Simulation methods for autonomous vehicles – the concept of simulation in Gazebo

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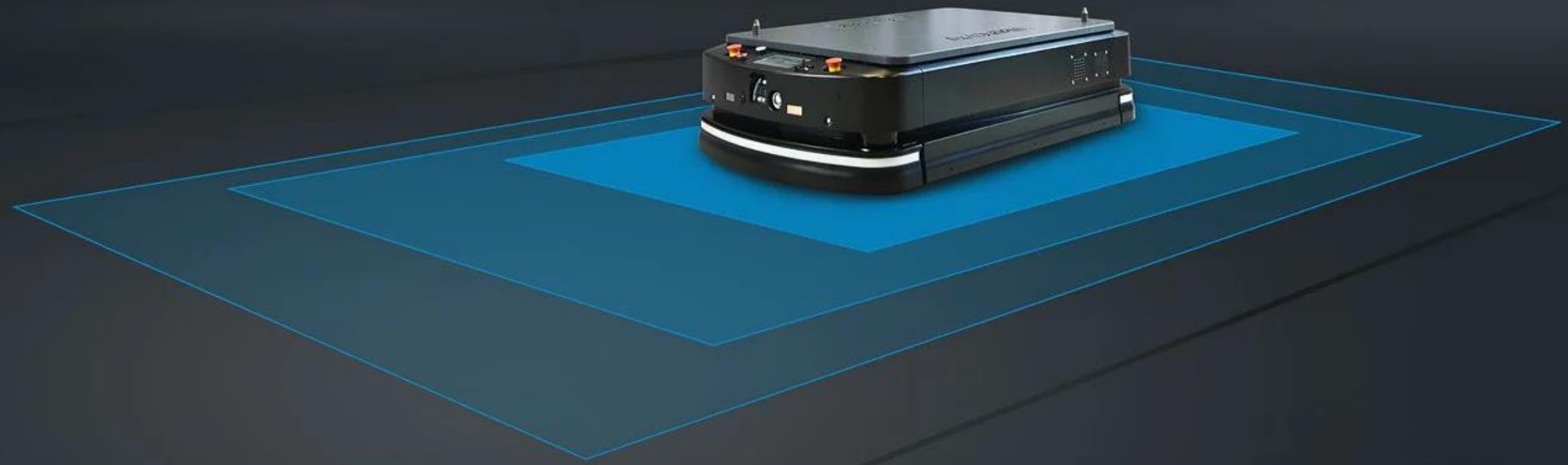


Agenda

- Who we are?
- Project tasks
- Simulation methods
- Our concept of AGV simulation environment
- Basic version of our solution
- Future plans
- Publications

Our team and interests

Jakub Szyguła

Dariusz Marek

- Embedded systems
- Drons simulators
- Networks research

Project tasks

- Literature review and analysis of simulation methods for Autonomous Guided Vehicles (State-of-the-Art)

- Development of simulation test environment for Autonomous Guided Vehicles (Assess the behavior of Automated Guided Vehicles in industry)

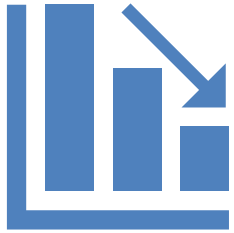
Project tasks

Analysis of the available simulation environments

The concept of the simulation methods for AGVs platforms for Industry 4.0

Preparation of the simulation methods for AGVs platforms

Why simulation methods?



Reducing the costs of designing, implementing and testing AGV systems

Protecting physical systems

Facilitating the planning of the logistics tasks

Assessment of the time required for the implementation in industry

Basic requirements for a simulation environments

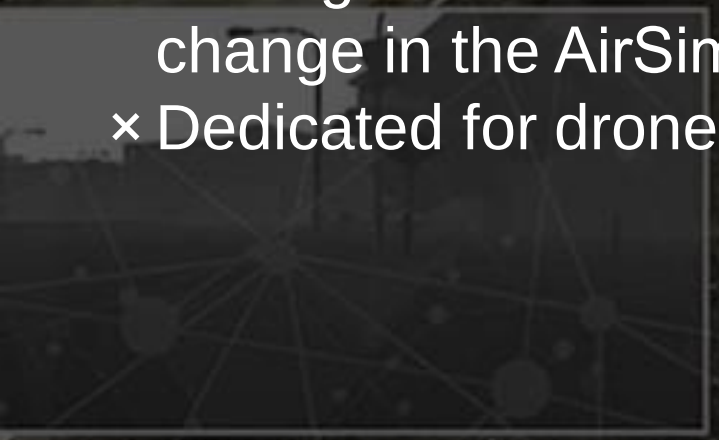
- Multiple vehicles
- LiDARs and cameras
- Physics and collision detection
- Simulation of the movements of people and other vehicles
- Simulation of the battery power consumption

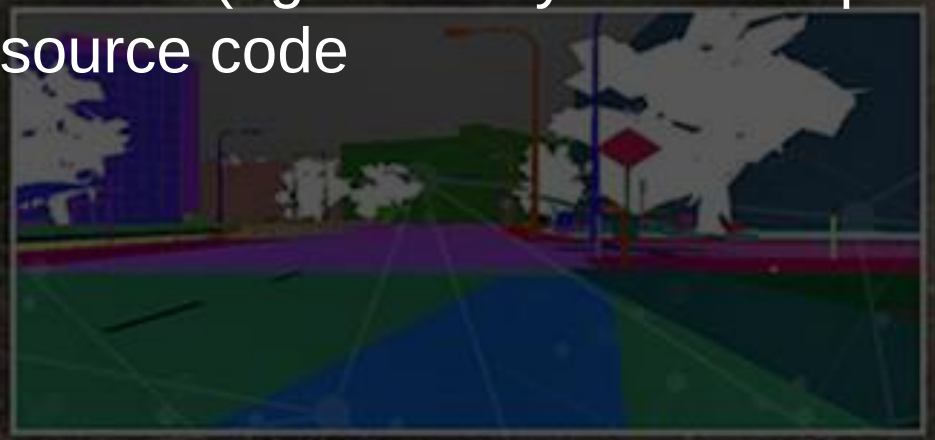
Available open-source simulation methods

- AirSim + Unreal Engine/Unity
- Carla
- Gazebo
- Own simulation environment

AirSim + Unreal Engine/Unity

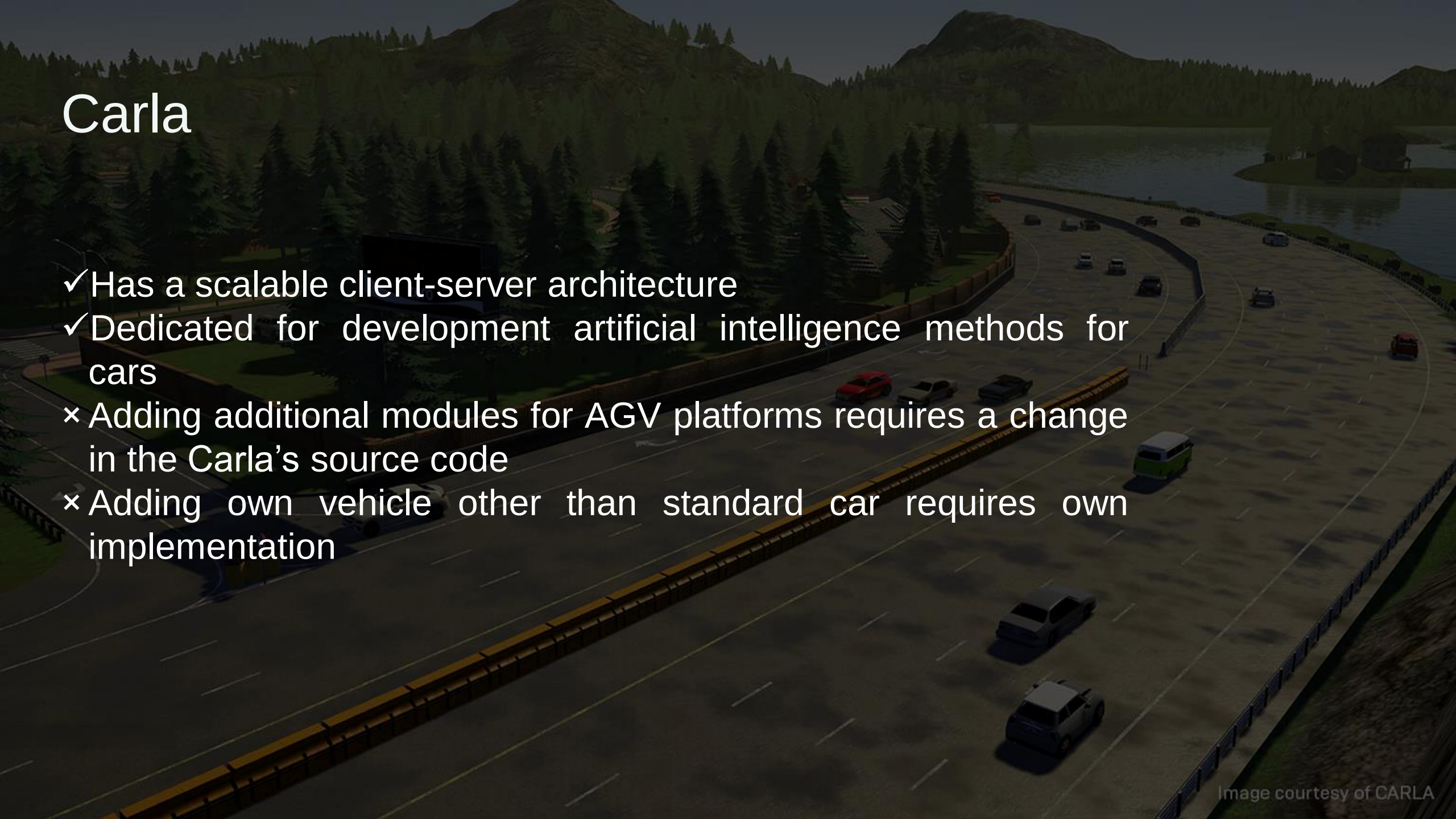
- ✓ Possible cooperation with the Unreal Engine and Unity
- ✓ Written in C++
- ✓ Controlling objects in the environment via a dedicated Python or C++ API interface
- ✓ Contains car physics model, LiDAR, radars, cameras and other sensors
- × Adding additional modules (eg. battery consumption) requires a change in the AirSim's source code
- × Dedicated for drones



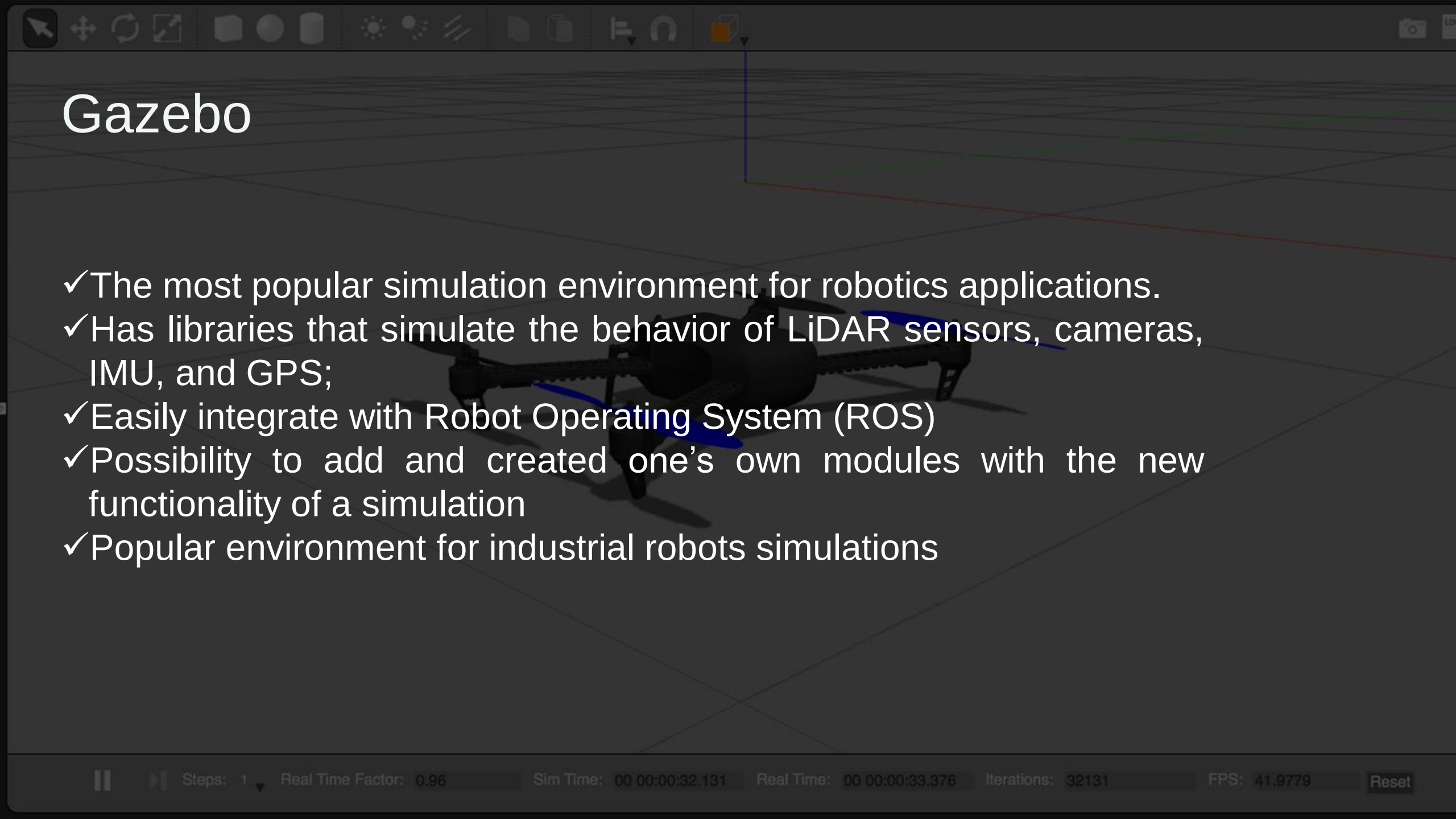


Carla

- ✓ Has a scalable client-server architecture
- ✓ Dedicated for development artificial intelligence methods for cars
- × Adding additional modules for AGV platforms requires a change in the Carla’s source code
- × Adding own vehicle other than standard car requires own implementation

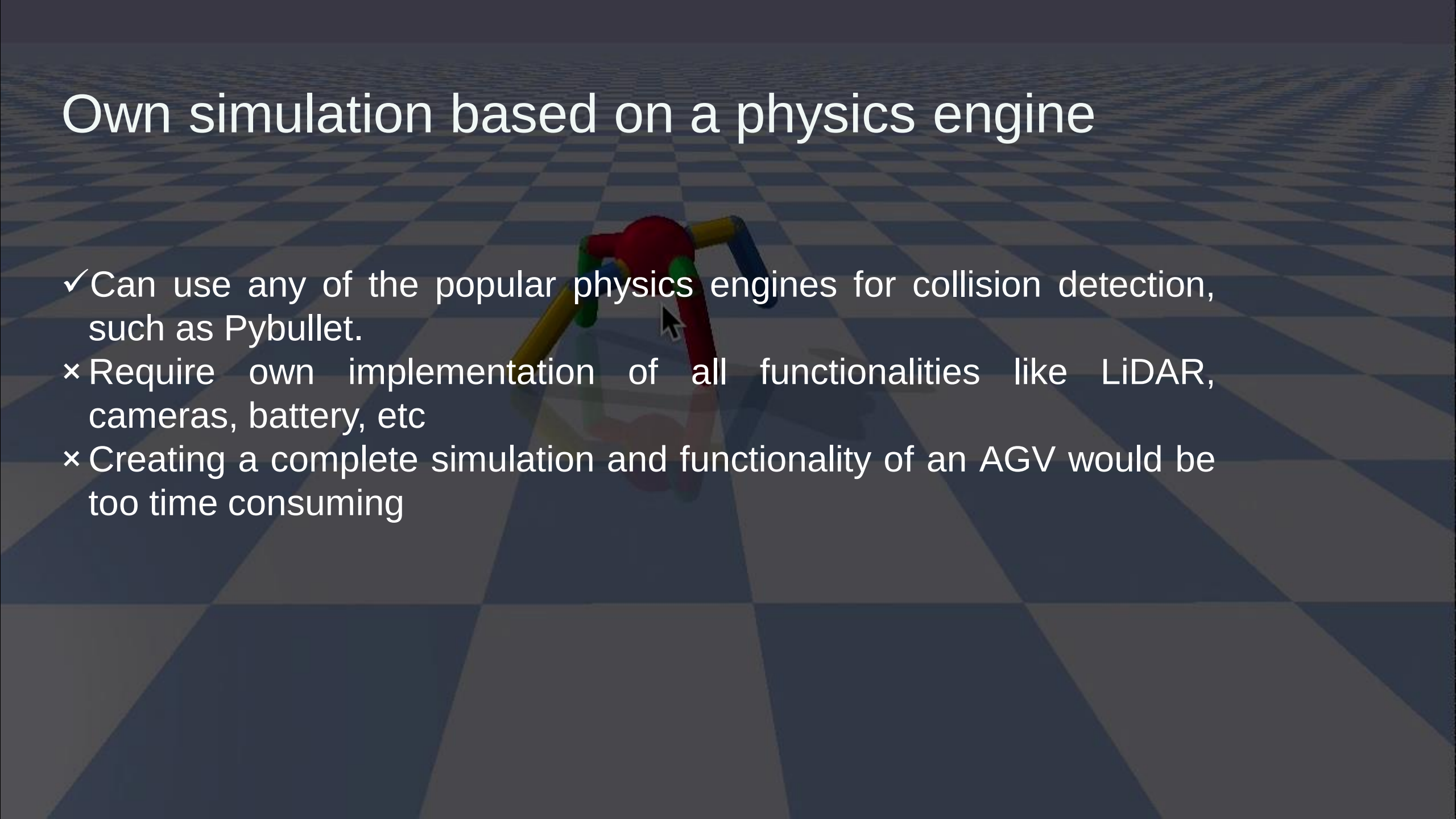


Gazebo



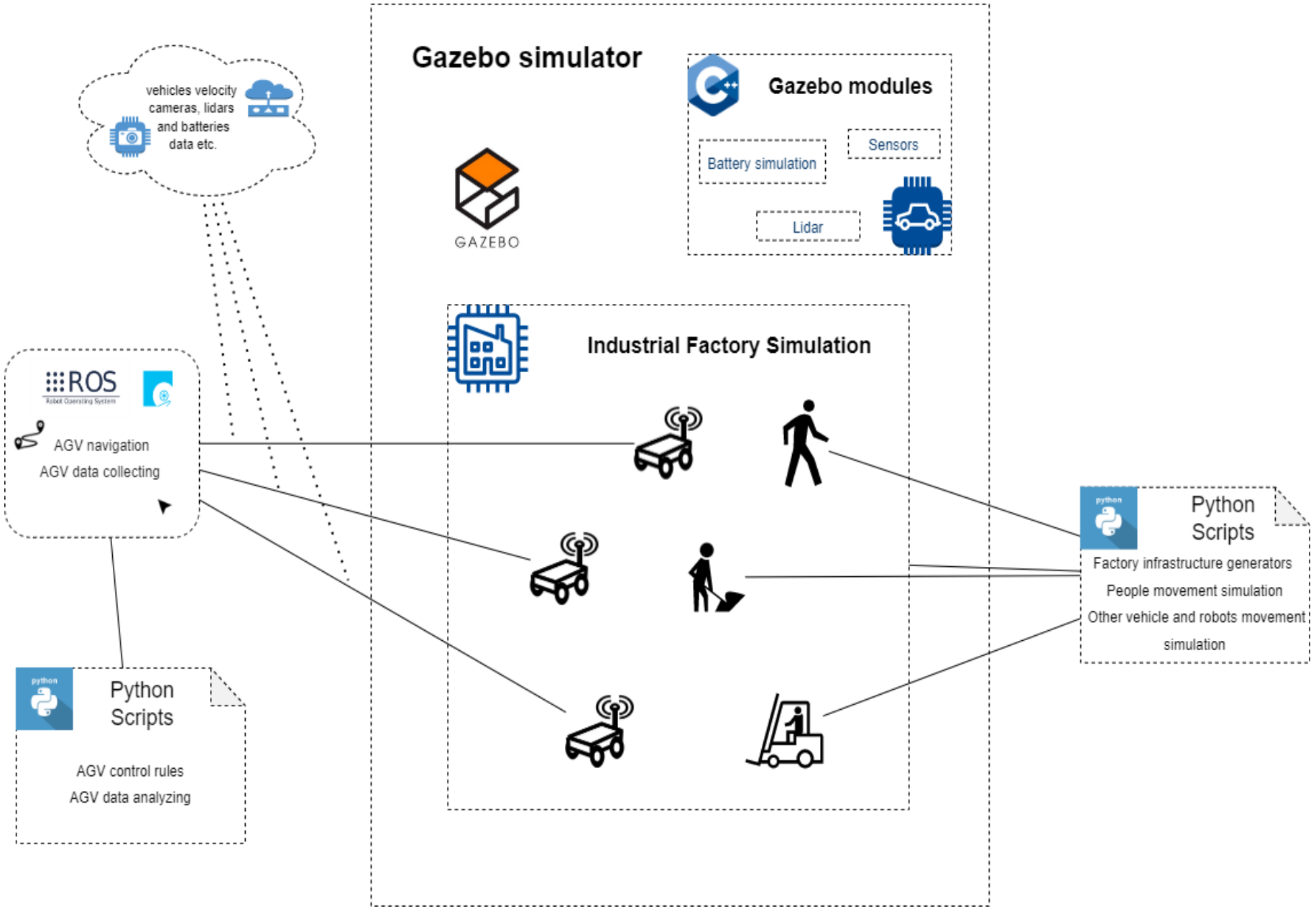
- ✓The most popular simulation environment for robotics applications.
- ✓Has libraries that simulate the behavior of LiDAR sensors, cameras, IMU, and GPS;
- ✓Easily integrate with Robot Operating System (ROS)
- ✓Possibility to add and created one’s own modules with the new functionality of a simulation
- ✓Popular environment for industrial robots simulations

Own simulation based on a physics engine



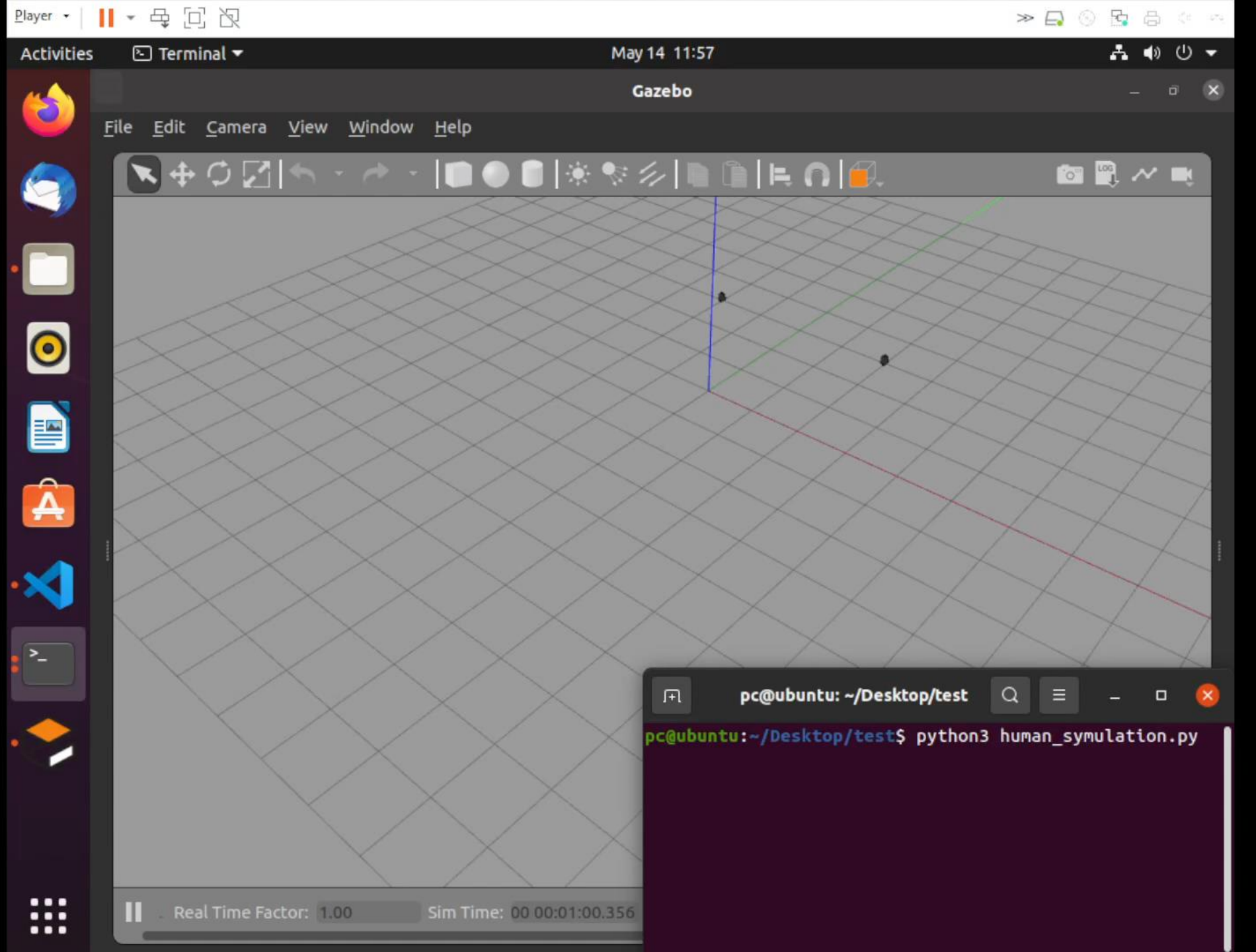
- ✓ Can use any of the popular physics engines for collision detection, such as Pybullet.
- × Require own implementation of all functionalities like LiDAR, cameras, battery, etc
- × Creating a complete simulation and functionality of an AGV would be too time consuming

The concept of the simulation methods for AGVs platforms



What do we have now?

- Simulation environment based on Gazebo Simulator
- Automatically generated map from points
- Multiple AGV’s movement simulation
- LiDAR on AGV’s to allows locating an obstacle
- Humans movement simulation
- Gathering the logs from the simulation environments:
  - number of AGV’s stops
  - time of AGV’s stops
  - time of AGV’s movements
  - time of simulation


Player
Activities
Terminal
May 14 11:57
Gazebo
File Edit Camera View Window Help
Real Time Factor: 1.00
Sim Time: 00 00:01:00.356
pc@ubuntu: ~/Desktop/test
pc@ubuntu:~/Desktop/test$ python3 human_symulation.py

Future plans

- Improvement human model and behaviour
- Adding a non-AGV vehicle model (adding other industrial platforms)
- Improvement of the AGV model movement
- Adjustment to the reality in the factory
- Improvement of the AGV navigation module
- Preparation of a more realistic simulation model with more logging functionalities
- Battery consumption simulation

Prepared publications

- Analysis of web-based geo-visualization methods applied for Automated Guided Vehicle using Satellite Navigation Systems (under review)
- General Concepts of a Simulation Method for Automated Guided Vehicle in Industry 4.0 (under review)

Thank you for your attention!