



Horizon
Robotics



Pedestrian Collision Prediction Using a Monocular Camera

Shiyuan Chen, Xue Qin, Zeyd Boukhers, John See,
Wei Sui, Cong Yang

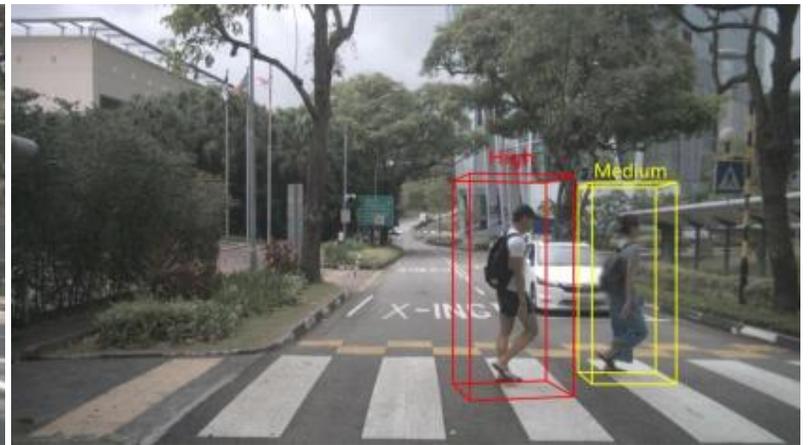
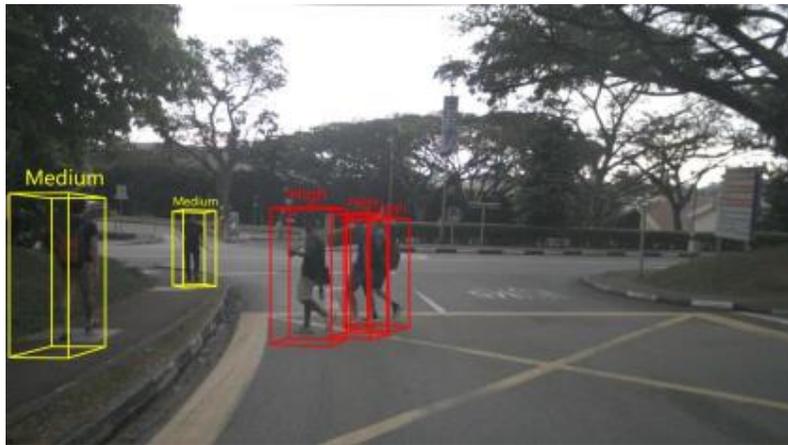
21. - 22. September 2023
Lübeck, Germany



Lübeck on September 21,
2023

What is Pedestrians Collision Warning?

- Calculates the location and movement of pedestrians based on automotive sensors
- Is critical components of **Advanced Driver Assistance System (ADAS)**
- Prevents more than 60% of rear-end collisions and traffic accidents caused by driver inattention

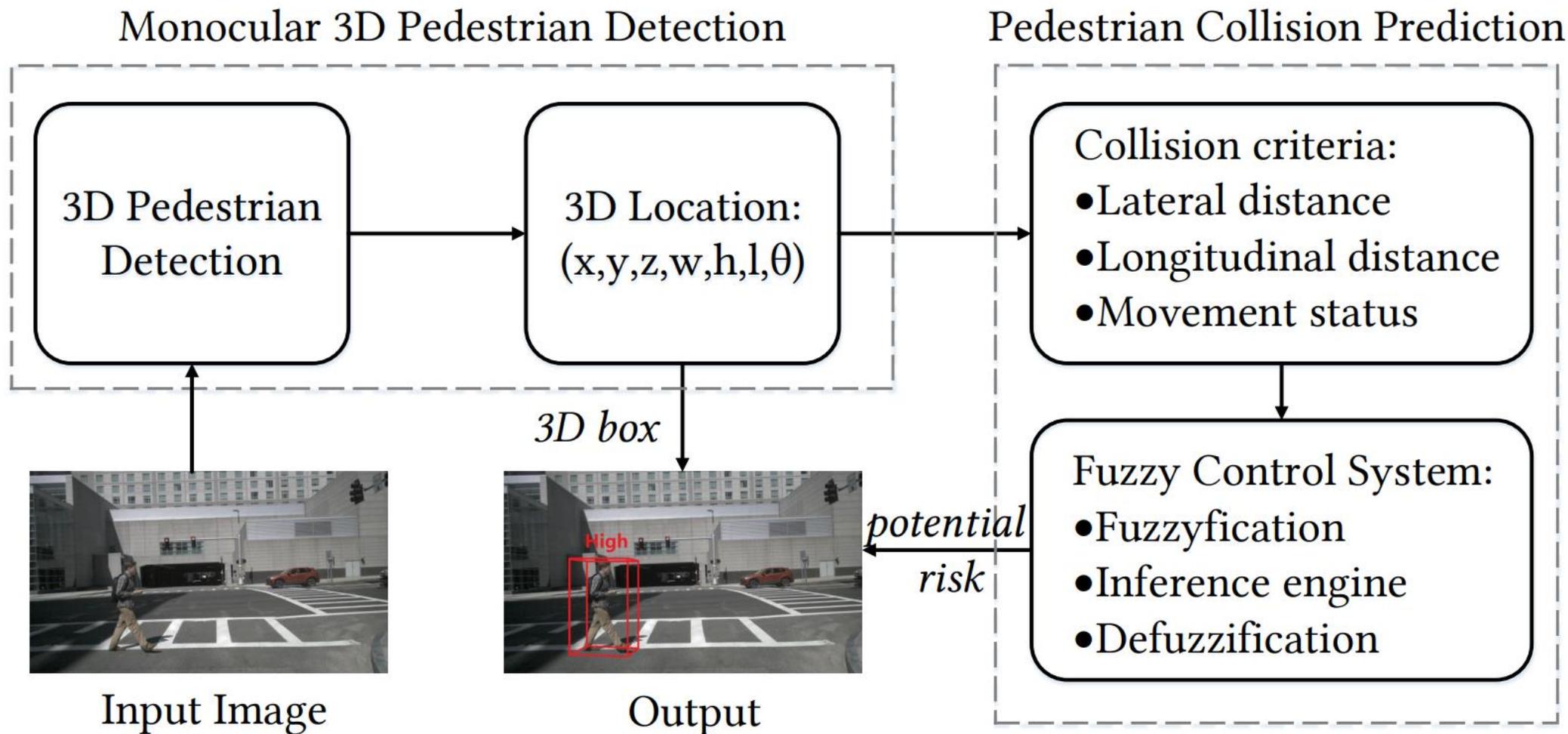


Sub-tasks:

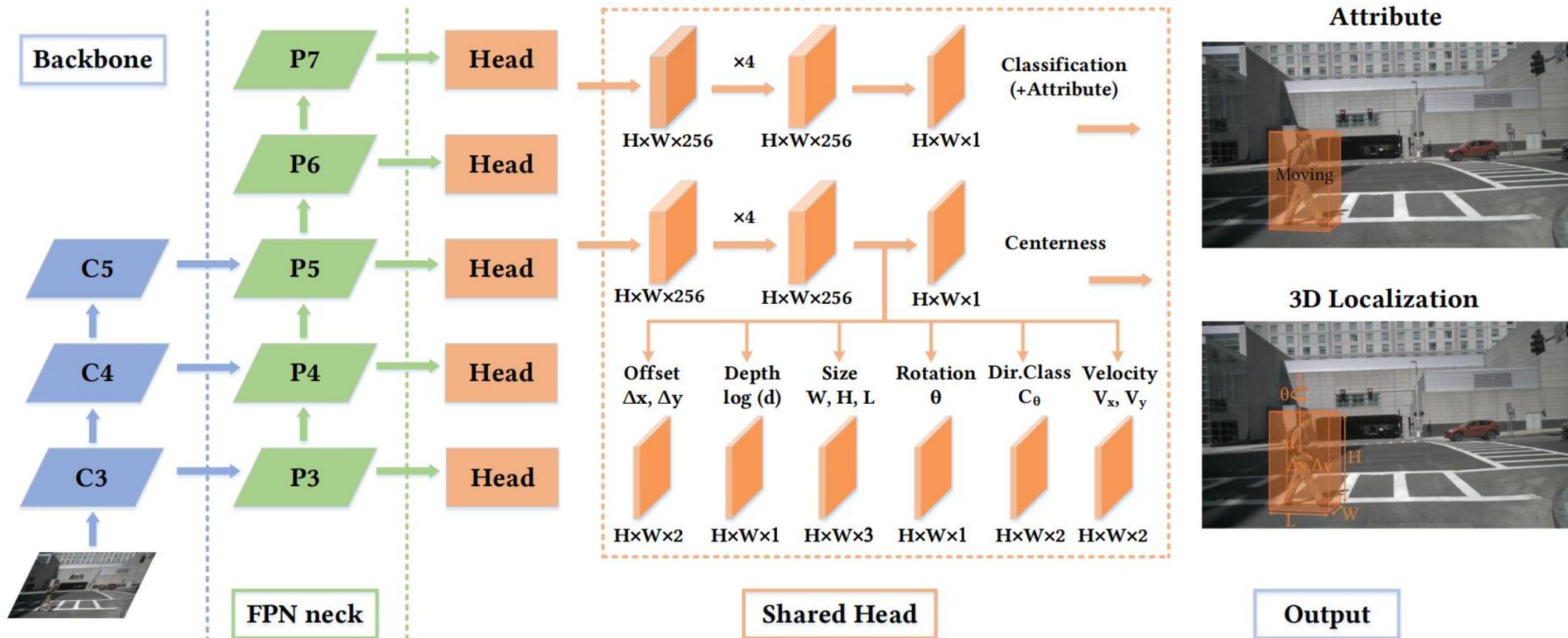
- Trajectory prediction
 - Time to Collision (TTC)
 - Pedestrian intention
 - ...
- **Complex**
 - Unnecessary system warning

Decision making

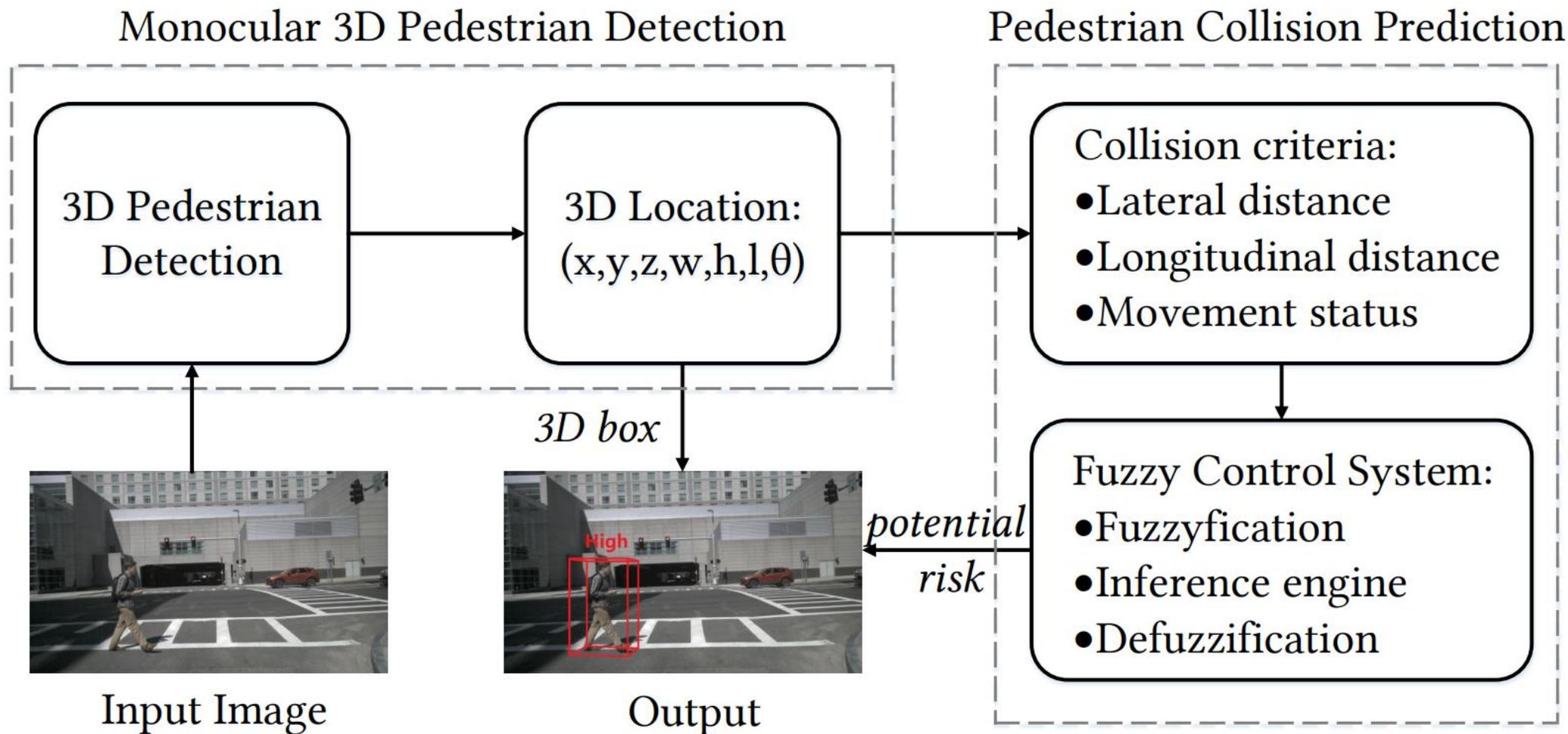
- Not just numerical values
 - Fuzzy semantic information
 - Distance: far/medium/close
 - ...
- **Qualitative understanding**
 - **More effective**



Contribution: *PedView*



[*] Wang, Tai, et al. "Fcos3d: Fully convolutional one-stage monocular 3d object detection." *Proceedings of the IEEE/CVF International Conference on Computer Vision*. 2021.



Collision Criteria:

- Lateral distance x_i
- Longitudinal d_i
- Movement status $attr_i$

Output: Hazard H_i

Fuzzyfication:

- x_i/d_i : {near, middle, far}
- $attr_i$: {moving, stationary}
- H_i : {low, medium, high}

nuScenes-collision

- Forward-looking camera
- 456 images

Scenarios:

- Pedestrians crossing crosswalks
- Pedestrians crossing roads
- Pedestrians walking or standing around cars

Pedestrian collision prediction on **nuScenes-collision**

Methods	Precision	Recall
DCR [6]	0.844	0.746
PedView	0.937	0.835

[6] Chen, Zhijun, et al. "Pedestrian-vehicular collision avoidance based on vision system." *17th International IEEE Conference on Intelligent Transportation Systems (ITSC)*. IEEE, 2014.

Pedestrian collision prediction on **nuScenes-collision**

Methods	Low	Medium	High
GT	376	623	70
DCR [6]	431	410	107
PedView	342	556	55

[6] Chen, Zhijun, et al. "Pedestrian-vehicular collision avoidance based on vision system." *17th International IEEE Conference on Intelligent Transportation Systems (ITSC)*. IEEE, 2014.

3D pedestrian detection on **nuScenes validation set**

Methods	Modality	AP	ATE (m)	AAE (1-acc)
PointPillars	L	0.6002	0.1739	0.0760
FCOS3D	C	0.4129	0.6818	0.1621
PedView	C	0.4284	0.6820	0.1664

Prediction



Ground Truth

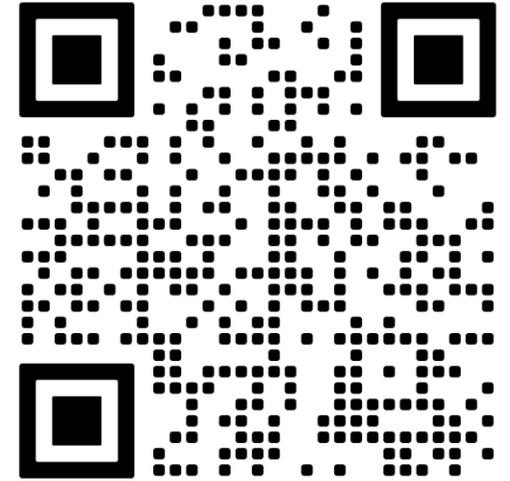


(a)

(b)

(c)

- A novel pedestrian collision prediction system tailored for Advanced Driver Assistance Systems (ADAS).
- Uses a monocular camera for 3D detection and incorporates pedestrian location and intent, outperforming distance-and-speed-only methods.
- Through the integration of a 3D detector and fuzzy rules, PedView achieves significantly improved prediction accuracy.
- Comprehensive experiments confirm PedView's potential as an efficient and reliable system for ADAS applications.



Code and data will be open-sourced:

<https://github.com/ChenShiyuan-csc/PedView>

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