KI WISSEN
Automotive AI Powered by Knowledge

1.14 Digital Twin Creation and Evaluation of Color-Dependent Object Detection

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Detection

Motivation

In Autonomes Valet Parking, a self-driving car operates autonomously in a controlled environment, testing the latest AI approaches. The Valeo AVP test site in Kronach uses static fisheye cameras for surveillance to enhance perception. To address potential failures and risks, our aim is to reinforce AVP with a simulation that identifies problematic scenarios and generates valuable insights.

World Generation

The environment's 3D model assets were created in Autodesk Revit [1] using blueprints from a high-density 3D laser scanner point cloud (Leica RTC360) [2].

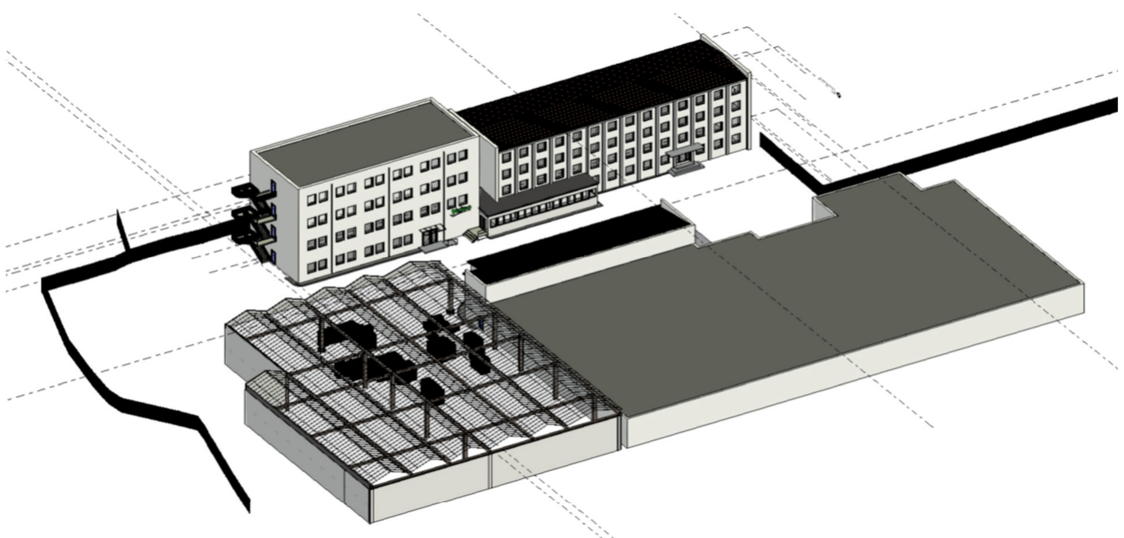

Figure 1: 3D Environment generation in Autodesk Revit (© Valeo)

The road is generated using Mathworks Roadrunner software, and it can be exported to OpenDRIVE and .fbx file formats.

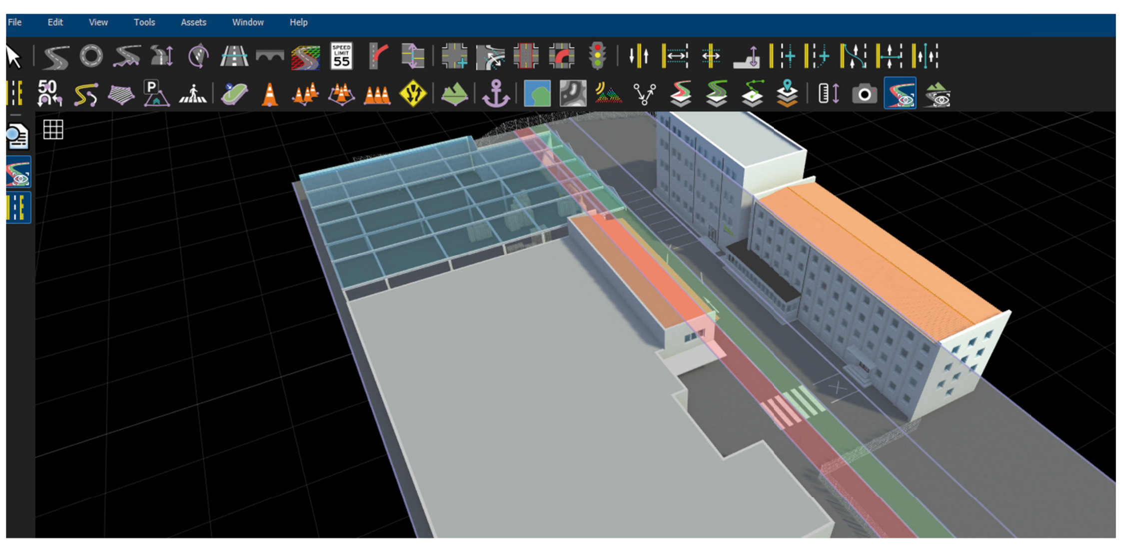

Figure 2: 3D Road generation in Mathworks Roadrunner (© Valeo)

VW Passat skeleton and Physical Asset for the Valeo test car were created using Blender [4].

Figure 3: Real-world Valeo testing car alongside a 3D car model generated in CARLA [5] (© Valeo)

Simulation Data Acquisition and Sensor Setup

A fisheye camera emulating the specific properties of its real counterpart is mounted and aligned at the desired spot in CARLA.

Figure 4: 3D Simulated and real world fisheye camera view (© Valeo)

Knowledge Extraction

By simulation we can explore scenarios which lead to a failure of the AI system and identify the exact root cause of the failure. One scenario in which the AI system gives inaccurate or false results is related to different car colors. The same car model on the same spot is detected with different detection confidences.

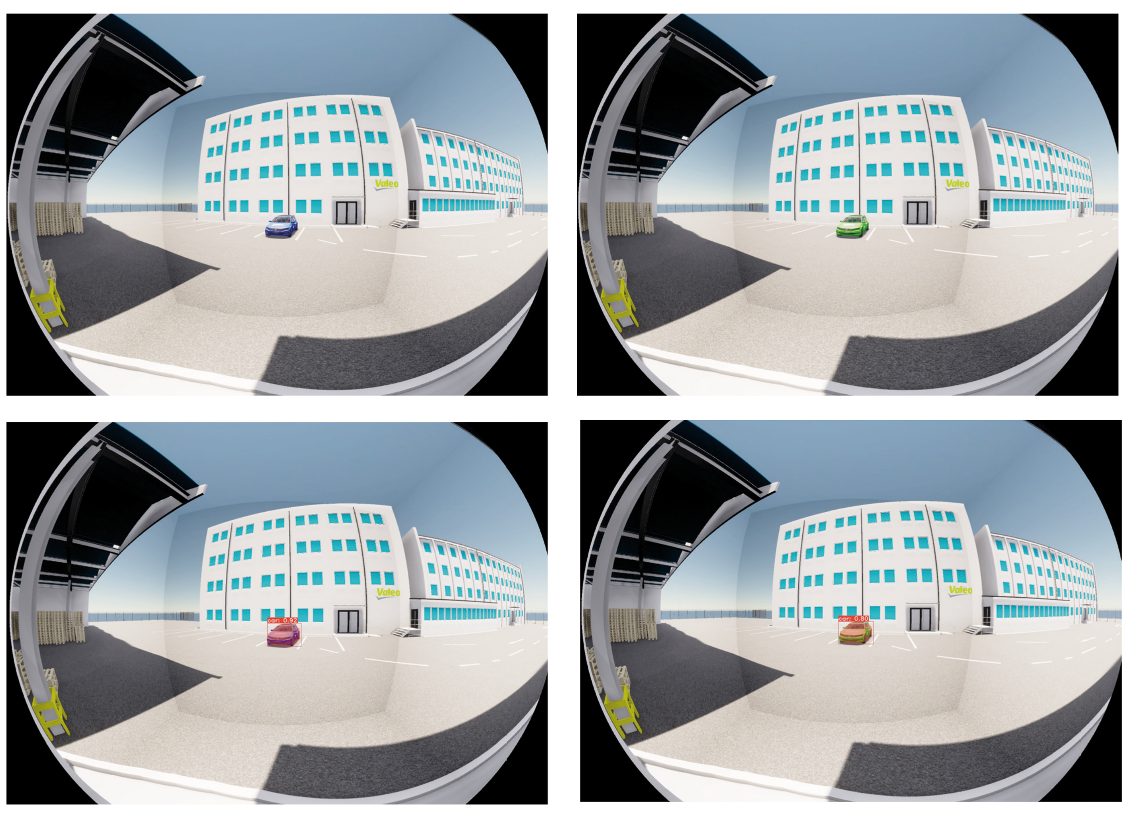

Figure 5: Car with blue and green color with Yolact detection [6] on simulated fisheye camera view (© Valeo)

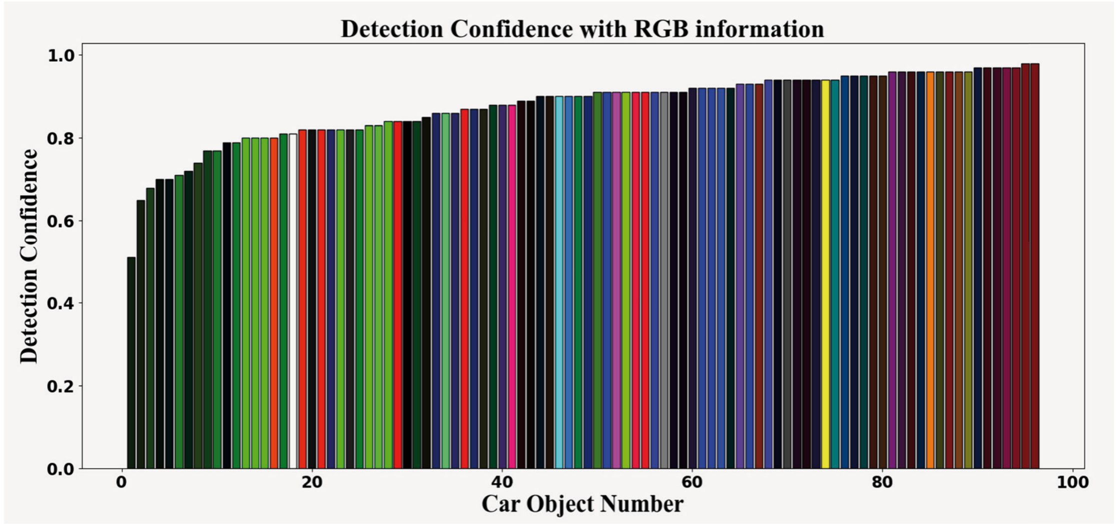

Figure 6: The object confidence distribution of the detected car upon varying its color (RGB value) yields the extracted knowledge (© Valeo)

References:

[1] https://www.autodesk.de/products/revit/overview (January 2024)
[2] https://leica-geosystems.com/de-ch/products/laser-scanners/scanners/leica-rtc360
[3] https://uk.mathworks.com/products/roadrunner.html (January 2024)
[4] https://www.blender.org/ (January 2024)
[5] A. Dosovitskiy et al. CARLA: An Open Urban Driving Simulator. Proceedings of the 1st Annual Conference on Robot Learning, in Proceedings of Machine Learning Research (2017)
[6] D. Bolya et al. YOLACT: Real-Time Instance Segmentation. Proceedings of the IEEE/CVF International Conference on Computer Vision (ICCV) (2019)

Partners

External partners

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KI Wissen is a project of the KI Familie. It was initiated and developed by the VDA Leitinitiative autonomous and connected driving and is funded by the Federal Ministry for Economic Affairs and Climate Action.

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Funded by the European Union NextGenerationEU

Supported by: Federal Ministry for Economic Affairs and Climate Action on the basis of a decision by the German Bundestag