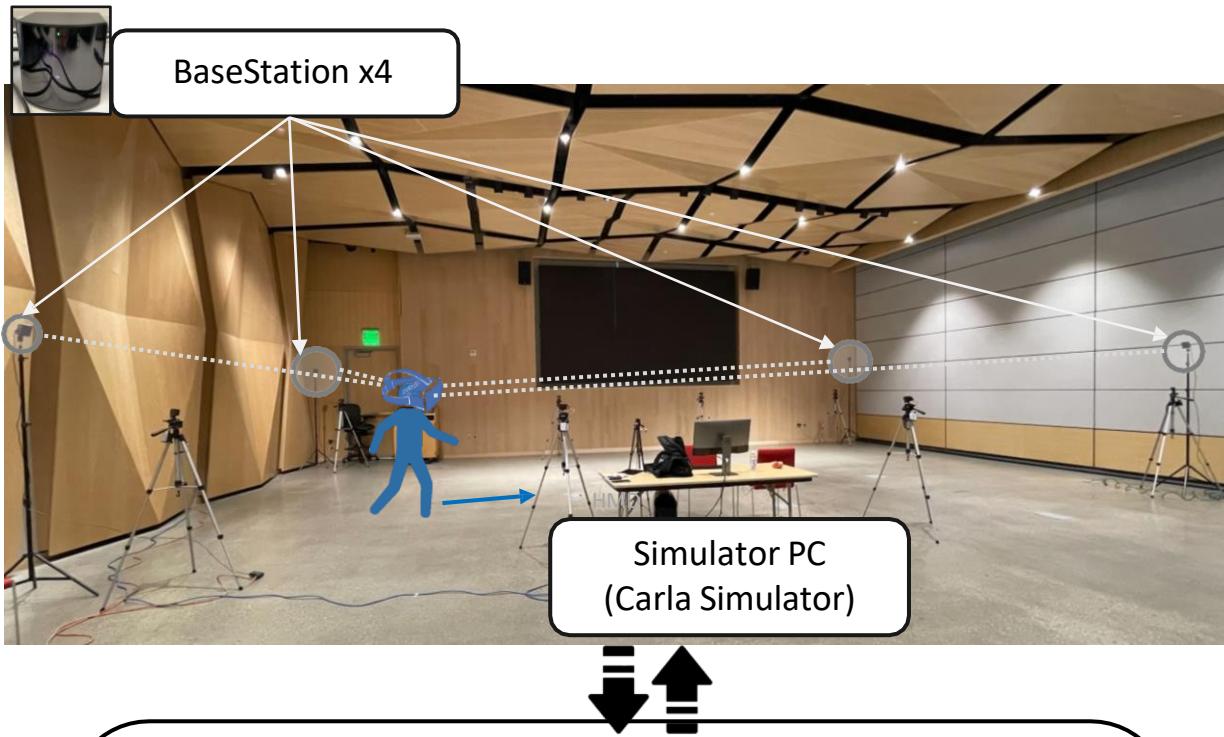


Evaluation
How to train/test?

JaywalkerVR - How to construct?



JaywalkerVR - How to construct?





Frame:946[-]

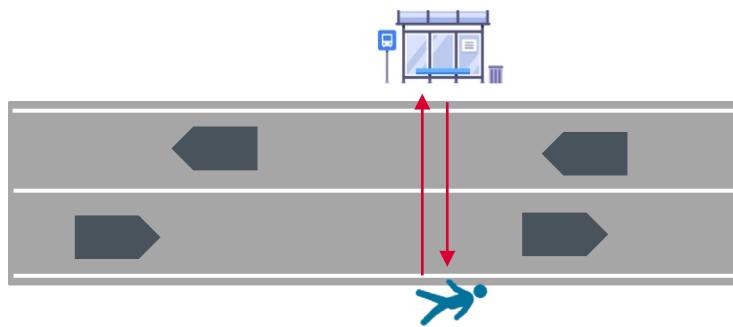
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Loc:[115.76, 302.55] [m]
Yaw:[-180.00] [deg]

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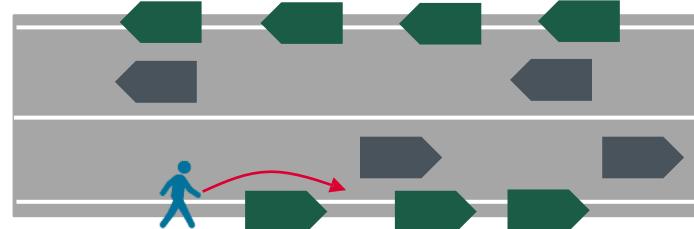
ObjID:600
Loc:[112.25, 306.01] [m]
Yaw:[87.06] [deg]



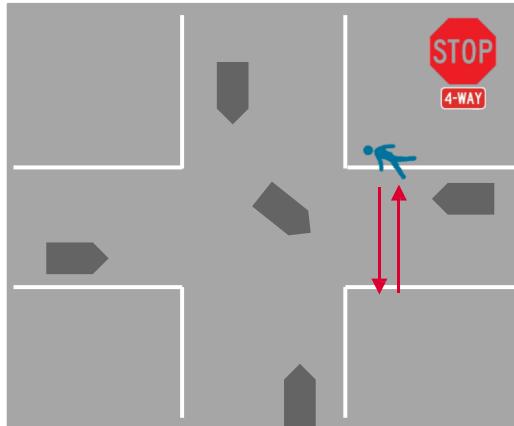
CARLA-VR Dataset - Which scenario?



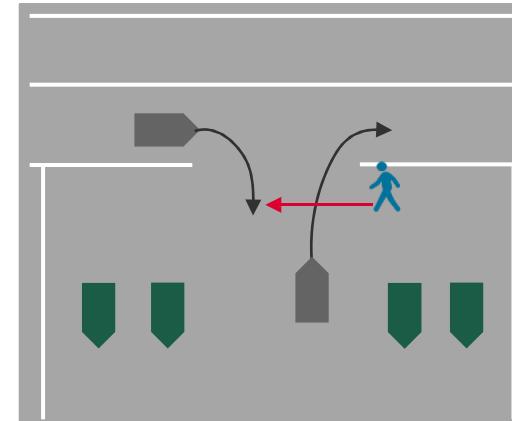
Jaywalk



Parking cars



4-way Stop



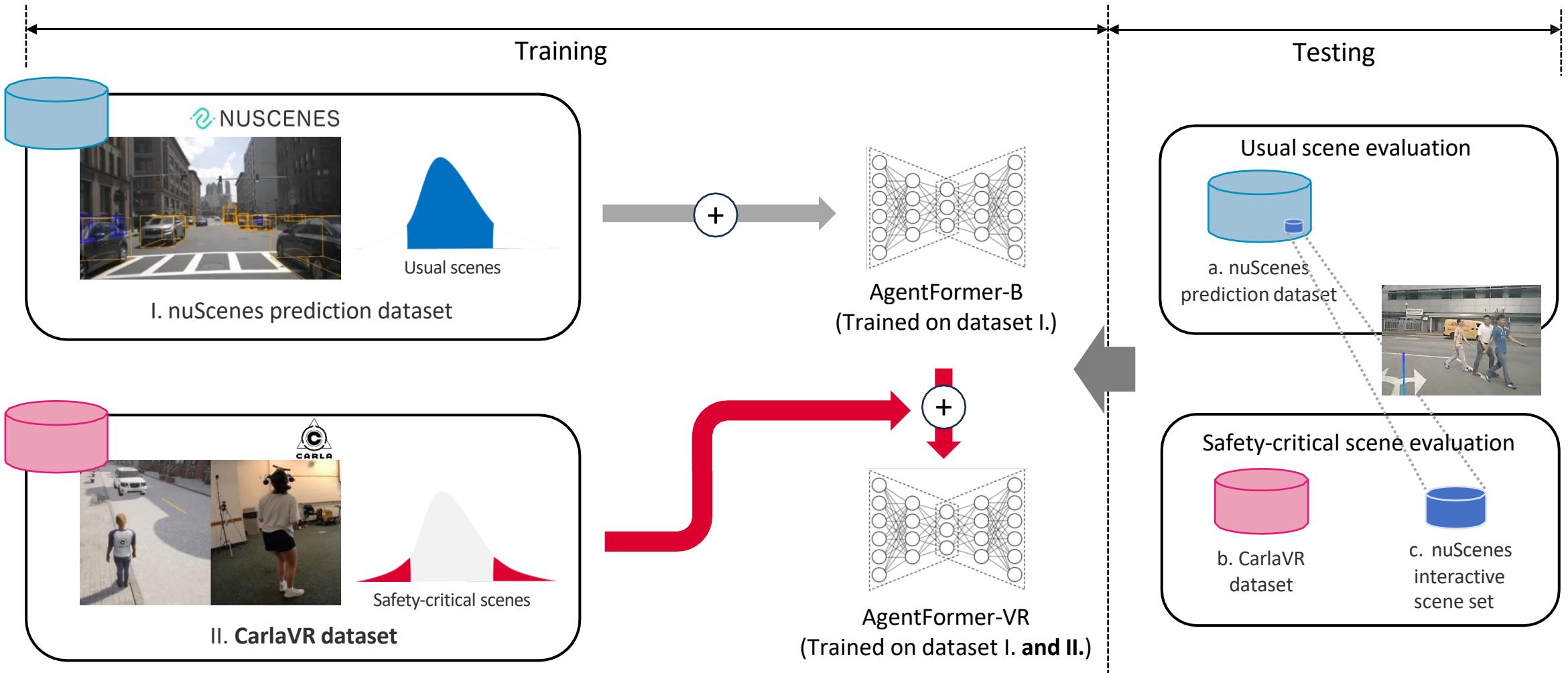
Parking lot

Gray: AD vehicle
Blue: VR pedestrian
Green: Parked car

- 80 participants
- 572 scenes
- 12702 frames
- 10-30s long in each scene

Evaluation - How to train/test?

Evaluated our hypothesis on trajectory forecasting task:



Qualitative result

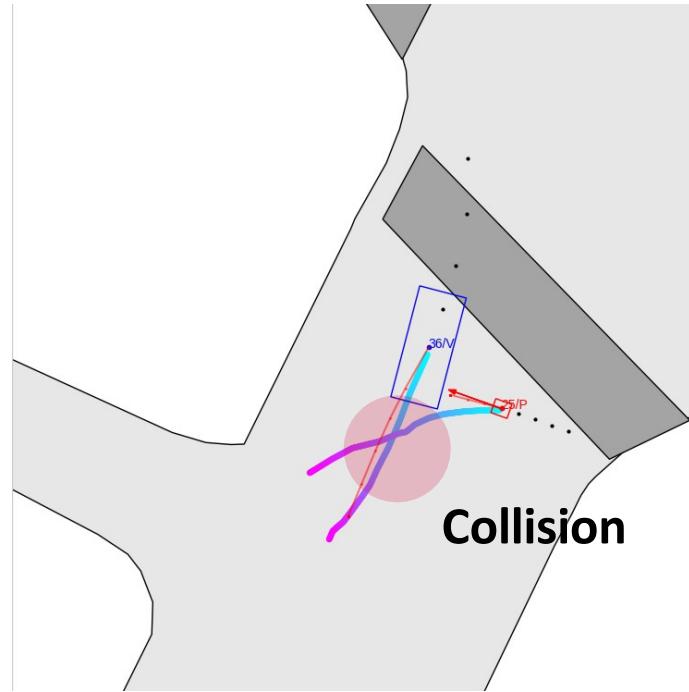
TABLE I
EVALUATION RESULT

Test Dataset	Model	Marginal XDE[m] (K=10)		Joint XDE[m] (K=10)		Collision rate[–] CR mean↓
		ADE↓	FDE↓	JADE↓	JFDE↓	
nuScenes-prediction	AgentFormer-B*	1.2299	2.7175	2.4023	5.9062	0.1275
	AgentFormer-VR**	1.4408	3.1088	2.7020	6.5288	0.1186
CARLA-VR	AgentFormer-B*	1.1404	2.7243	1.9274	5.1474	0.3266
	AgentFormer-VR**	0.9319	2.1491	1.6193	4.1201	0.2856
nuScenes-interaction	AgentFormer-B*	1.2712	2.8285	2.5995	6.4676	0.3170
	AgentFormer-VR**	1.1349	2.4637	2.2680	5.3770	0.3016

* AgentFormer trained on the nuScenes prediction dataset only

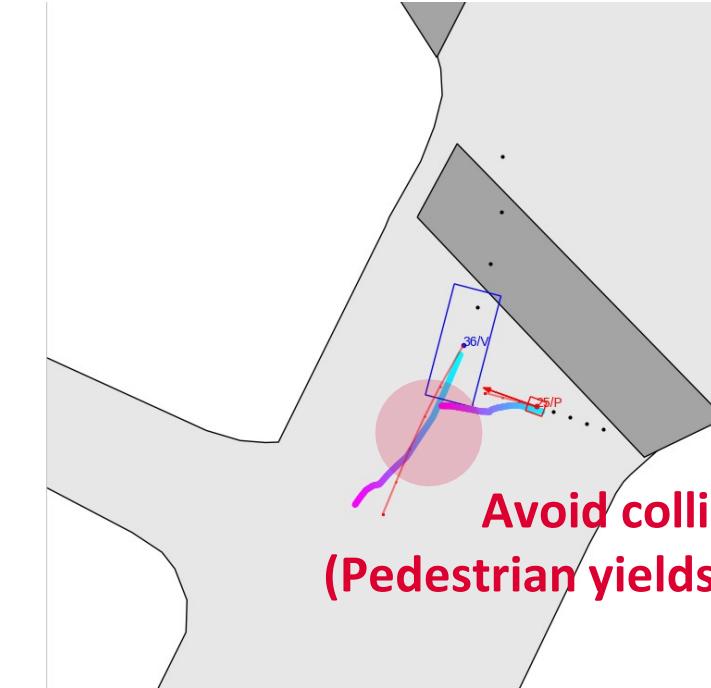
** AgentFormer trained on the nuScenes prediction dataset and the CARLA-VR dataset

Visualizations - Jaywalk



AgentFormer-B
(Trained on nuScenes prediction)

- : Past trajectory
- : Ground truth

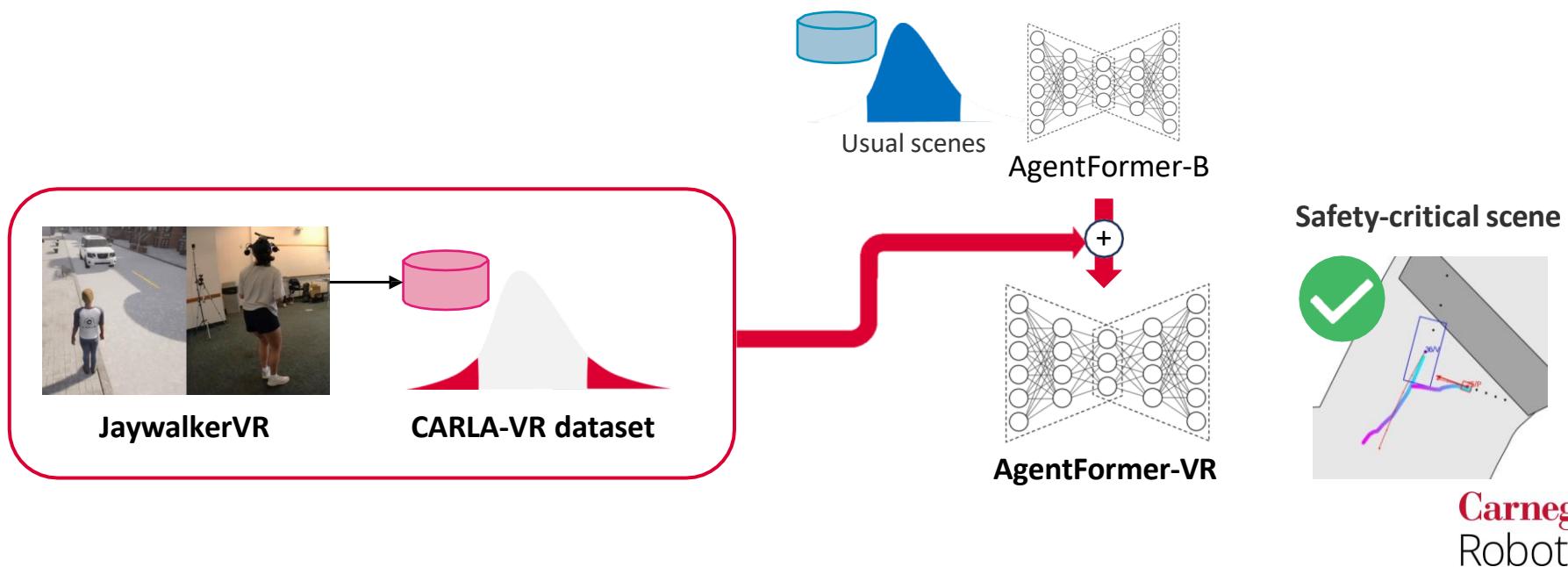


AgentFormer-VR
(Trained on nuScenes prediction & CARLA-VR)

- : Past trajectory
- : Ground truth

Summary

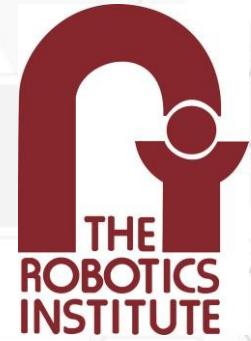
- **JaywalkerVR:** A VR-based simulator that can realistically simulate vehicle-pedestrian interaction
- **CARLA-VR dataset:** High-quality vehicle-pedestrian interaction dataset in safety-critical scenarios
- **AgentFormer-VR:** Significant performance improvement in highly-interactive scenes with fine-tuning on CARLA-VR dataset





ICRA 2024
May 13-18, Yokohama, Japan

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Thank you!

DENSO
Crafting the Core



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