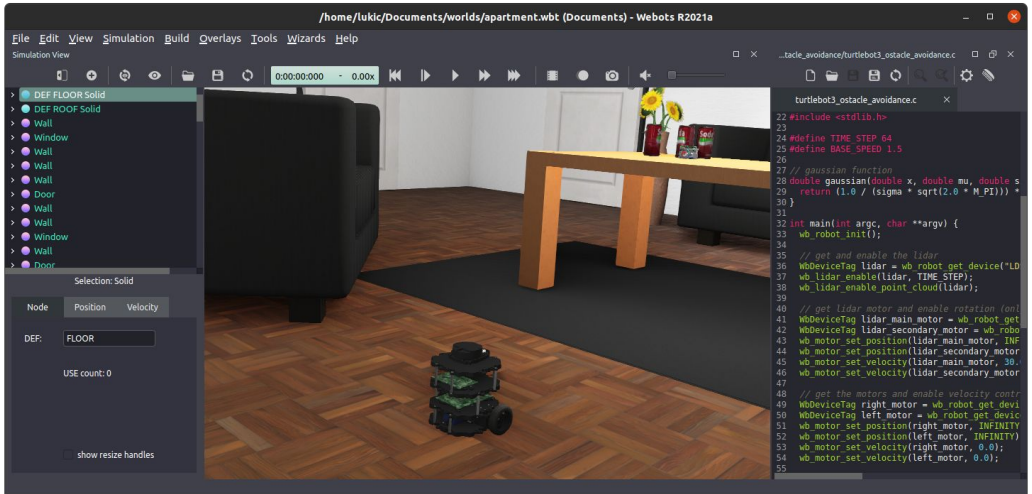
Webots

Open-source robot simulator



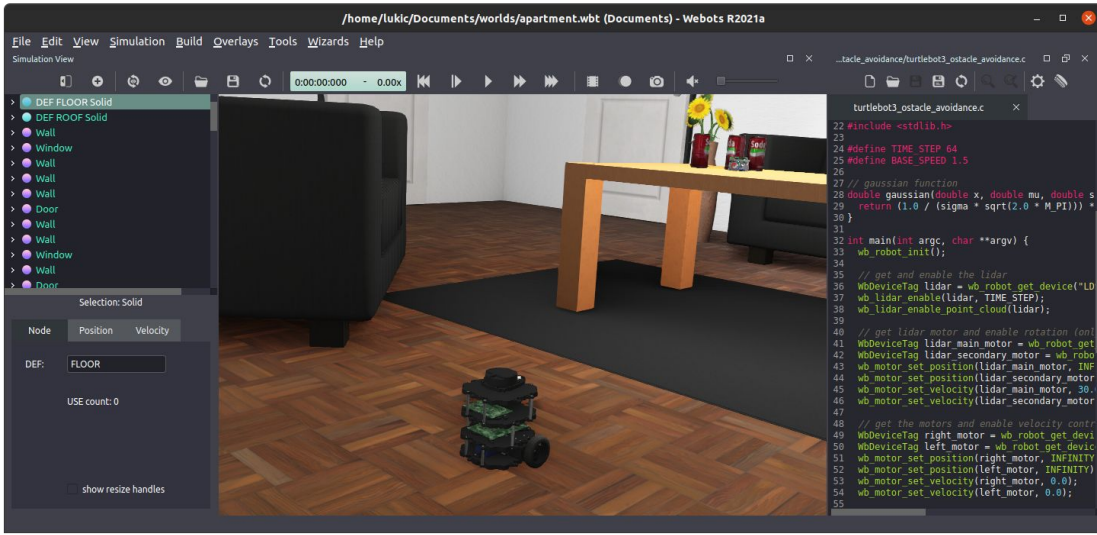
Company
Cyberbotics Ltd.

Presenter
Darko Lukić

Date
8. April 2021

Overview

- Fully-featured robot simulator
  - physics engine,
  - 3D rendering engine,
  - programming interface,
  - sensors and actuators,
  - robot builder,
  - robot models, and more.
- Open-source since december 2018
- Already 1,300+ stars on GitHub



Overview / Scene Tree

- Powerful world and robot editor
  - Complete design in UI
  - WYSIWYG (what you see is what you get)
  - Quick design iteration
- Meshes from Blender, Collada, STL, X3D, and more
- Robot can be exported as URDF

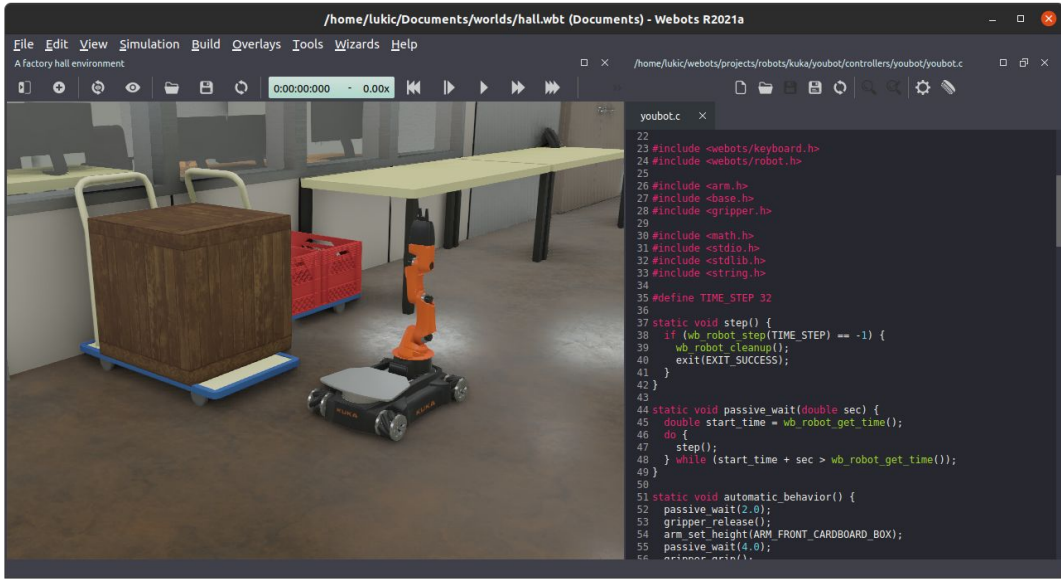
Overview / Realistic Simulations

- Visual
  - PBR appearances (metalness, roughness...) and shaders
- Physics
  - inertia matrix, center of mass, damping, backlash...
- High quality models

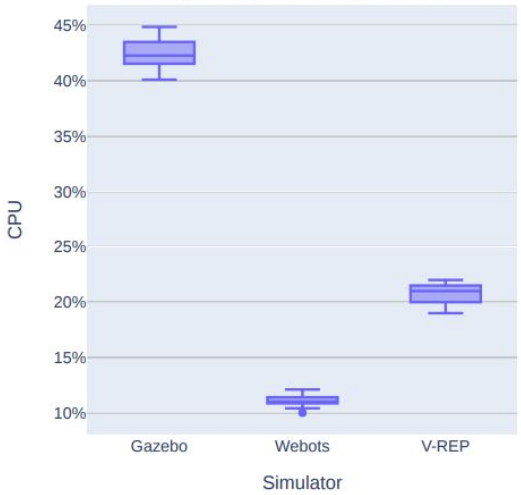
Overview / Programming Interface

Integrated programming interface:

C, C++, Java, MATLAB, ROS, and Python



Overview / Performance



Ayala, Angel, et al. "A Comparison of Humanoid Robot Simulators: A Quantitative Approach." arXiv preprint arXiv:2008.04627 (2020).

Hand-picked Features

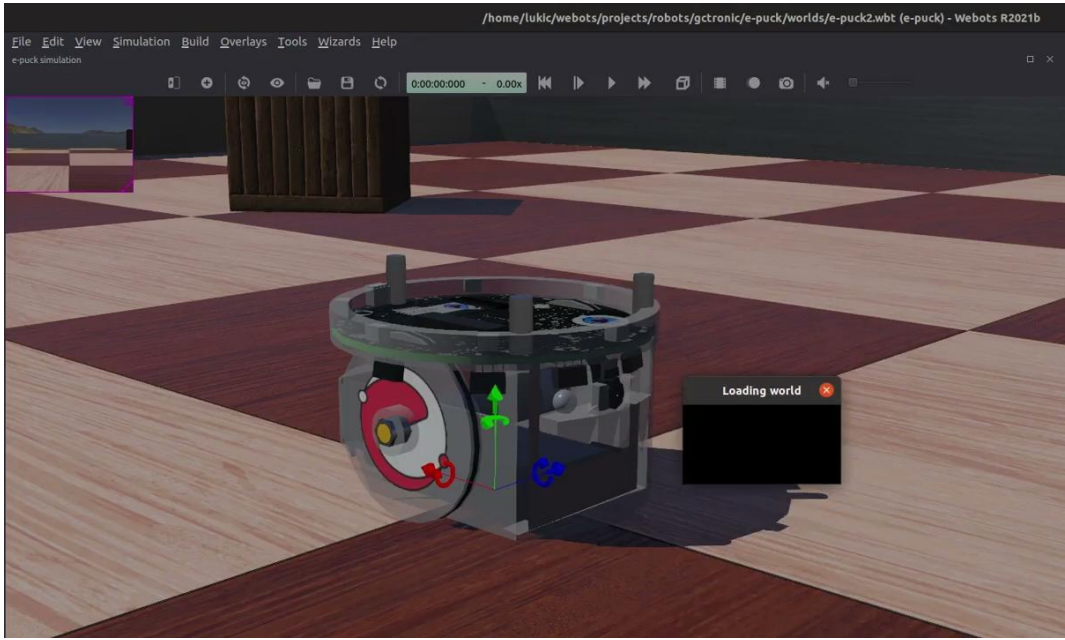
Getting started:

- Official tutorials: https://cyberbotics.com/doc/guide/tutorials
- Video tutorials: https://www.youtube.com/channel/UCrl9pLcAAKy8wuXkN-on3xQ (Google Summer of Docs)

I would like to show you some hand-picked features that may be of interest to you, to spark your creativity :)

Feature / Sample Worlds

- File > Open Sample World...
- Examples:
  - devices (sensors and actuators),
  - robots,
  - environments,
  - supervisor...



https://cyberbotics.com/doc/guide/sample-webots-applications · https://www.cyberbotics.com/doc/guide/samples-howto

Feature / Supervisor

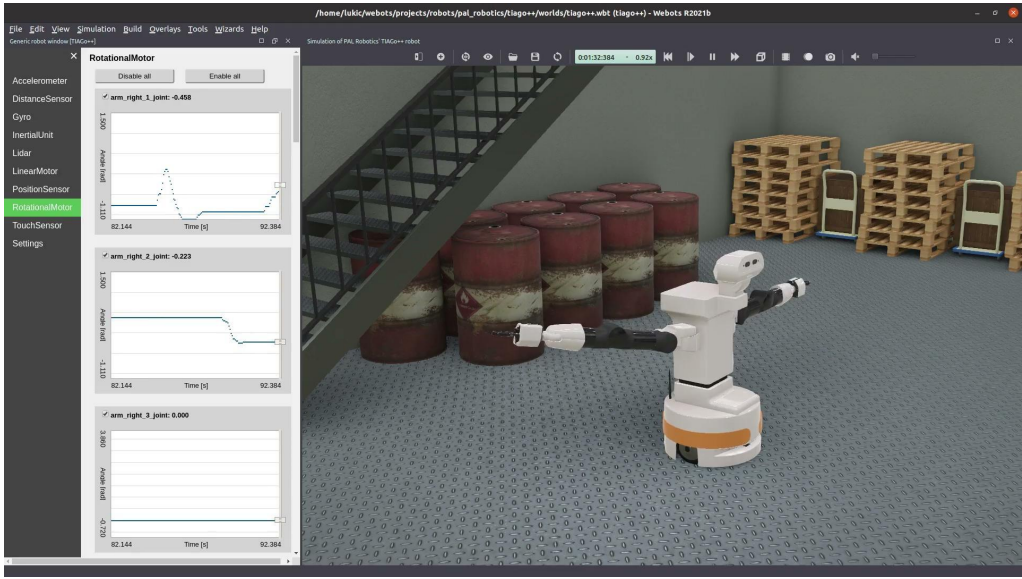
- Any robot can be a supervisor
- Supervisor can:
  - add/remove objects,
  - move objects,
  - apply force,
  - read object position and velocity,
  - control simulation (like reset),
  - retrieve contact points...

https://www.cyberbotics.com/doc/reference/supervisor

- Supervisor Functions
  - wb_supervisor_node_get_root
  - wb_supervisor_node_get_self
  - wb_supervisor_node_get_from_def
  - wb_supervisor_node_get_from_id
  - wb_supervisor_node_get_from_device
  - wb_supervisor_node_get_selected
  - wb_supervisor_node_get_def
  - wb_supervisor_node_get_id
  - wb_supervisor_node_get_parent_node
  - wb_supervisor_node_is_proto
  - wb_supervisor_node_get_from_proto_def
  - wb_supervisor_node_get_type
  - wb_supervisor_node_get_type_name
  - wb_supervisor_node_get_base_type_name
  - wb_supervisor_node_remove
  - wb_supervisor_node_get_field
  - wb_supervisor_node_get_proto_field
  - wb_supervisor_node_get_position
  - wb_supervisor_node_get_orientation
  - wb_supervisor_node_get_center_of_mass
  - wb_supervisor_node_get_contact_point
  - wb_supervisor_node_get_contact_point_node
  - wb_supervisor_node_get_number_of_contact_points
  - wb_supervisor_node_get_static_balance
  - wb_supervisor_node_get_velocity
  - wb_supervisor_node_set_velocity
  - wb_supervisor_node_reset_physics
  - wb_supervisor_node_restart_controller
  - wb_supervisor_node_move_viewpoint
  - wb_supervisor_node_set_visibility
  - wb_supervisor_node_add_force
  - wb_supervisor_node_add_force_with_offset
  - wb_supervisor_node_add_torque

Feature / Robot Window

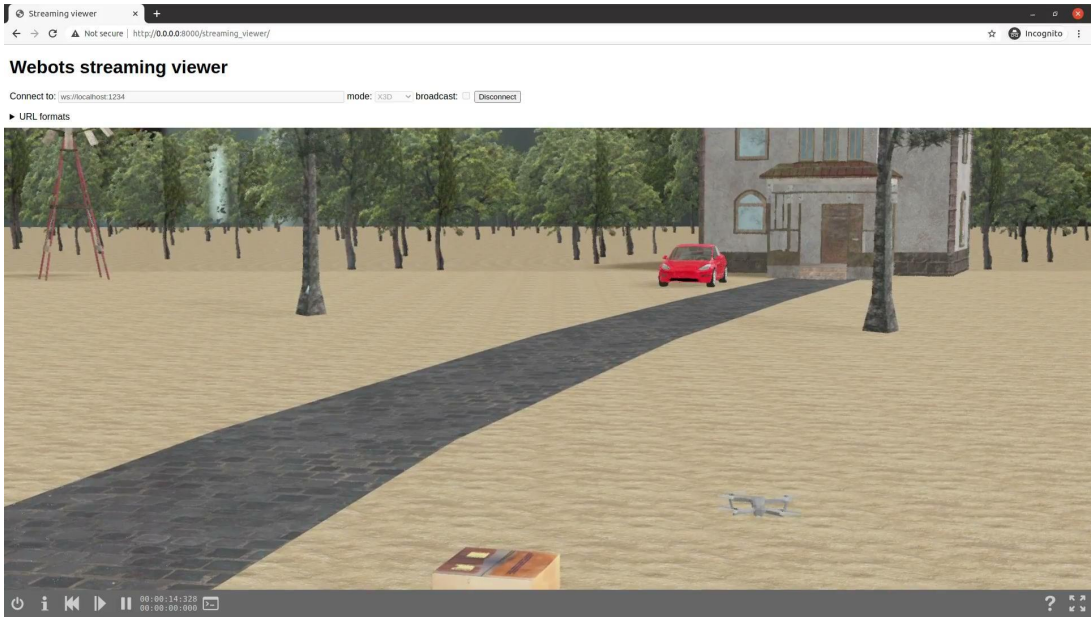
- Default one allows sensor readings and control
- You can make a custom robot window in HTML5/JavaScript (very simple)



https://cyberbotics.com/doc/guide/controller-plugin#robot-window

Feature / Streaming

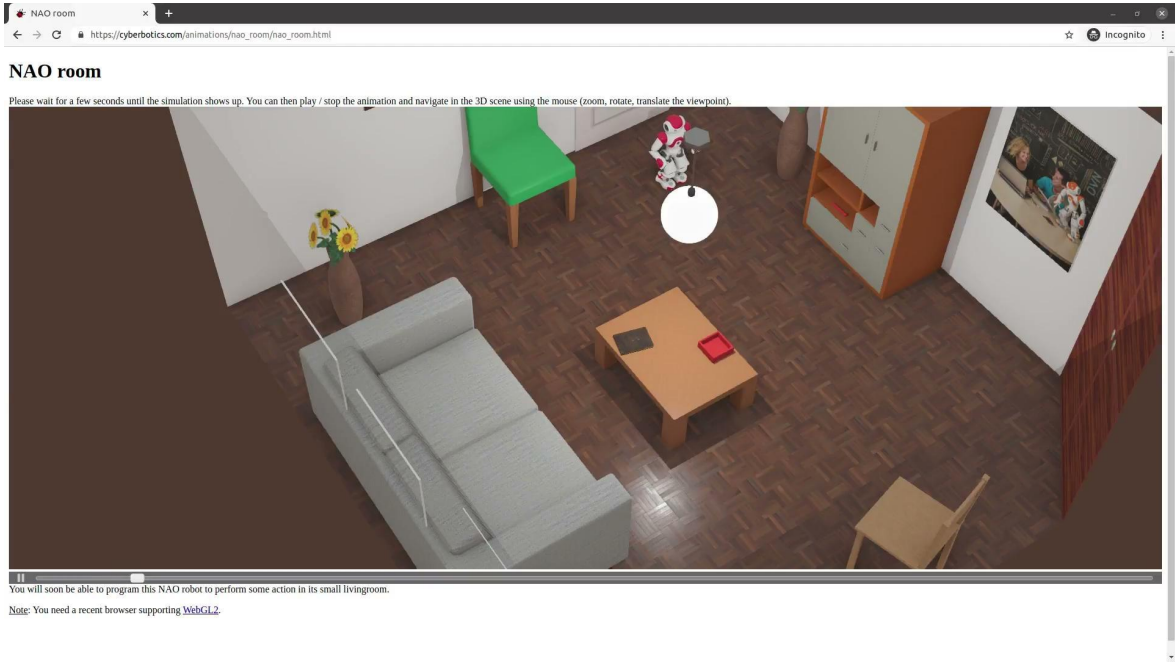
- Run `webots --stream` to open the simulation in the browser
- Featured at: robotbenchmark.net



https://cyberbotics.com/doc/guide/web-streaming

Feature / HTML5 Export

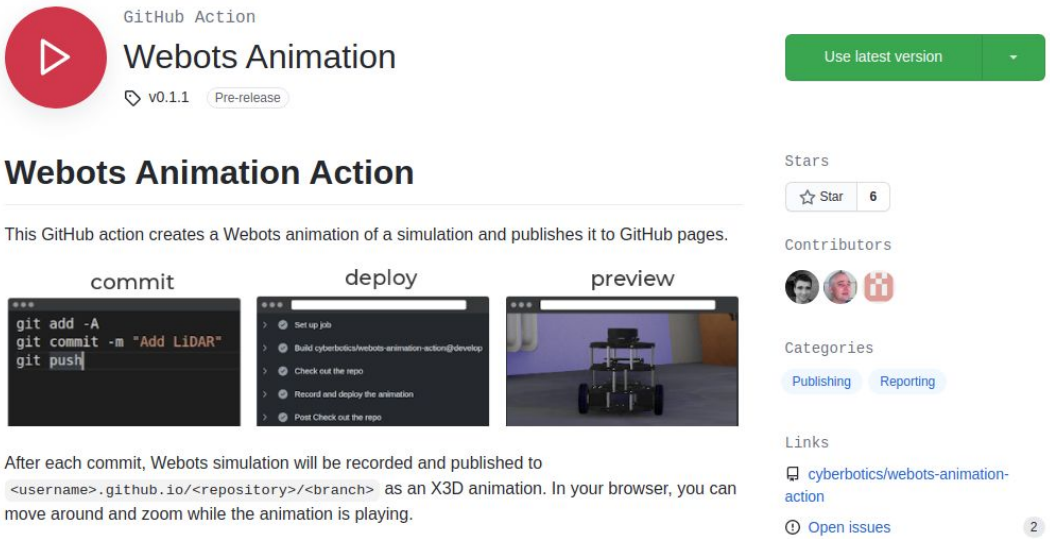
- File > Export HTML5 Model...
- HTML5 page that you can host



https://cyberbotics.com/animations/nao_room/nao_room.html

Feature / GitHub Action

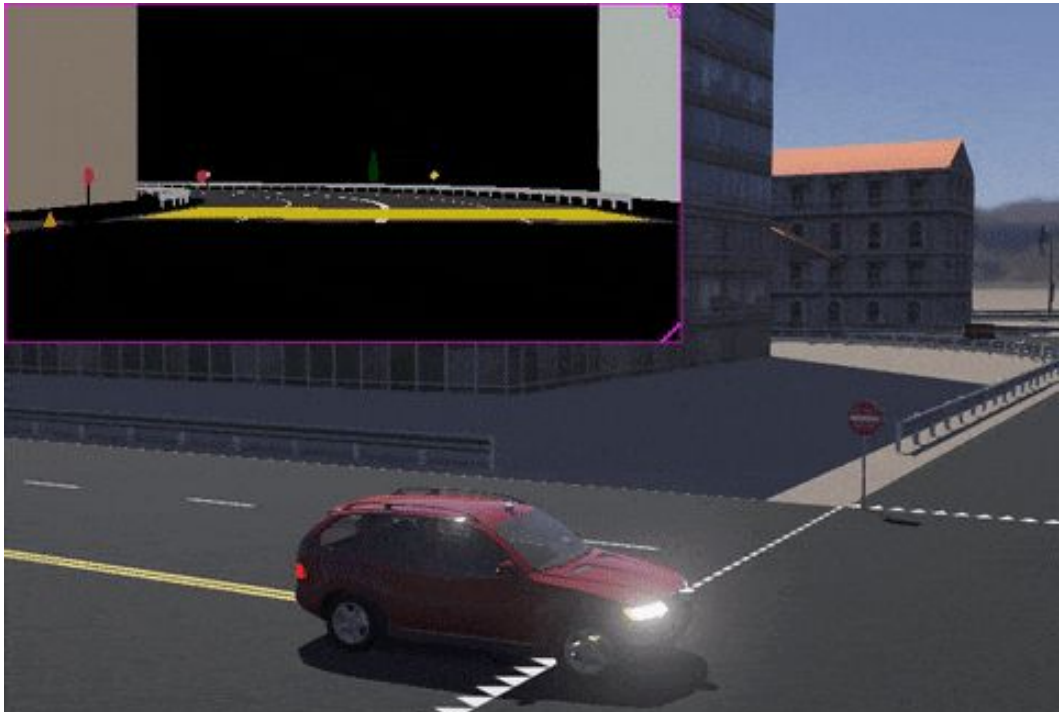
- Makes it easier to run unit tests in CI
- Automatically generates an animation and publishes it to GitHub Pages



https://github.com/marketplace/actions/webots-animation · https://github.com/lukicdarkoo/webots-example-visual-tracking

Feature / Camera Segmentation

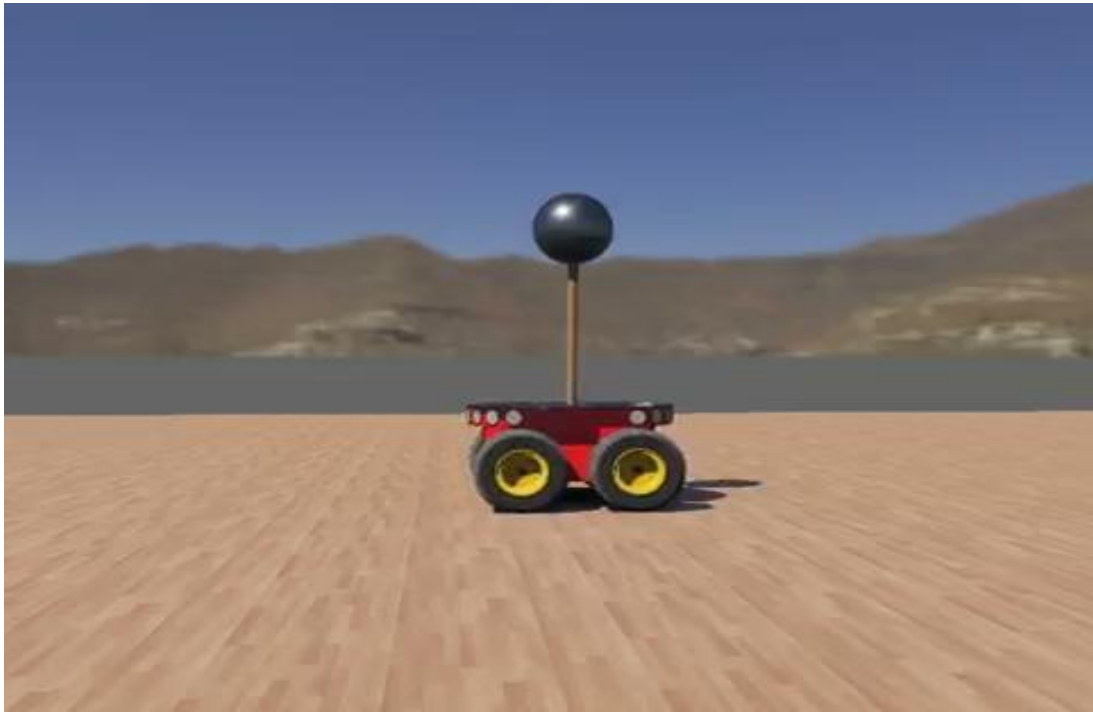
- Generates ground truth segmentation



https://cyberbotics.com/doc/reference/camera#wb_camera_recognition_has_segmentation

Feature / Reinforcement Learning

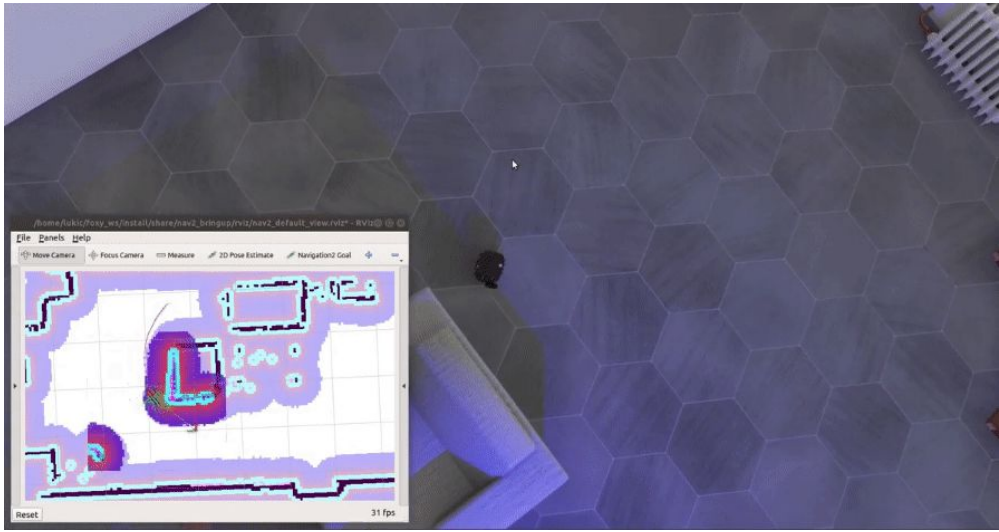
- OpenAI Gym interface
- Compatible with stable-baselines3



https://www.cyberbotics.com/doc/guide/samples-howto?version=master#openai_gym-wbt · https://github.com/aidudezzz/deepbots

Feature / ROS 2

- **Webots ROS 2 translation** layer — e.g. automatically creates ROS 2 interface from Webots robot model
- **Examples** with:
  - ground mobile robots,
  - robotic arms (with MoveIt),
  - drone, and
  - vehicle.
- Multirobot support
- URDF to Webots PROTO converter



https://github.com/cyberbotics/webots_ros2

Plans

- Better ROS 2 Support
  - *ros2_control* integration
  - URDF importer
- Better web support
  - rendering engine in WebAssembly (with shaders)
  - share a simulation in a single click
  - competitions
- Better reinforcement learning support
  - more tools for interfacing with deep learning frameworks (OpenDR EU project)
  - deployment on HPC with CPU/GPU/FPGA acceleration (OPTIMA EU project)

https://github.com/cyberbotics/webots/pull/2769 · https://github.com/cyberbotics/webots-competition-organizer-template

Discussion...

Ask me anything!

Community:
https://discord.com/invite/nTWbN9m

Project:
https://github.com/cyberbotics/webots

Business inquires:
support@cyberbotics.com