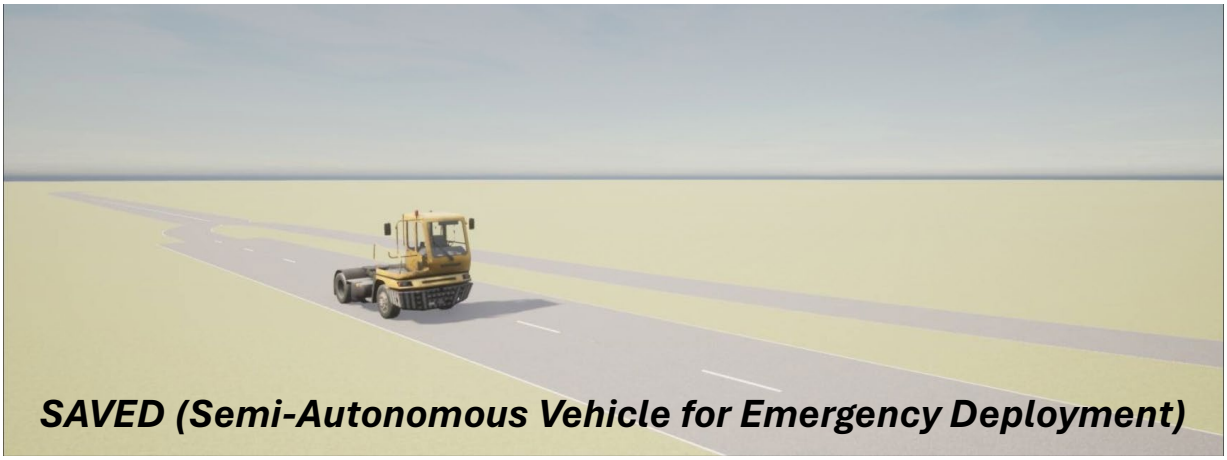


INTRODUCTION

We are a multidisciplinary student team from HAN University of Applied Sciences, working on the SAVED project. Our team aims to design and test a **system capable of smart navigation** in emergency zones using both **real and simulated** environments. The project was initiated by the XL Businesspark in Almelo with the aim of exploring automated truck deliveries from the port to the industries.

We collaborated closely with university coaches and used cutting-edge tools like **ROS2**, **CARLA simulator**, and **TurtleBot3** hardware powered by a **Raspberry Pi 5**.

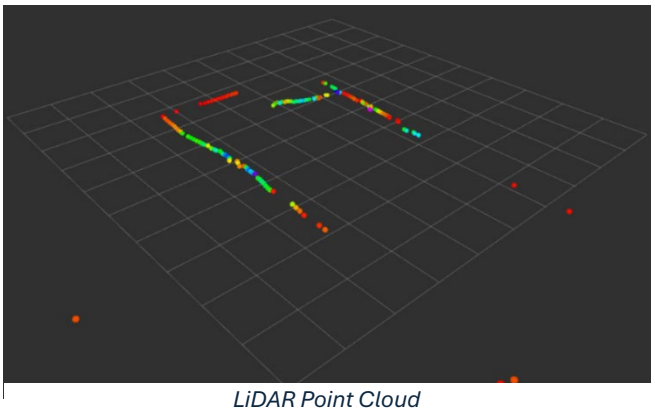
Our goal was to create a **robot** that could **dynamically respond** to its surroundings by **detecting obstacles** and **adjusting its path** in real time along with improved trailer electronics and automated fifth-wheel operation.

This was not just a fun challenge — in real-world situations, autonomous systems like these could save time, reduce human risk and effort, and bring critical tools or resources where they're most needed.

JOURNEY & LEARNINGS

We started with high ambitions and big questions: How do we reliably simulate a robot's environment? Can a **LiDAR**-equipped robot in the physical world share its insights with a virtual twin in CARLA — and vice versa?

We explored the following technical components:



LiDAR Point Cloud

- Used **ROS2** inside **CARLA**
- Created a ROS2 node for real-time processing of **LiDAR** data.
- Integrated camera-based **object detection** using open-source **Machine Learning** and LiDAR-based object **localization**
- Developed a system that could update paths in both the real and virtual environment whenever new obstacles appeared.

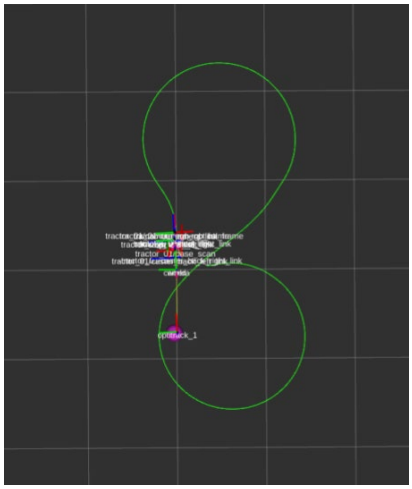
One key moment that changed our thinking: realizing that simulating a shared environment between virtual and real systems wasn't just cool — it was essential for scalable, low-cost testing. It taught us that automation isn't just about hardware; it's about building reliable, flexible ecosystems that evolve.

OUTCOME & IMPACT

We developed a semi-autonomous robot with a shared virtual-physical setup: a TurtleBot3-based physical vehicle connected with a CARLA-based digital twin.

This dual-environment setup opens up powerful possibilities:

- Emergency responders can test robot behavior in CARLA before deploying it physically.
- Developers can scale up without needing 10 real robots — just spin up 10 digital twins.
- The robot can handle dynamic environments with better resilience and adaptability.



Path Creation in CARLA

This work lays a foundation for testing based on digital twin in logistics, emergency services, etc. It could inspire similar systems for delivery, warehouse robots, or even urban planning tools. The ability to link real-time sensor feedback with a responsive digital world is a game-changer.