

Robotics Projects

Session 04 – TurtleBot 3

2024

Presentator: Joaquin Rodriguez

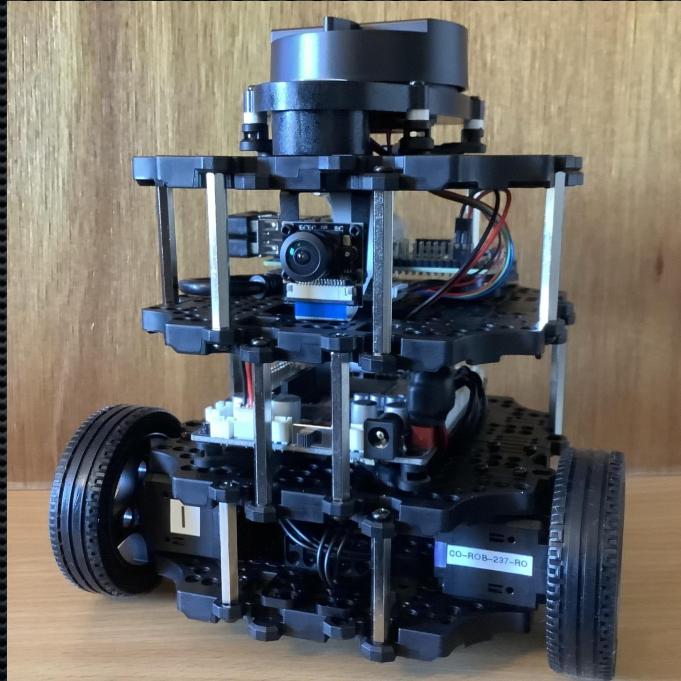
Based on slides of Ralph Seulin



Session 04 – TurtleBot 3

Objective

> Fully Master this Robot :



Session 04 – TurtleBot 3

Objective

- Right NOW :

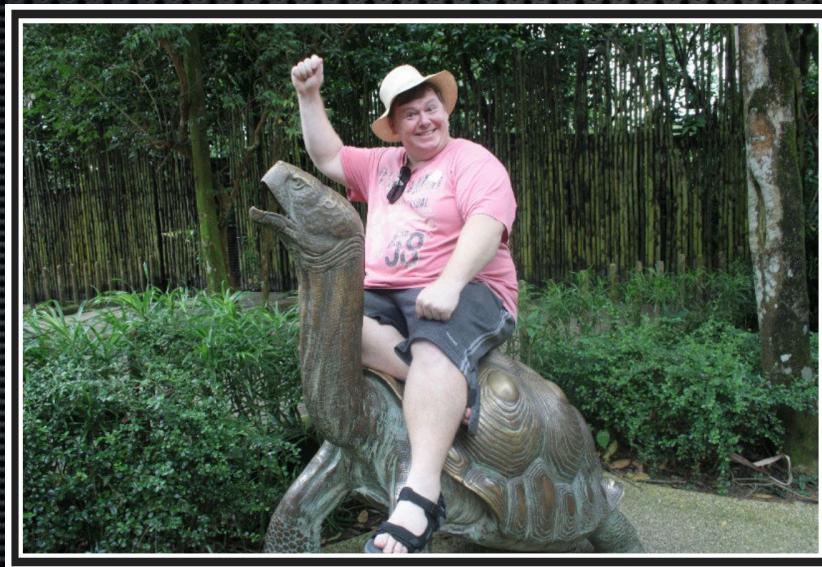


Image taken from « Brave Wilderness Youtube Channel »

Session 04 – TurtleBot 3

Objective

- . End of the Day :



from « <https://www.travelblog.org/Photos/7842272> »

Tutorials

Session 04 – TurtleBot 3

- Learn How to “Tame” your Robot
 - Hardware
 - Network Architecture
 - Software (ROS !)
 - Monitoring tools (RQt_Graph, RViz, ...)
 - Simulation (Gazebo)
 - Homework > Navigation

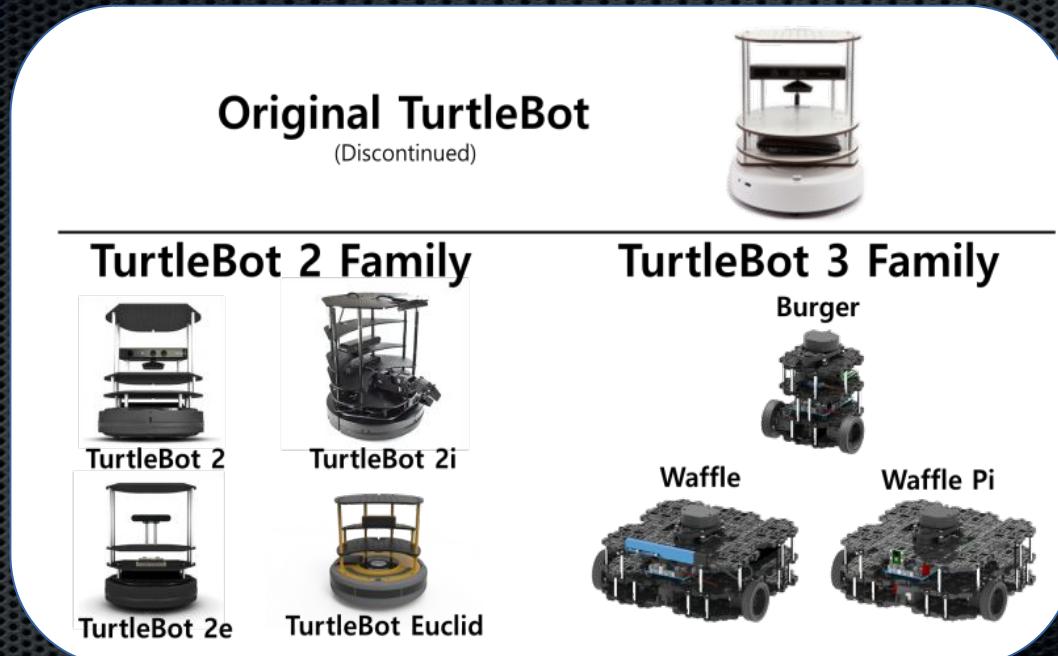


TurtleBot 3 e-manual: <https://emanual.robotis.com/docs/en/platform/turtlebot3/overview>

TurtleBot 3

History

- 1, 2, 3 ...



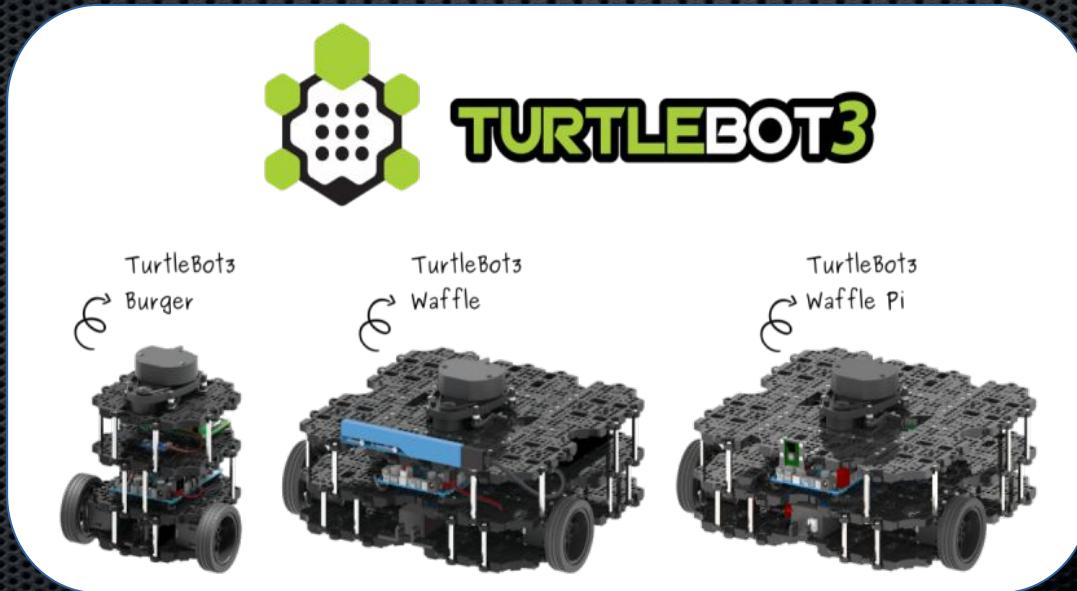
https://www.youtube.com/watch?v=9OC3J53RUsk&t=101s&ab_channel=ROBOTIS

<https://www.turtlebot.com/>

TurtleBot 3

History

- . TB3 Family

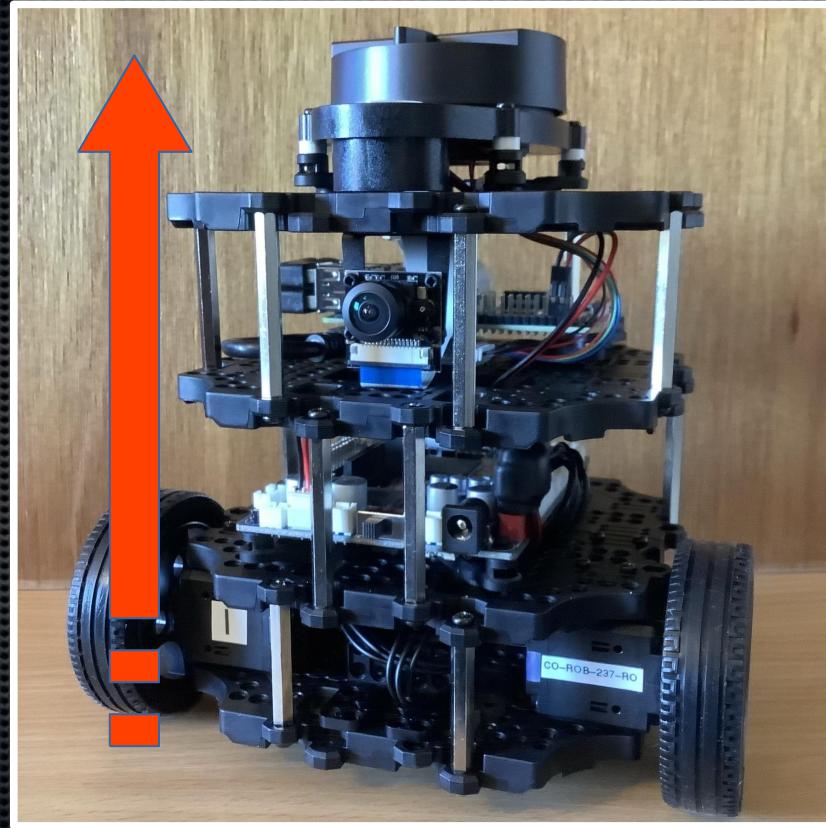


<https://www.turtlebot.com/>

TurtleBot 3

Features

- . From Bottom ...
- to Top

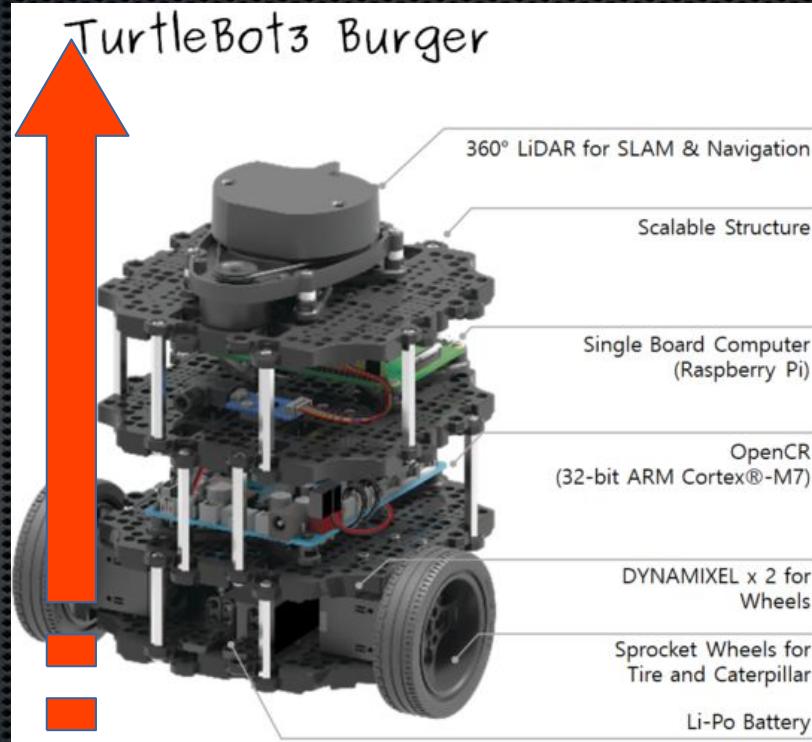


<https://emanual.robotis.com/docs/en/platform/turtlebot3/features/>

TurtleBot 3

Features

- From Bottom ...
- ... to Top

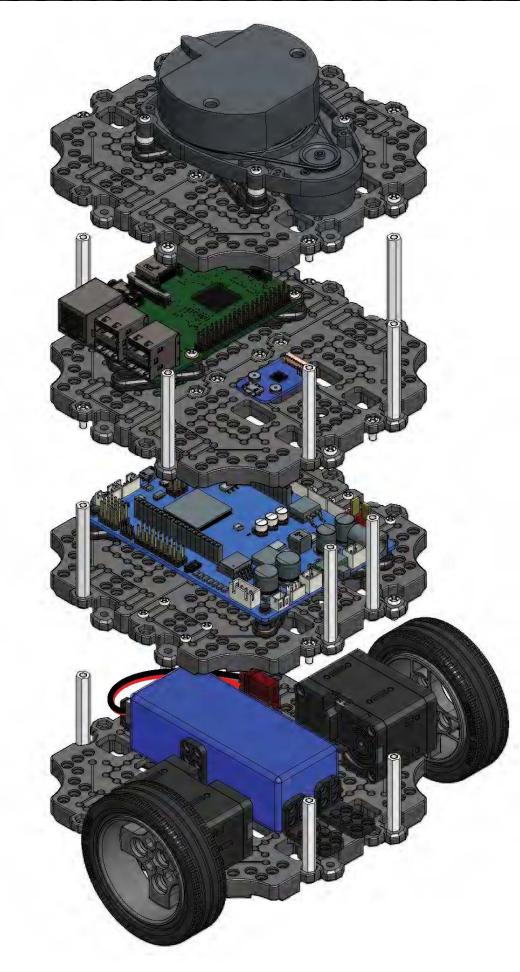


<https://emanual.robotis.com/docs/en/platform/turtlebot3/features/>

TurtleBot 3

Features

- . From Bottom ...
- to Top

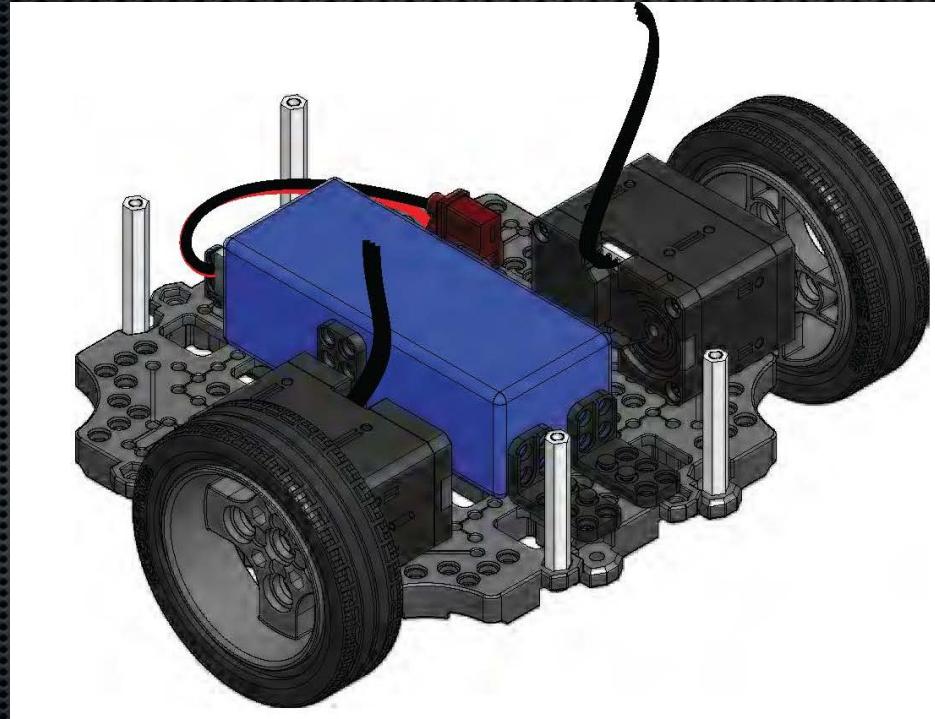


<https://emanual.robotis.com/docs/en/platform/turtlebot3/features/>

TurtleBot 3

Features

- . First Layer

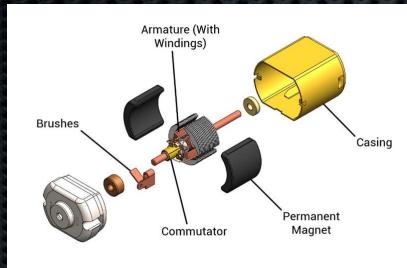


<https://emanual.robotis.com/docs/en/platform/turtlebot3/features/>

TurtleBot 3

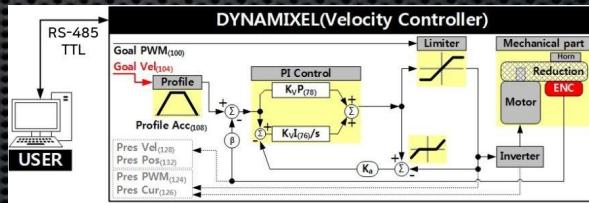
Features

- Motors – Dynamixel XL430-W250



Cored DC
Motor

+ Gears



+ Controller

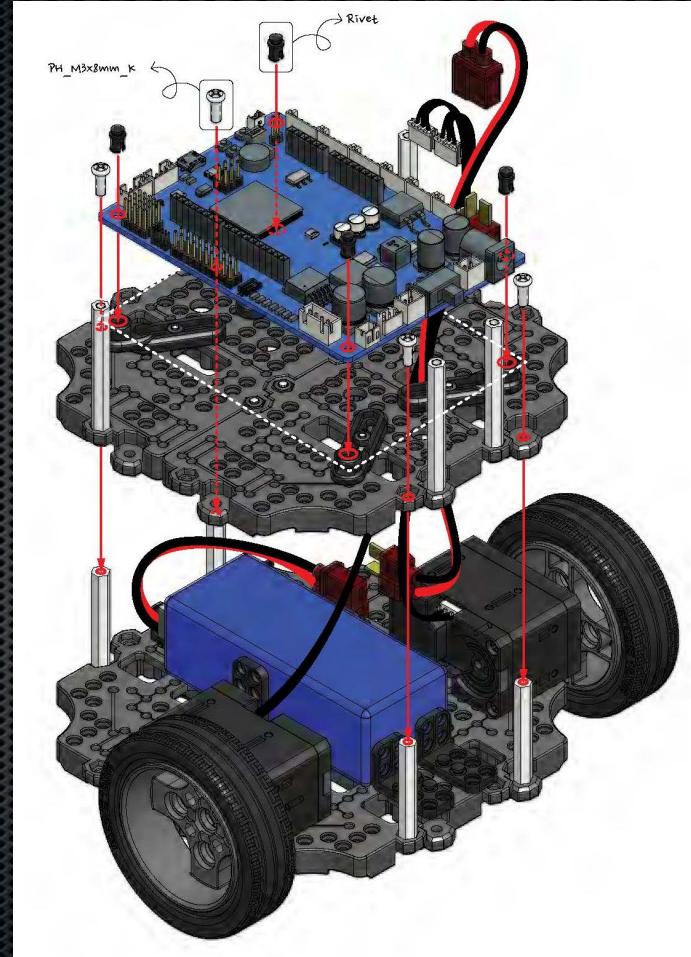
> Odometry

<https://www.youtube.com/watch?v=aO4XNIP94q8>
<https://emanual.robotis.com/docs/en/dxl/x/xl430-w250/>

TurtleBot 3

Features

- 2nd Layer

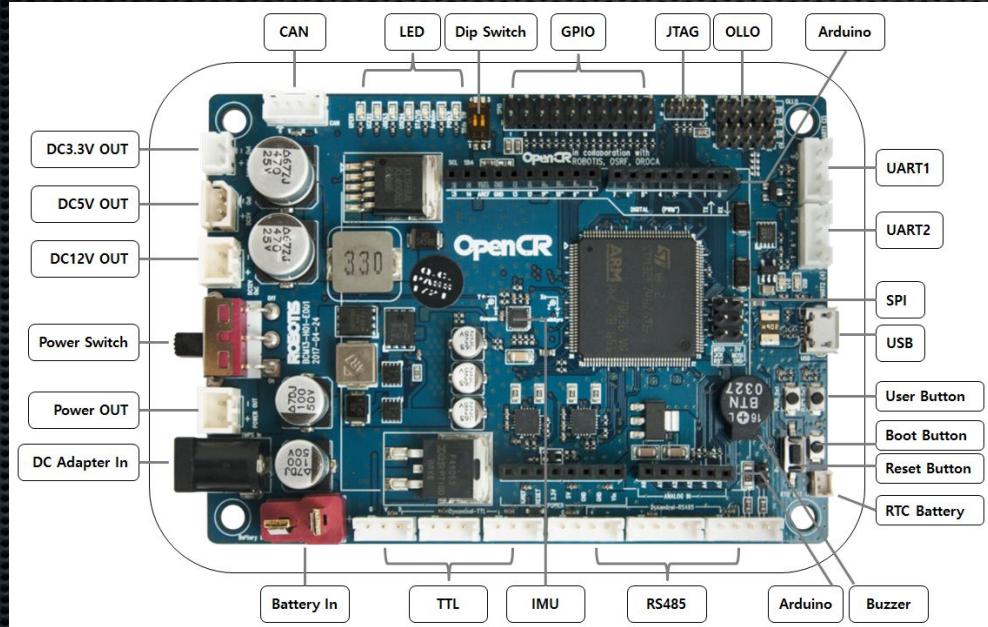


<https://emanual.robotis.com/docs/en/platform/turtlebot3/features/>

TurtleBot 3

Features

- OpenCR Board

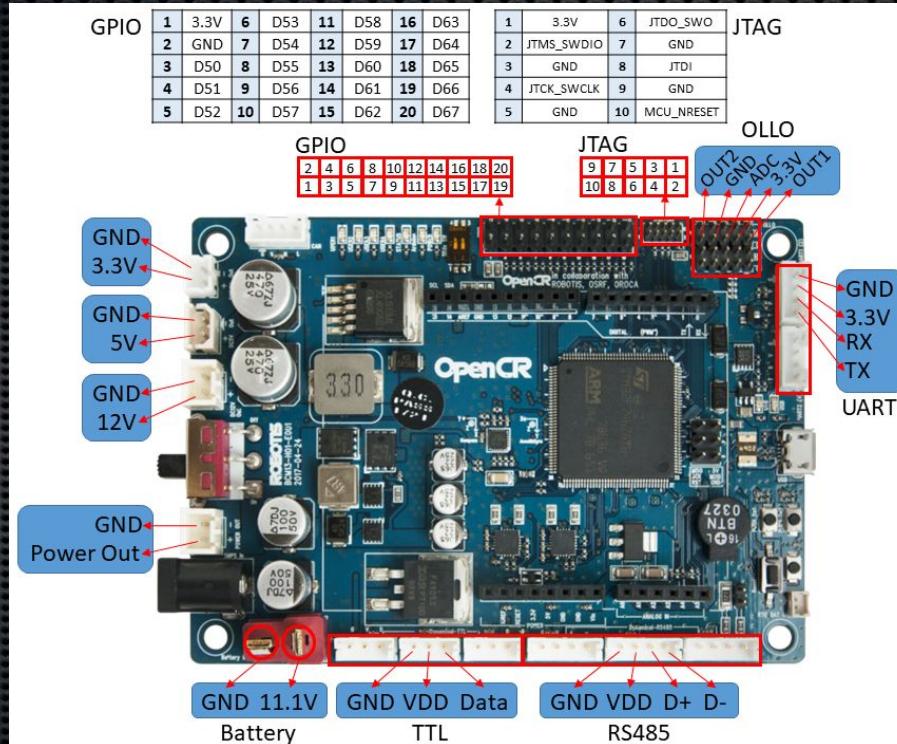


<https://emanual.robotis.com/docs/en/parts/controller/opencr10/>

TurtleBot 3

Features

- OpenCR Board

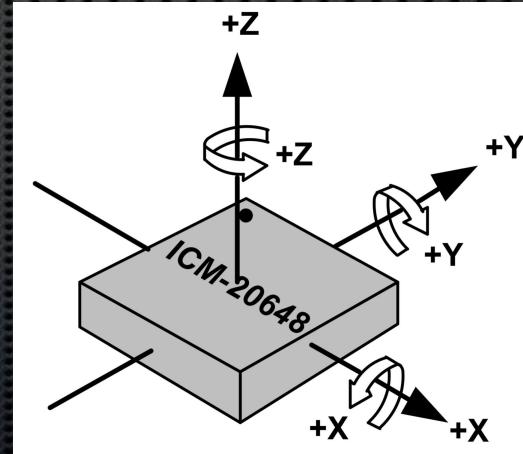


<https://emanual.robotis.com/docs/en/parts/controller/opencr10/>

TurtleBot 3

Features

- OpenCR Board > IMU
- 3-axis gyroscope / 3-axis accelerometer
- + a Digital Motion Processor

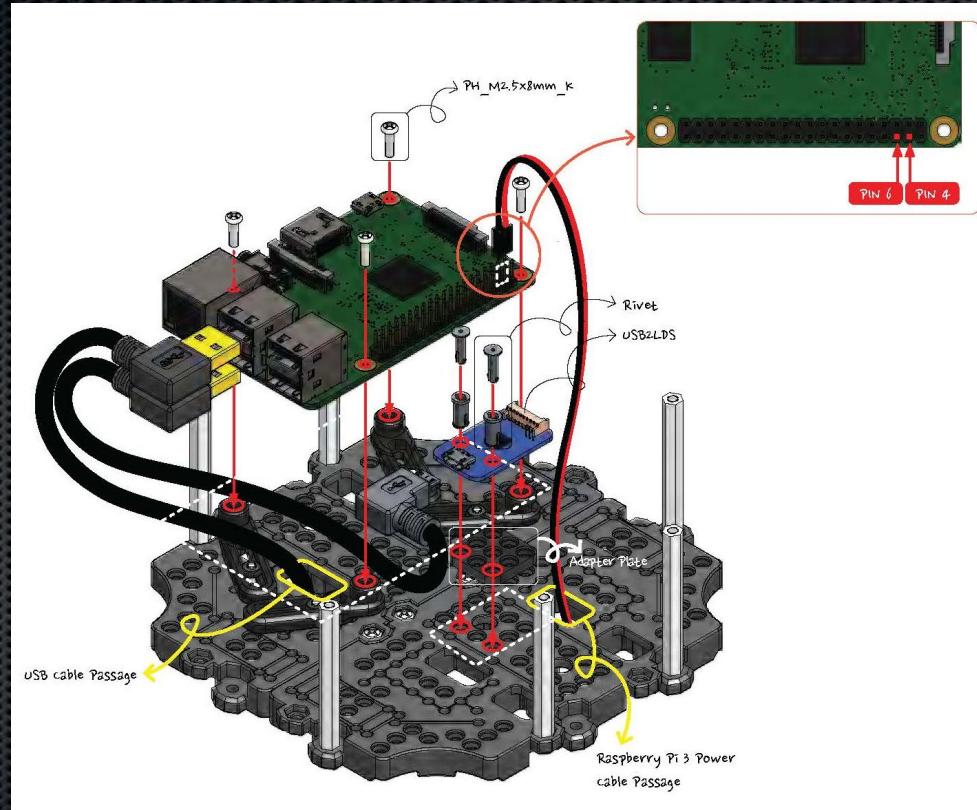


<https://invensense.tdk.com/products/motion-tracking/6-axis/icm-20648/>

TurtleBot 3

Features

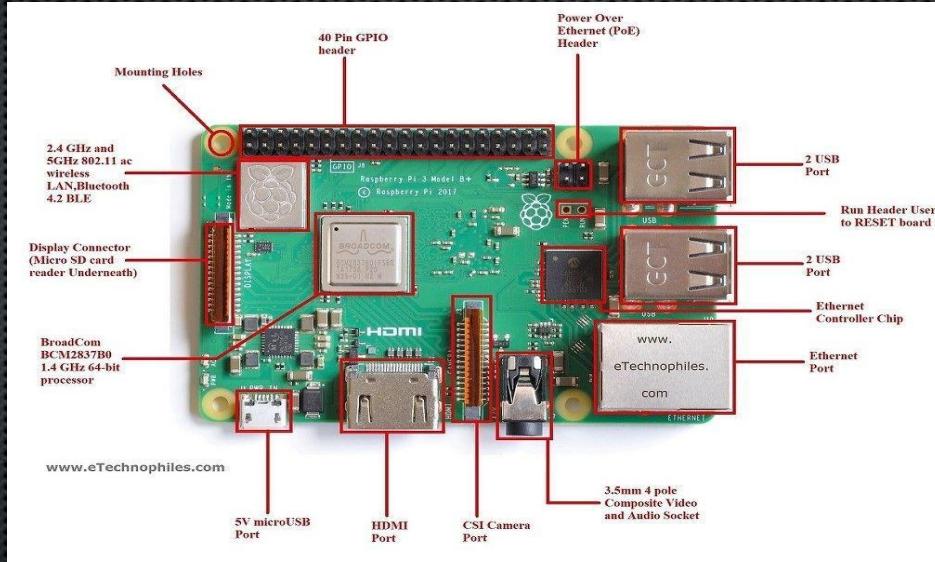
- 3rd Layer



<https://emanual.robotis.com/docs/en/platform/turtlebot3/features/>

TurtleBot 3 Features

- Single Board Computer
- Raspberry Pi 3B+ > Arm 7

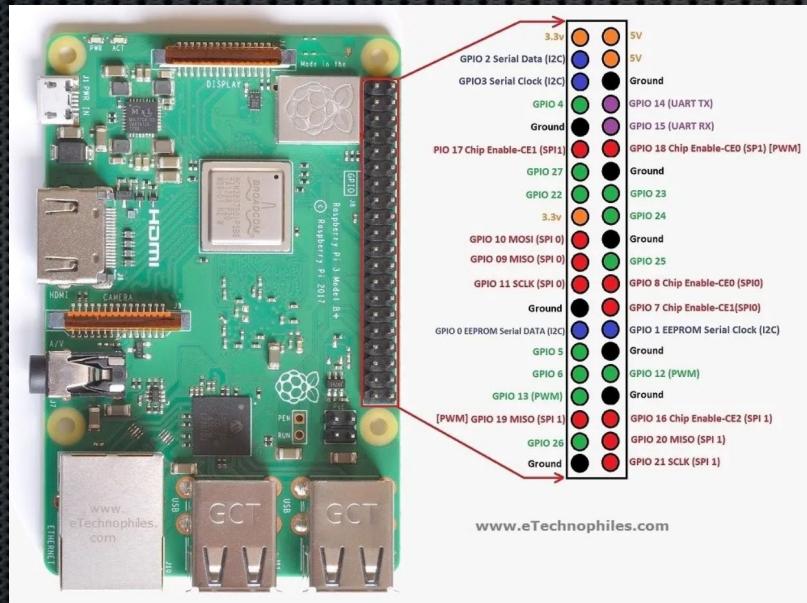


<https://www.raspberrypi.org/products/raspberry-pi-3-model-b-plus/>

TurtleBot 3

Features

- Single Board Computer - Raspberry Pi 3B+

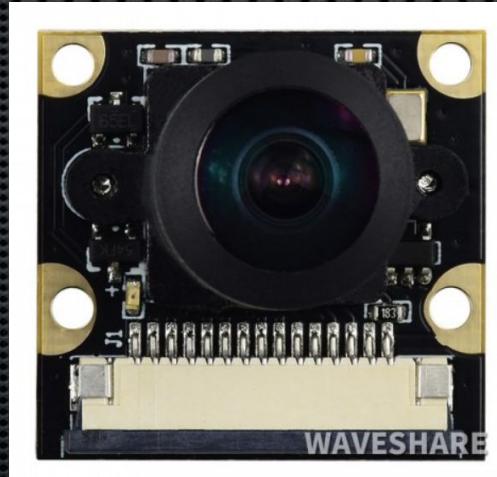


<https://www.raspberrypi.org/products/raspberry-pi-3-model-b-plus/>

TurtleBot 3

Features

- . Camera – WaveShare RPi Camera (G)
 - 5 Mega Pixels – OmniVision's OV5647 sensor
 - 160° Fisheye Lens

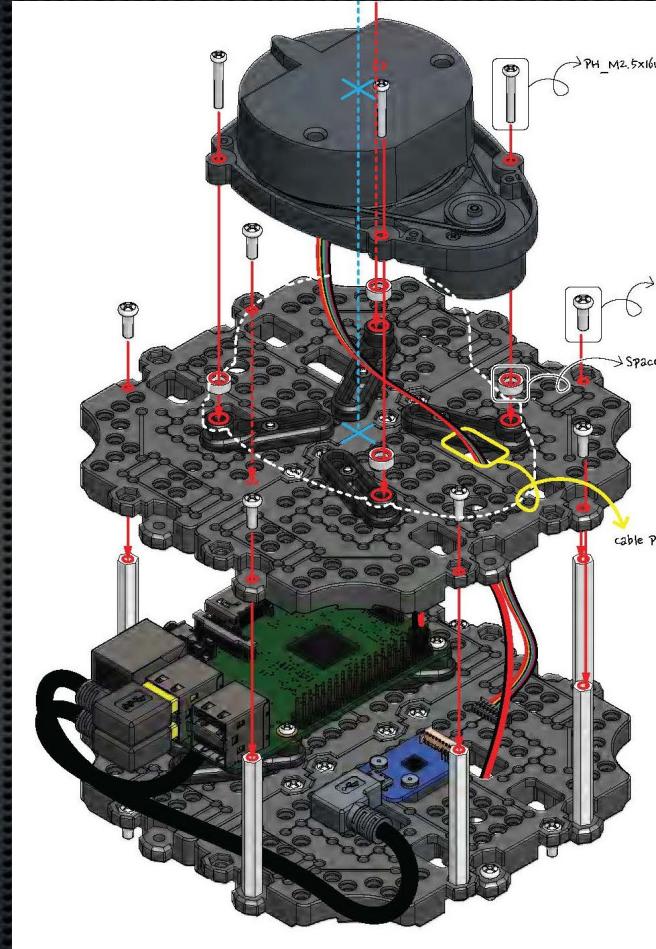


<https://www.waveshare.com/rpi-camera-q.htm>

TurtleBot 3

Features

- 4th Layer

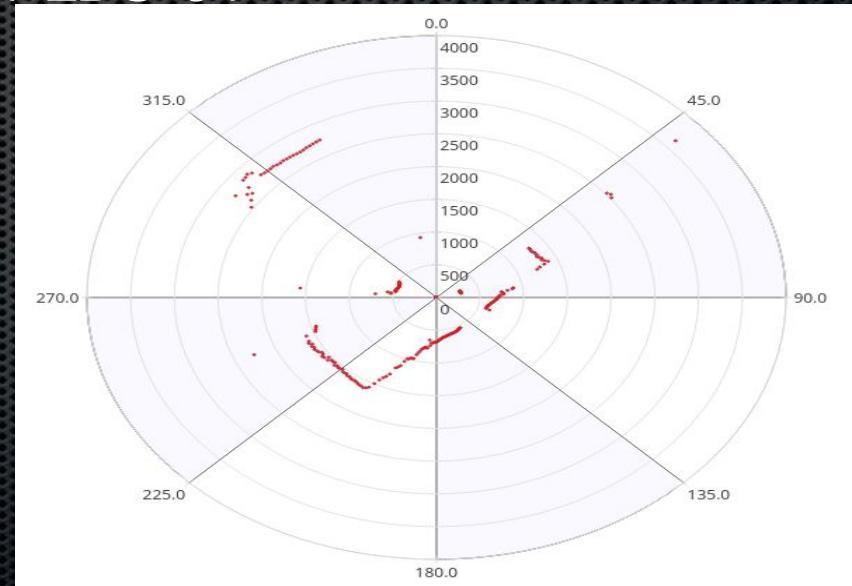


<https://emanual.robotis.com/docs/en/platform/turtlebot3/features/>

TurtleBot 3

Features

- LiDAR - 360 Laser Distance Sensor LDS-01

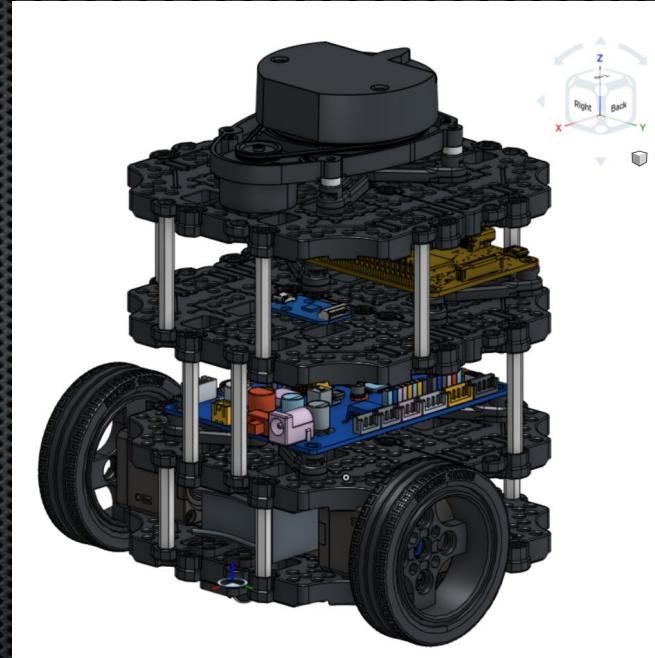


https://emanual.robotis.com/docs/en/platform/turtlebot3/appendix_lidar/

TurtleBot 3

Features

- Open Source Hardware



<https://emanual.robotis.com/docs/en/platform/turtlebot3/features/#open-source-hardware>

TurtleBot 3

Battery & Power Supply

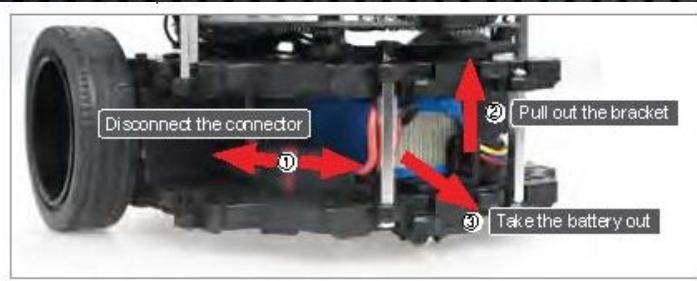
- To Switch ON Robot
 - 1 – Switch ON OpenCR Board
- . To Switch OFF Robot
 - 1 - Turn OFF Raspberry Pi
 - *SSH + \$ sudo shutdown now*
 - WAIT for Green LED of Rpi to be OFF
 - 2 – Switch OFF OpenCR Board



TurtleBot 3

Battery & Power Supply

- BEEP => !!! Low Battery !!!
 - 1 - Switch OFF Robot
 - 2 - Remove Empty Battery → EMPTY BOX
 - 3 - Plug FULL Battery



<https://emanual.robotis.com/docs/en/platform/turtlebot3/faq/#faq>

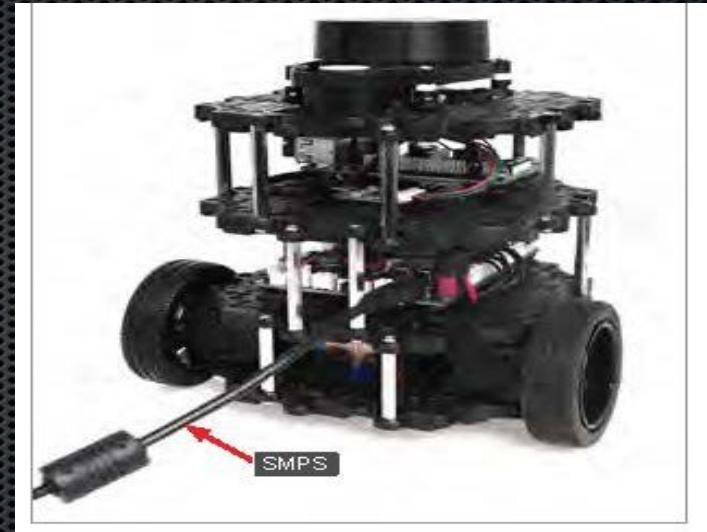
TurtleBot 3

Battery & Power Supply

Prefer SMPS Power Supply for Development

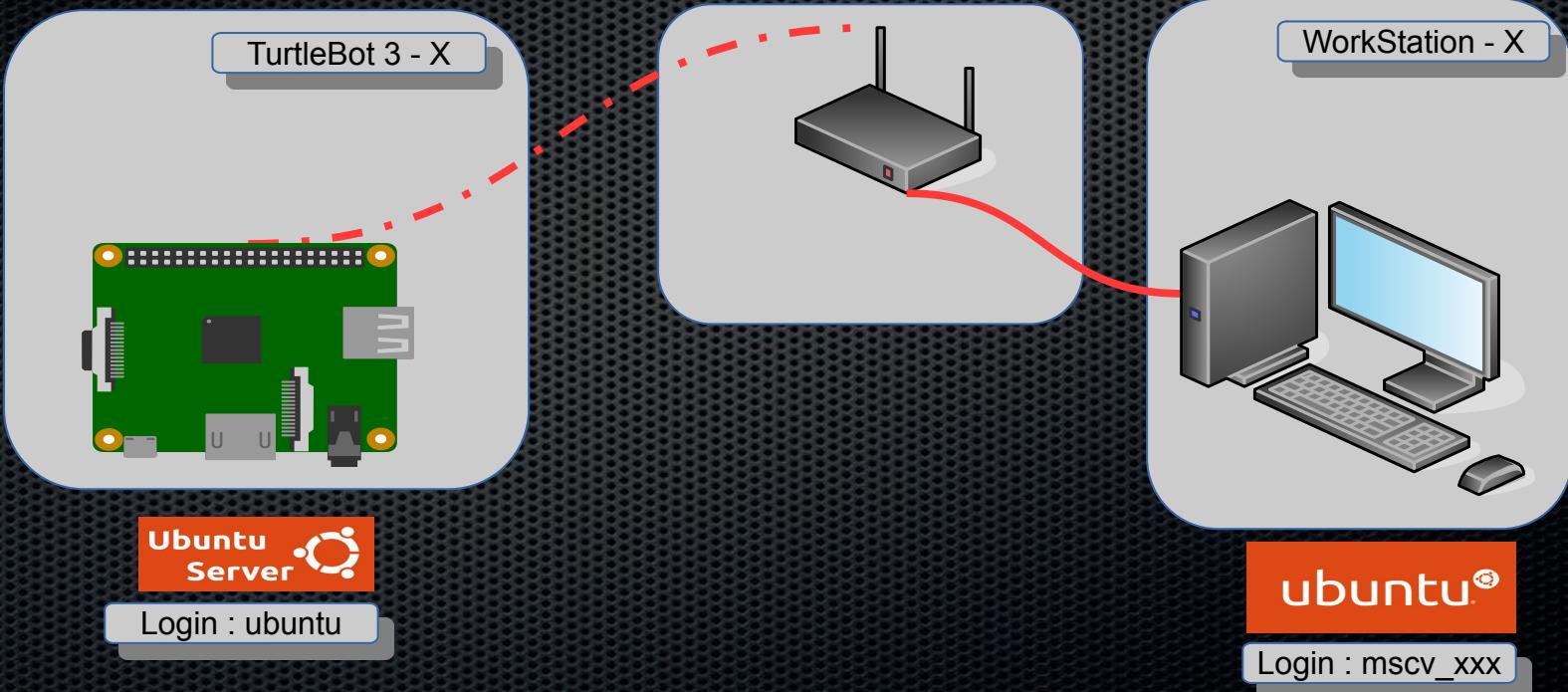
- Hot Swap : Power Supply <-> Battery
- Documented but RELIABLE ? > turn off ROS processes before swap

If you connect the SMPS directly to the robot, the battery can be removed from the robot for charging while the robot is remaining online.



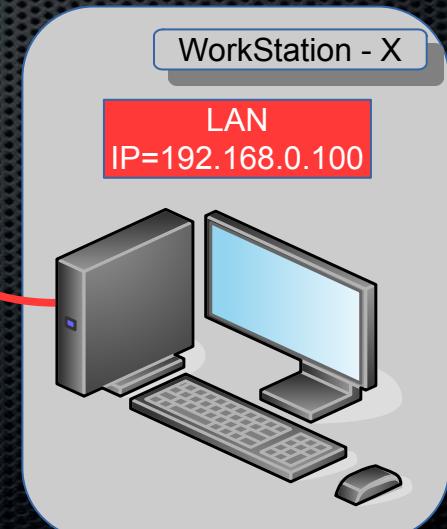
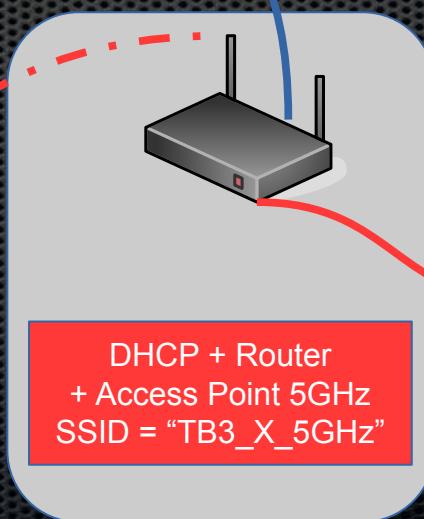
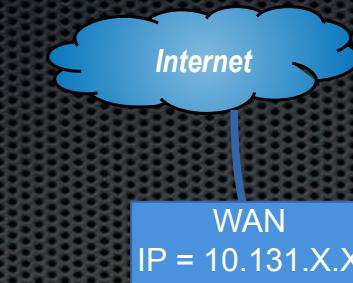
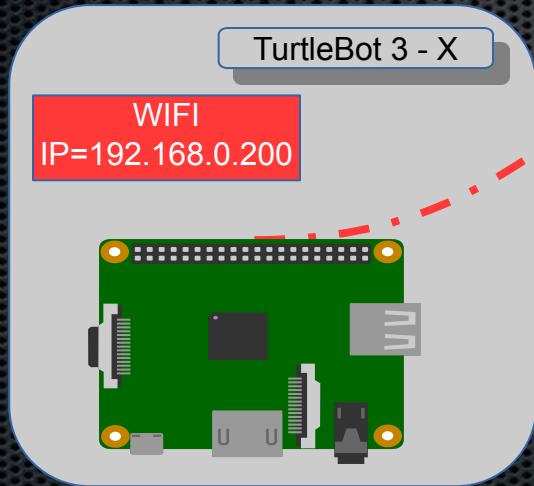
TurtleBot 3

2 x Operating Systems > Network Architecture



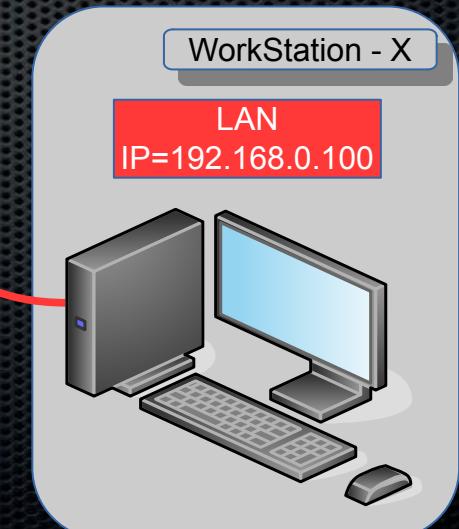
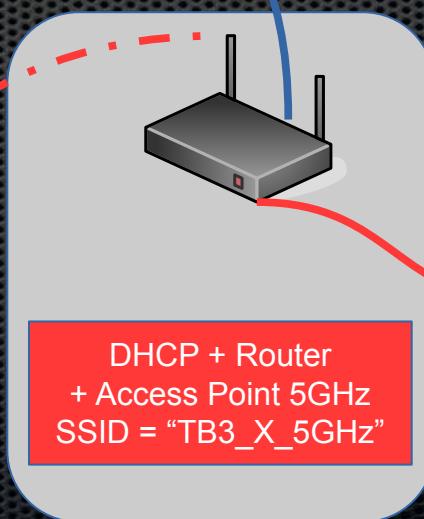
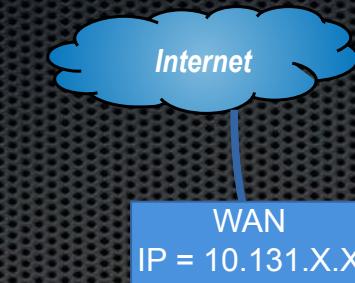
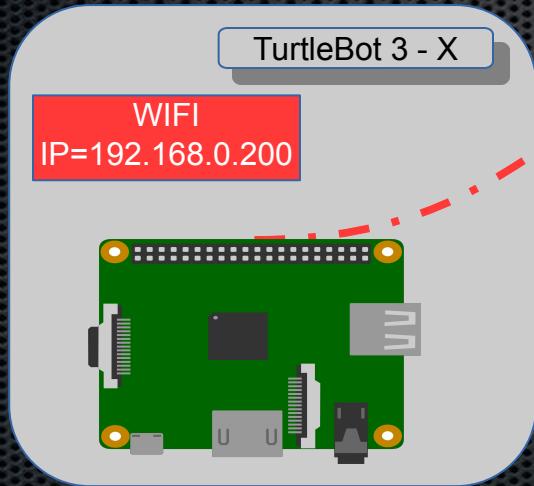
TurtleBot 3

Network Architecture



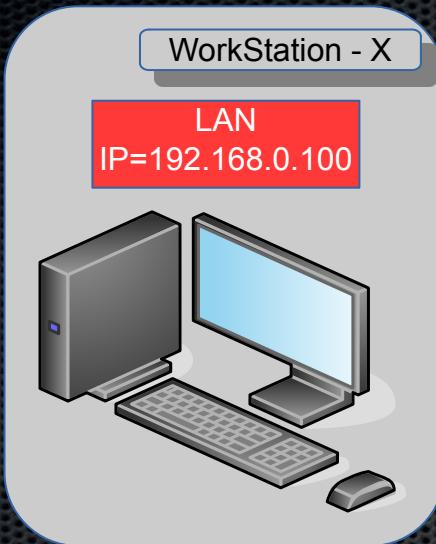
TurtleBot 3

Network Architecture

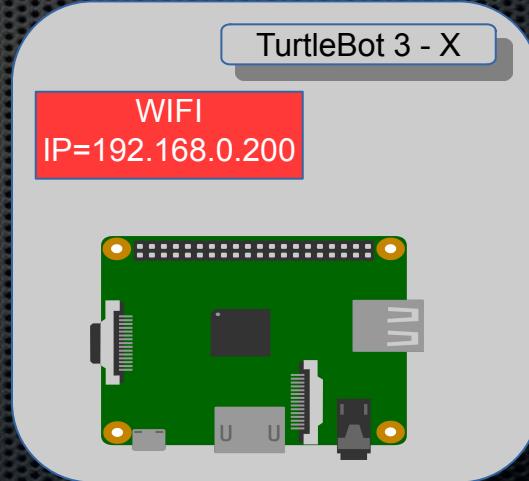


TurtleBot 3

Bring-up > Start your Robot



\$ roscore



SSH + \$ launch robot

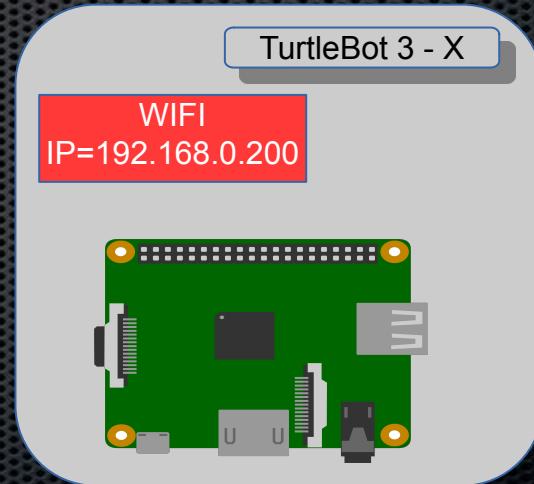
<https://emanual.robotis.com/docs/en/platform/turtlebot3/bringup/#bringup>

TurtleBot 3

Teleoperation - KeyBoard



*Bringup
+ \$ keyboard teleop*

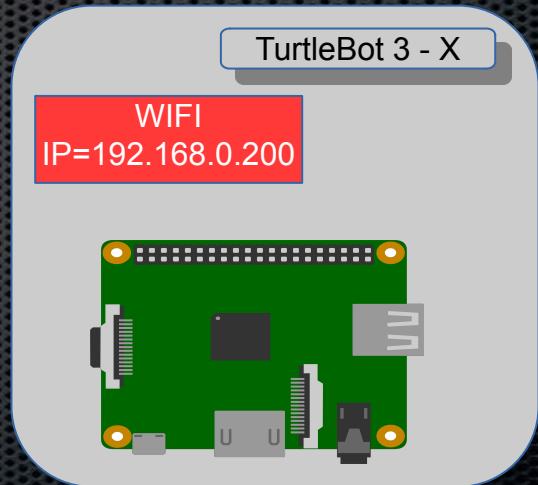


SSH + \$ launch robot

https://emanual.robotis.com/docs/en/platform/turtlebot3/basic_operation/#keyboard-1

TurtleBot 3

Teleoperation – Logitech Joystick



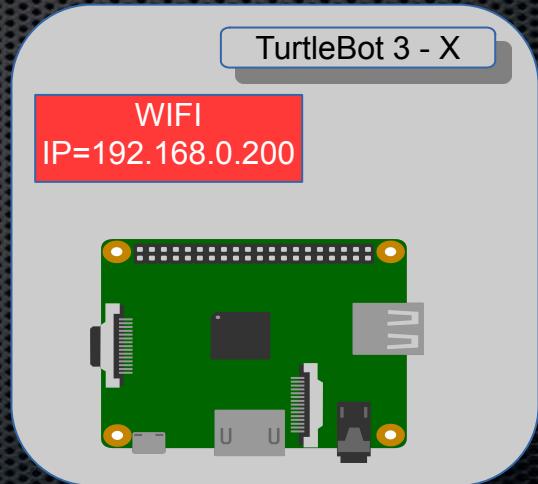
Bringup
+ *\$ teleop logitech*

SSH + \$ launch robot

https://github.com/roboticslab-fr/teleop_twist_joy

TurtleBot 3

Teleoperation – Topic Monitoring (rqt)



Bringup
+ \$ teleop logitech

SSH + \$ launch robot

https://emanual.robotis.com/docs/en/platform/turtlebot3/basic_operation/#topic-monitor-1

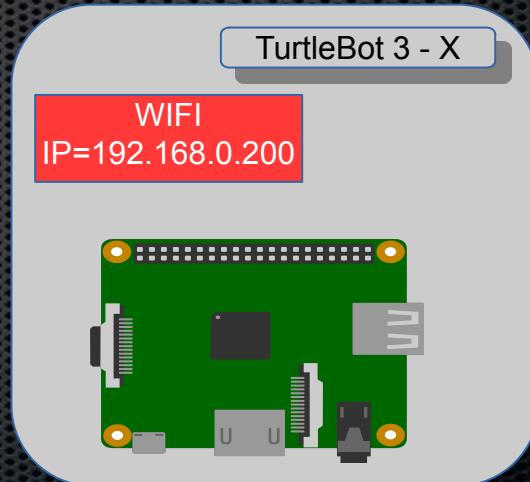
TurtleBot 3

Teleoperation – Topic Publishing



*Bringup
+ \$ publish to ???*

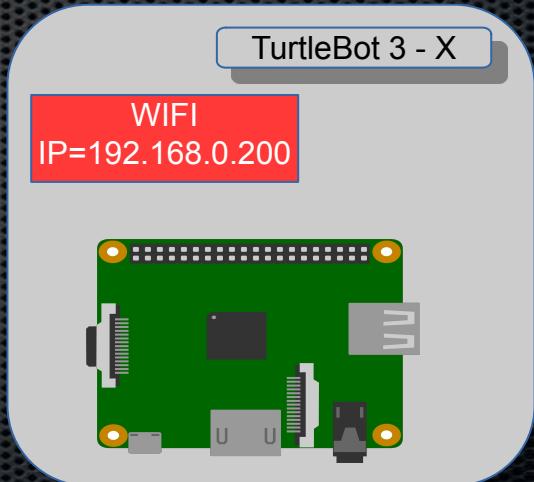
???



SSH + \$ launch robot

TurtleBot 3

Rviz > Robot State & Sensors Monitoring



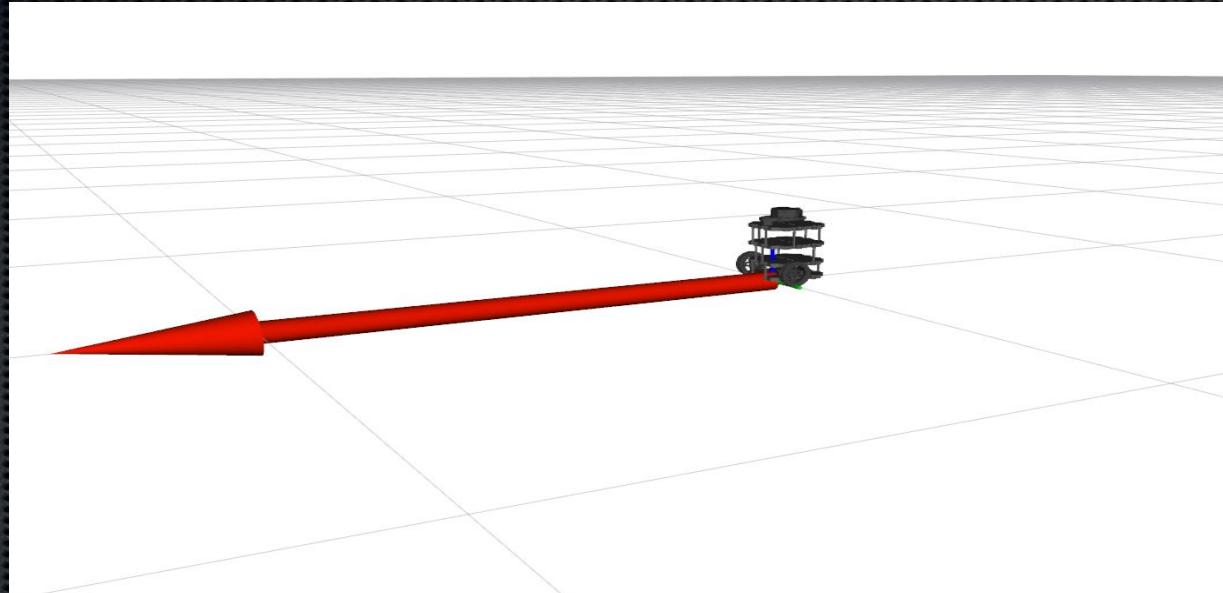
\$ *roscore*
+ \$ *remote robot*
+ \$ *rviz*

SSH + \$ *launch robot*

<https://emanual.robotis.com/docs/en/platform/turtlebot3/bringup/#load-turtlebot3-on-rviz-1>

TurtleBot 3

Simulation – Fake Node



Observe Topics & Nodes

https://emanual.robotis.com/docs/en/platform/turtlebot3/fakenode_simulation/

TurtleBot 3

Simulation – Gazebo

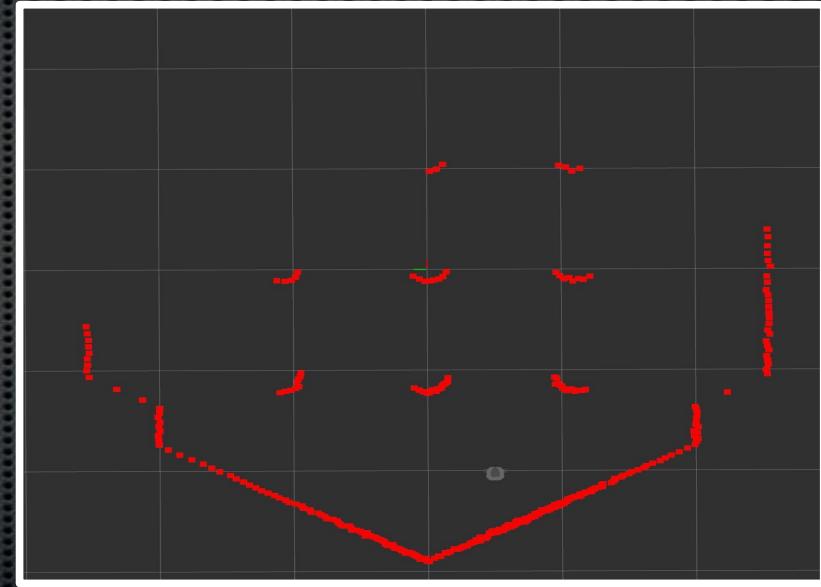
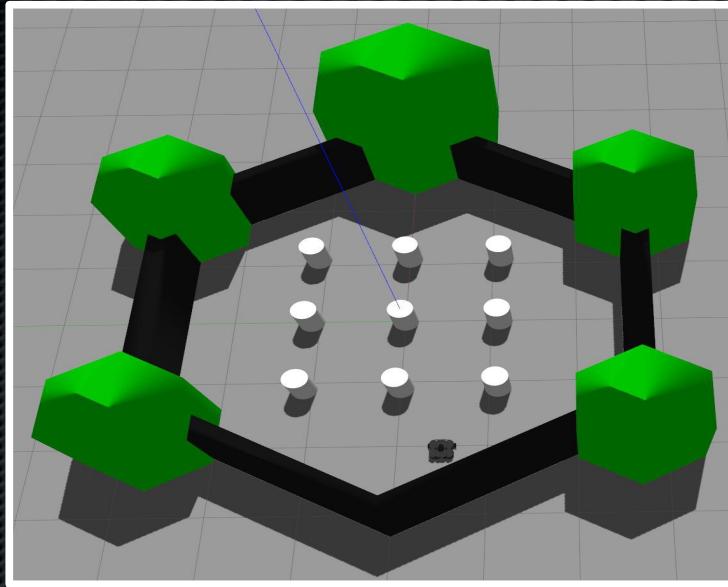


Observe Topics & Nodes

<https://emanual.robotis.com/docs/en/platform/turtlebot3/simulation/#gazebo-simulation-1>

TurtleBot 3

Simulation = Gazebo + Monitoring = RViz



Additional Tutorials

Mastering with ROS: Turtlebot3

- Learn how to work with a Turtlebot3 robot
 - Basic Usage and control of the Turtlebot3 robot
 - How to perform Navigation with Turtlebot3
 - Follow a line with Turtlebot3
 - Object Recognition with Turtlebot3
 - Motion Planning in Moveit with Turtlebot3

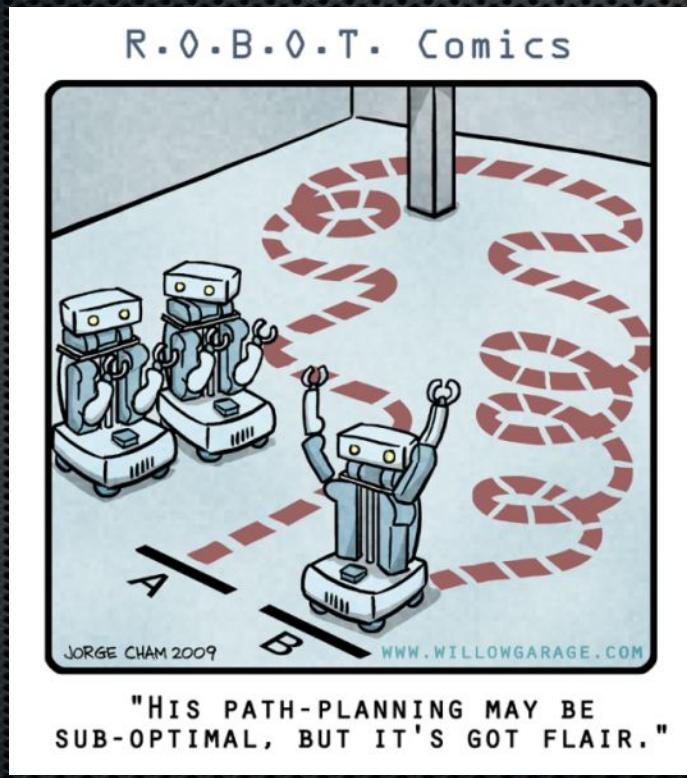


Course: <https://www.theconstructsim.com/.../mastering-with-ros-turtlebot3/>

Project: <https://www.theconstructsim.com/.../ros-projects-turtlebot3/>

TurtleBot 3

Homework > Simulation of TB3 navigation



TurtleBot 3

Homework > Simulation of TB3 navigation

Objective: To learn basic navigation concepts & get ready for final defense presentation

Instructions:

- > Submit a video of your **robot simulation** to demonstrate that it can perform **navigation** in a **map**
- > Video has to be **clean**, with **titles** and **additional information** to be **self-explanatory (NO WATERMARK!!!!)**

!!! Deadline = 17 October – 08:00 AM !!!

https://emanual.robotis.com/docs/en/platform/turtlebot3/slam_simulation/

https://emanual.robotis.com/docs/en/platform/turtlebot3/nav_simulation/

Robotics Projects

End of Session 04 – TurtleBot 3

2024

