Conde_Simulator

(Autonomous Driving Simulator)

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Context

- Autonomous Driving
- Portuguese Robotics Open (Festival Nacional de Robótica)
- Autonomous Driving Competition at *Portuguese Robotics Open*

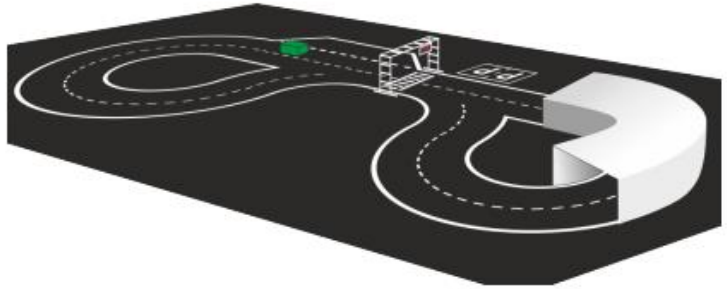
Levels of Autonomy

- http://www.techrepublic.com/article/autonomous-driving-levels-0-to-5-understanding-the-differences/
- https://www.wired.com/2016/08/self-driving-car-levels-sae-nhtsa/

- **Level 0:** This one is pretty basic. The driver (human) controls it all: steering, brakes, throttle, power. It's what you've been doing all along.
- **Level 1:** This driver-assistance level means that most functions are still controlled by the driver, but a specific function (like steering or accelerating) can be done automatically by the car.
- **Level 2:** In level 2, at least one driver assistance system of "both steering and acceleration/ deceleration using information about the driving environment" is automated, like cruise control and lane-centering. It means that the "driver is disengaged from physically operating the vehicle by having his or her hands off the steering wheel AND foot off pedal at the same time," according to the SAE. The driver must still always be ready to take control of the vehicle, however.
- **Level 3:** Drivers are still necessary in level 3 cars, but are able to completely shift "safety-critical functions" to the vehicle, under certain traffic or environmental conditions. It means that the driver is still present and will intervene if necessary, but is not required to monitor the situation in the same way it does for the previous levels. Jim McBride, autonomous vehicles expert at Ford, said this is "the biggest demarcation is between Levels 3 and 4." He's focused on getting Ford straight to Level 4, since Level 3, which involves transferring control from car to human, can often pose difficulties. "We're not going to ask the driver to instantaneously intervene—that's not a fair proposition," McBride said.
- **Level 4:** This is what is meant by "fully autonomous." Level 4 vehicles are "designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip." However, it's important to note that this is limited to the "operational design domain (ODD)" of the vehicle—meaning it does not cover every driving scenario.
- **Level 5:** This refers to a fully-autonomous system that expects the vehicle's performance to equal that of a human driver, in every driving scenario—including extreme environments like dirt roads that are unlikely to be navigated by driverless vehicles in the near future.

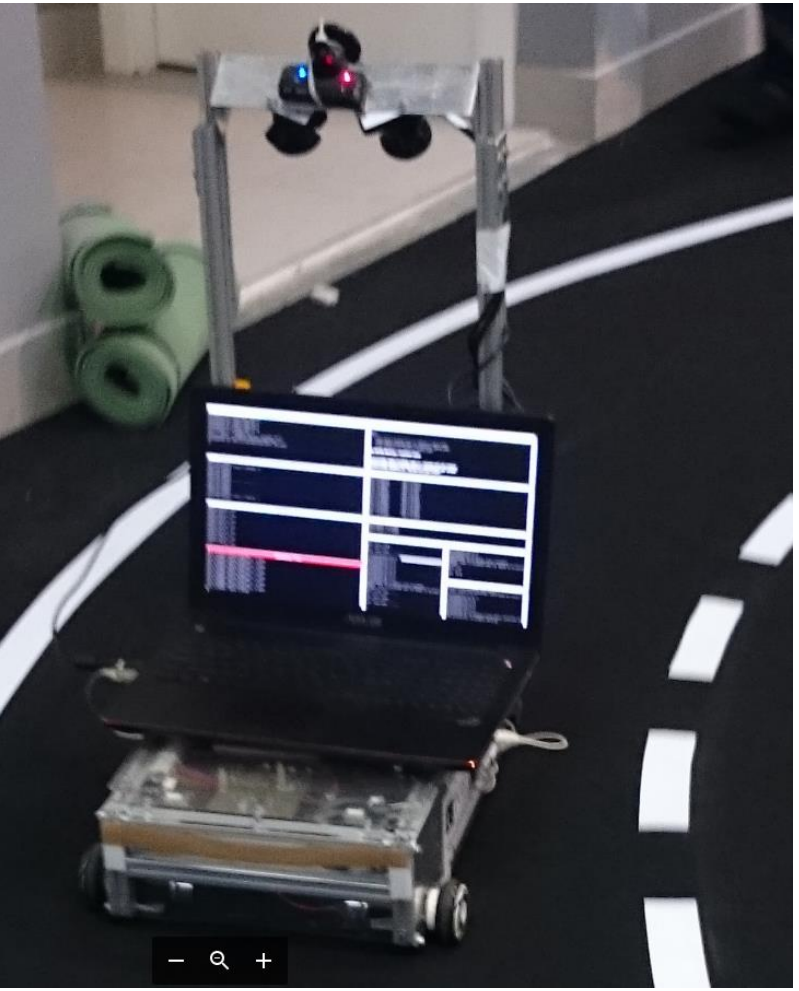
Rules and More Info

- Portuguese Robotics Open
- https://web.fe.up.pt/~robotica2019/index.php/pt/conducao-autonoma
- Video (Simulator + Real): https://youtu.be/tQpD9GCn7Ts
- Video (IPM): https://youtu.be/6XN29PRc5Eg



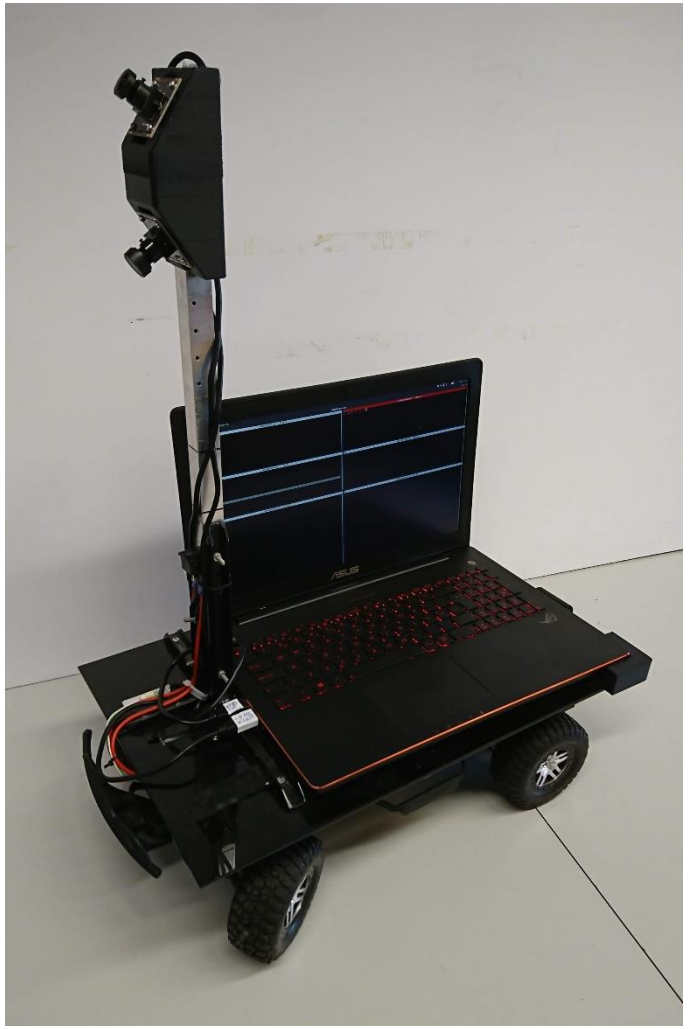
Vid

“Conde” vs. “Alvega”



- Differential Drive
- 3 PS2Eye cameras
- LiPo Batteries
- Laptop on top of computer
- Full ROS

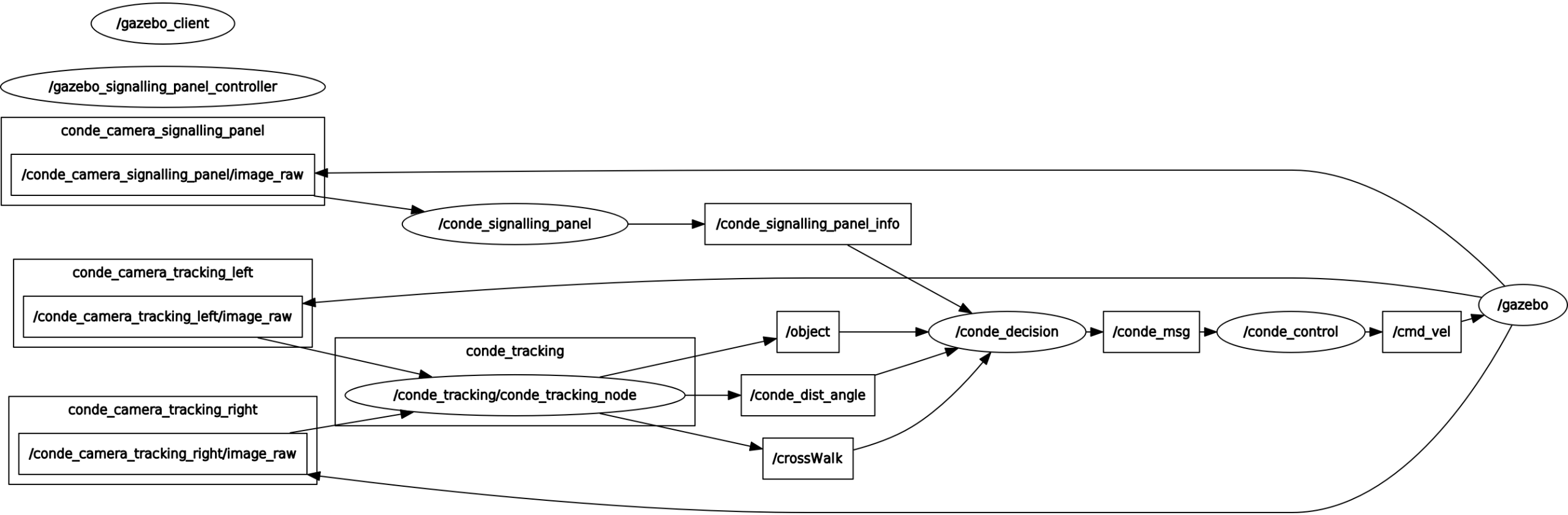
- Ackerman
- 2 cameras
- LiPo Batteries
- Laptop on top of computer
- Full ROS



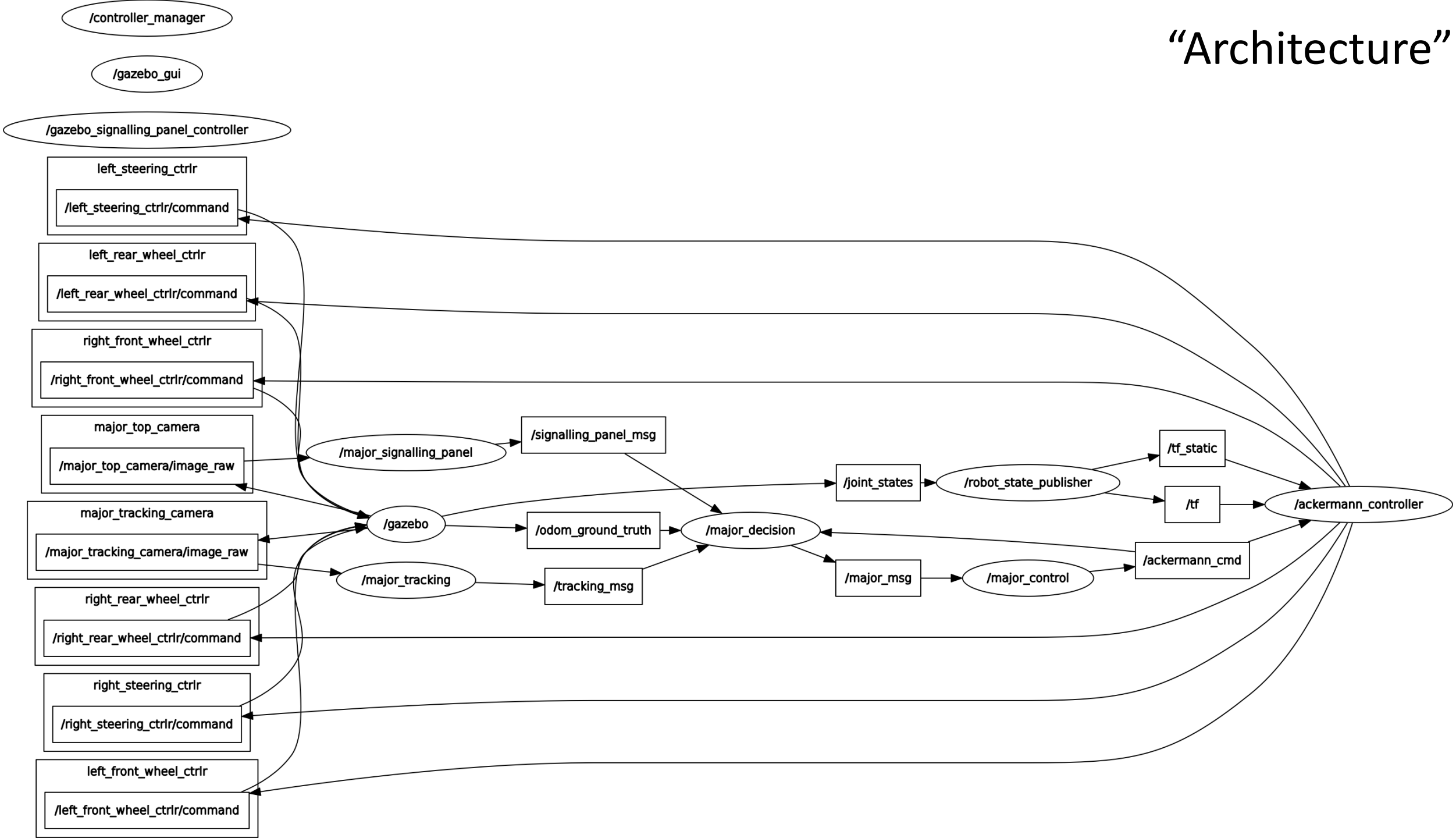
Modules

- ROS + Gazebo (3D, physics) => WORLD
  - roslaunch conde_world main.launch
- Process Screen “Semaphore” (3rd camera)
  - rosrun conde_semaphore conde_semaphore_node
- Hi Level Decision =>
  - rosrun conde_decision conde_decision_node
- Differential Control
  - rosrun conde_control conde_control_node
- Control Interface for the info to show on the Screen “Semaphore” of the track
  - rosrun gazebo_semaphore gazebo_semaphore_node
- Left and Right Cameras targeting the ground
  - roslaunch conde_tracking run.launch

“Architecture”



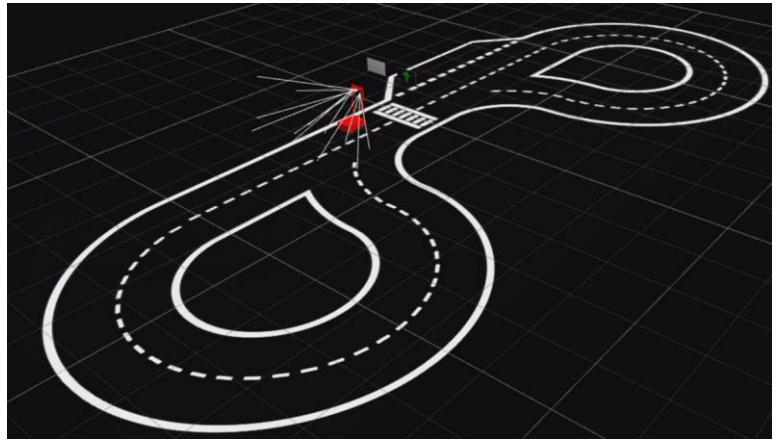
“Architecture”

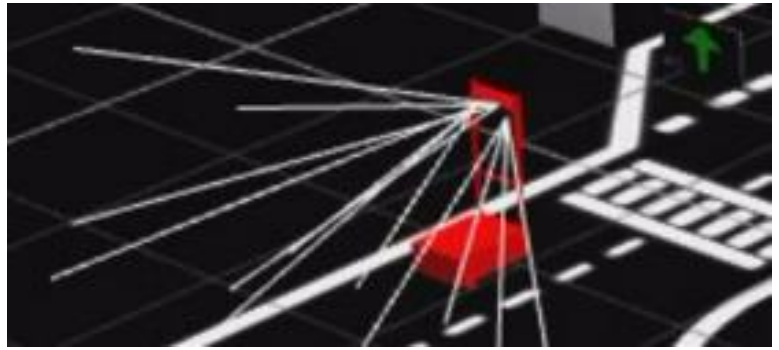


Installing Conde_Simulator

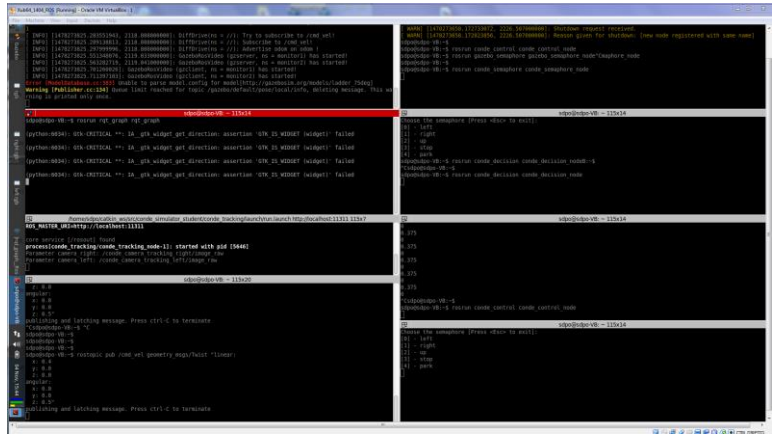
- Follow instructions

  https://github.com/ee09115/conde_simulator





- ROS nodes
  - conde_tracking - it is responsible for the detection of the track
  - conde_signalling_panel - it is responsible to recognize the signalling panels
  - conde_traffic_sign - it is responsible to recognize the traffic signs
  - conde_decision - it is responsible for all the decisions followed by the robot (it is the intelligence of the robot)
  - conde_control - it is responsible to calculate the velocities accordingly to the reference to follow
  - conde_key_teleop - it controls the robot's movement manually by publishing a /cmd_vel message



Test & Debug

(ROS Noetic)

- rosrun rqt_graph rqt_graph
- rostopic pub -r 10 /cmd_vel geometry_msgs/Twist "{linear: {x: 0.25, y: 0.0, z: 0.0}, angular: {x: 0.0,y: 0.0, z: 0.25}}"
- rostopic pub /cmd_vel geometry_msgs/Twist
  (end with a space and press tab key twice)

```
sdpo@sdpo-VB:~$ rostopic pub /cmd_vel geometry_msgs/Twist "linear:
  x: 0.25
  y: 0.0
  z: 0.0
angular:
  x: 0.0
  y: 0.0
  z: 0.25"
publishing and latching message. Press ctrl-C to terminate
```

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