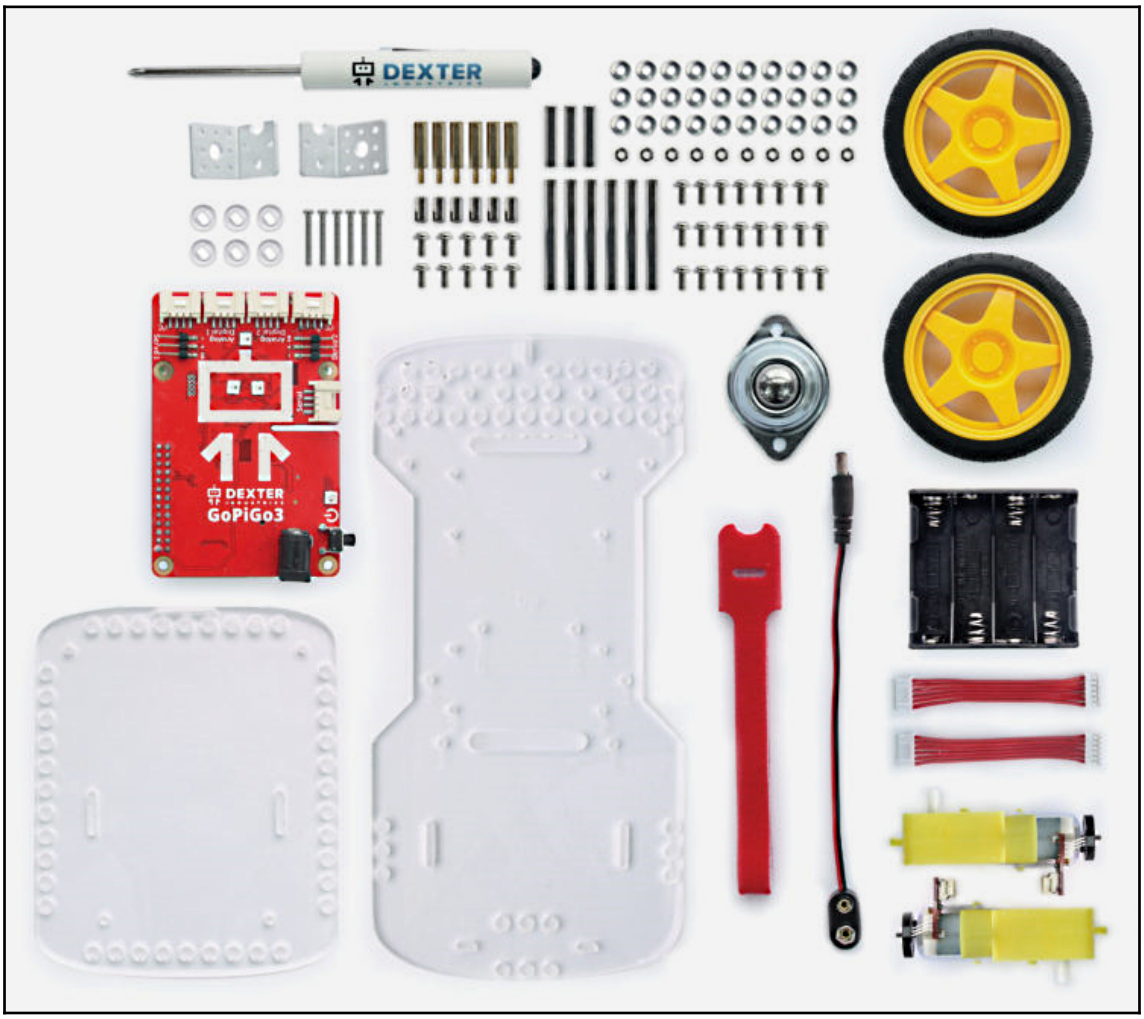
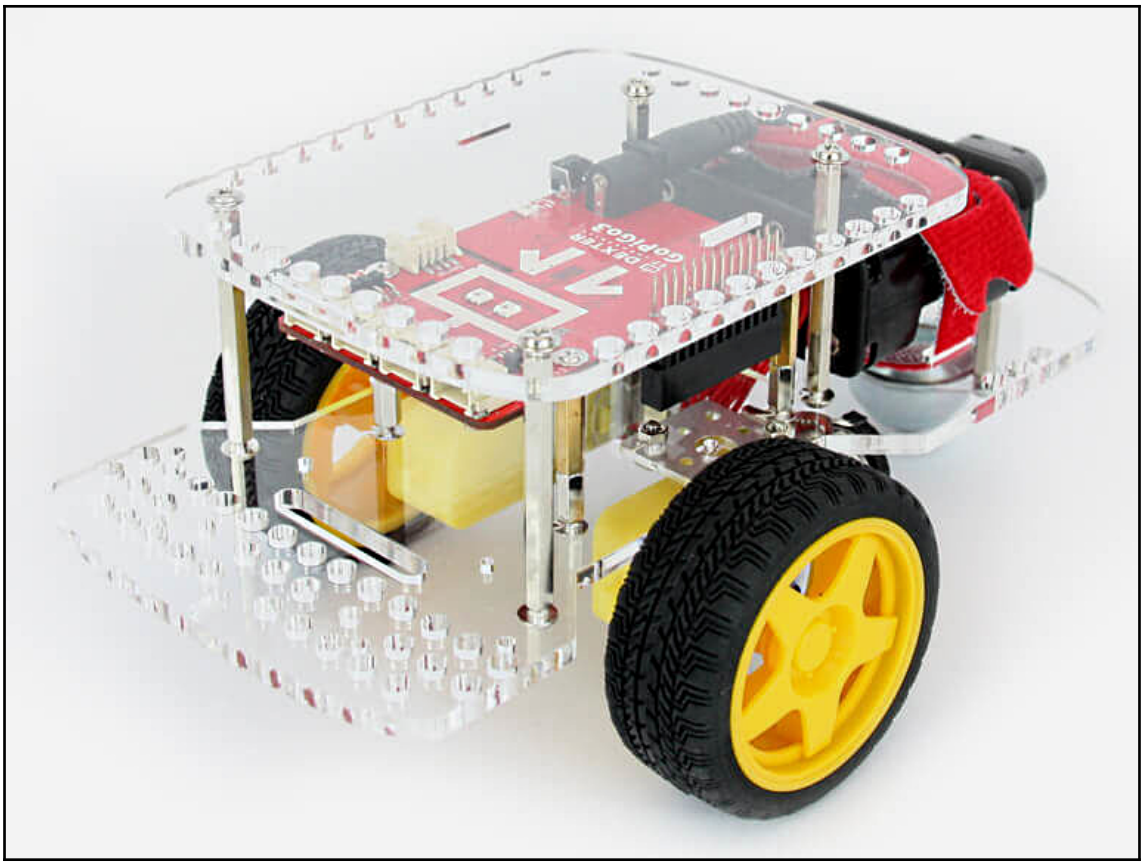
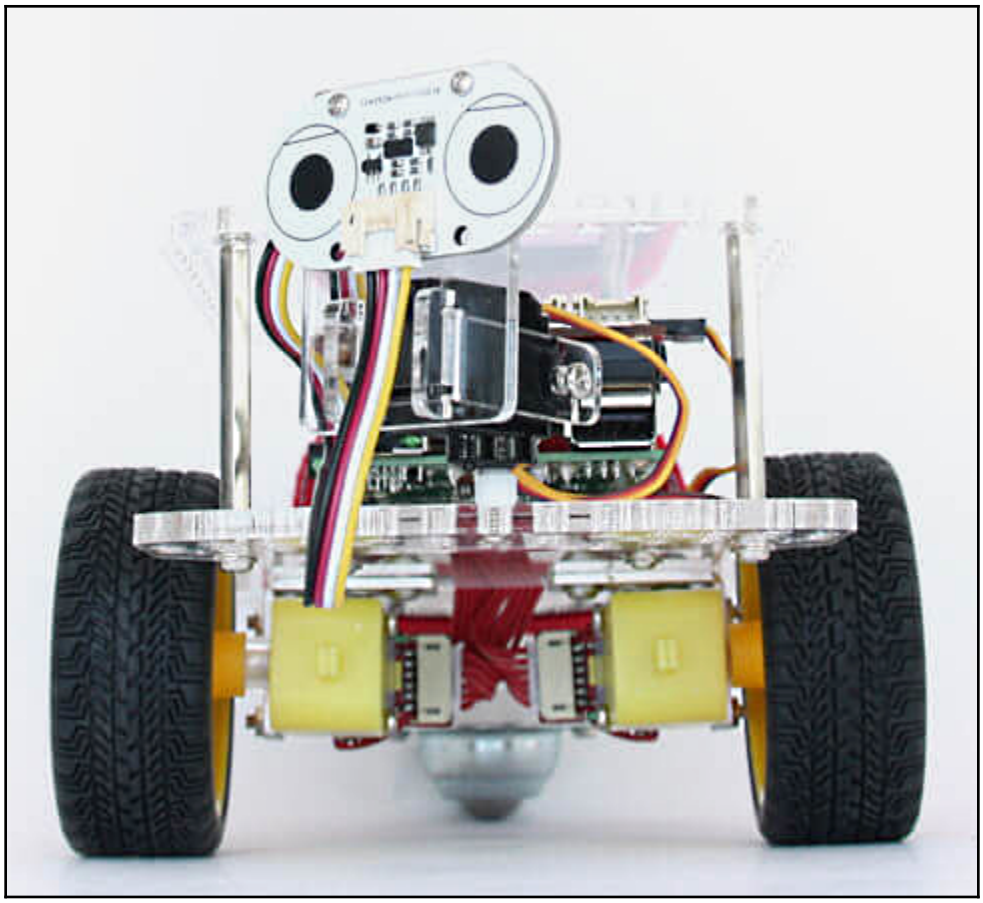
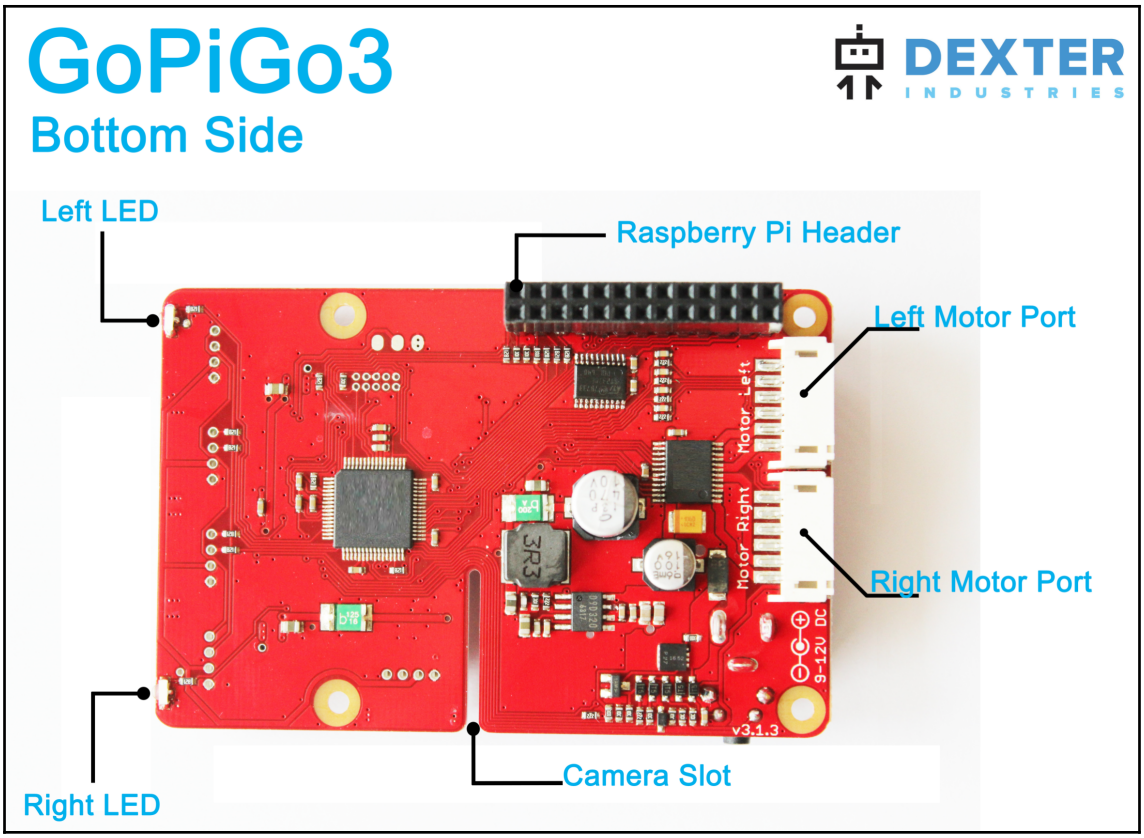
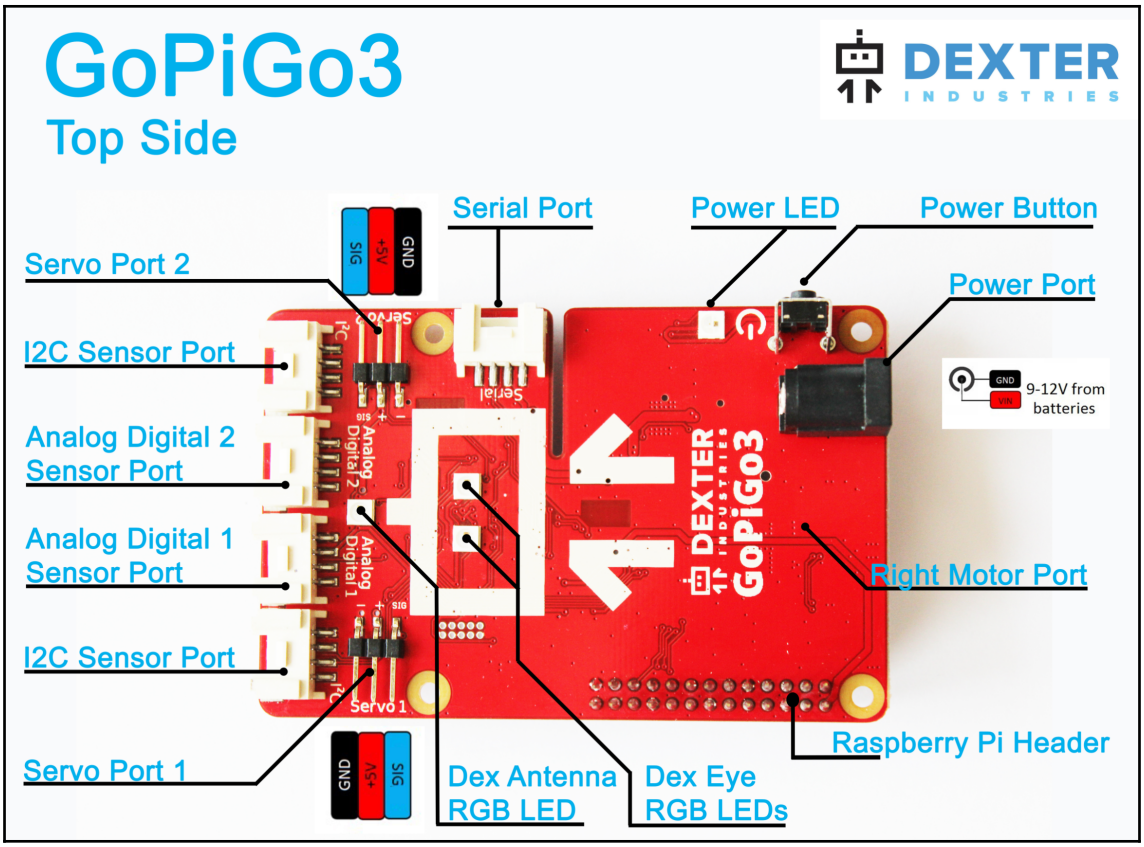
Chapter 1: Assembling the Robot

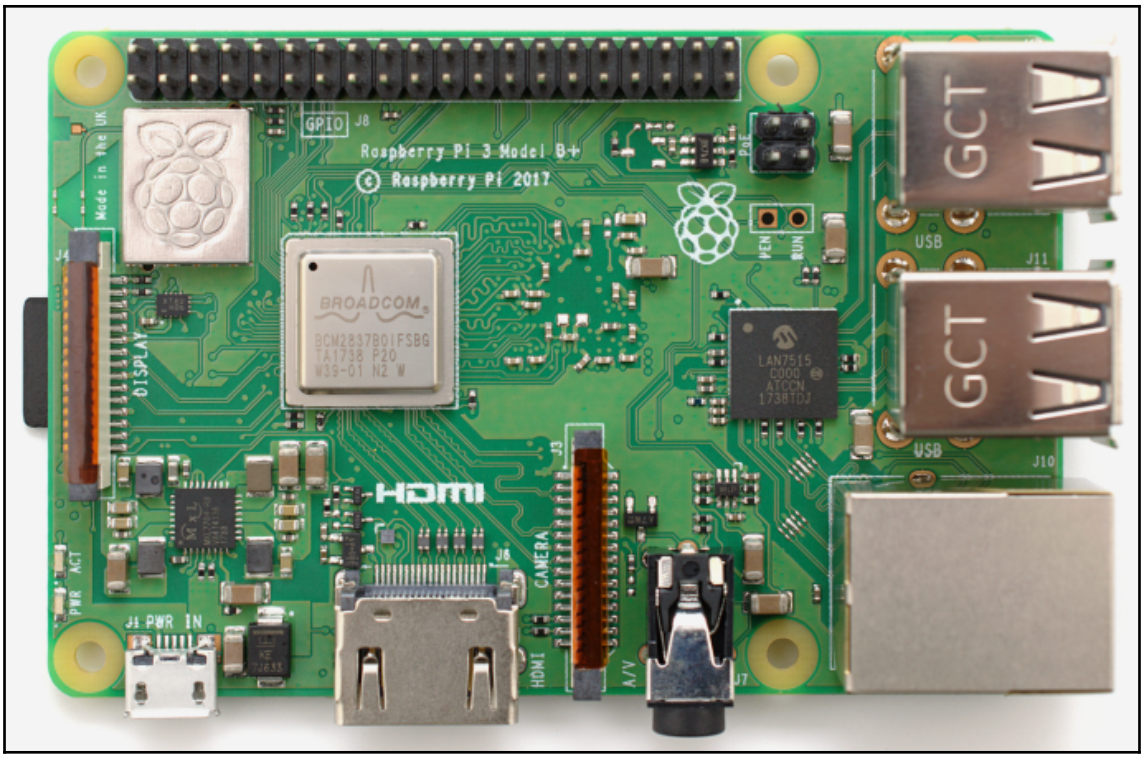


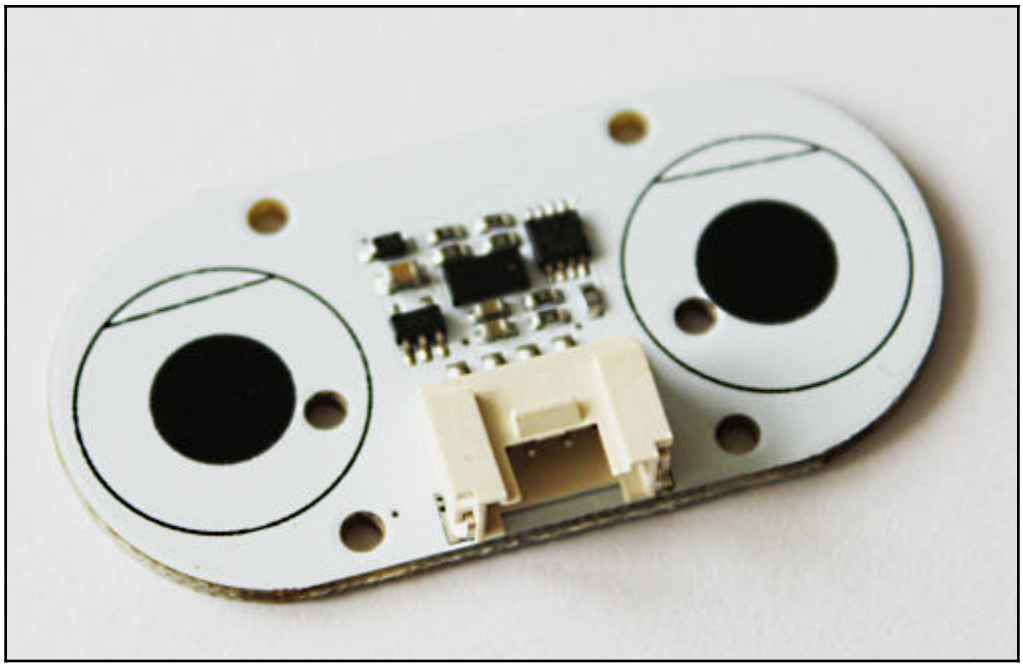


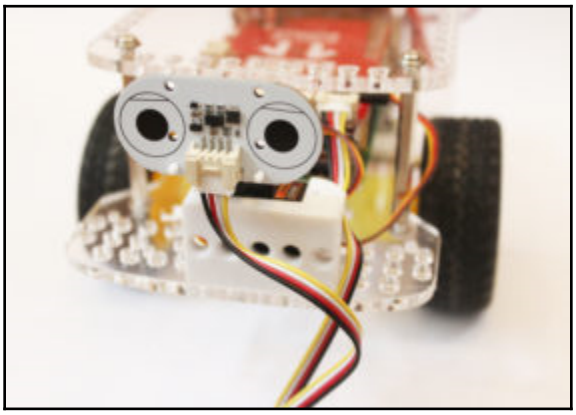


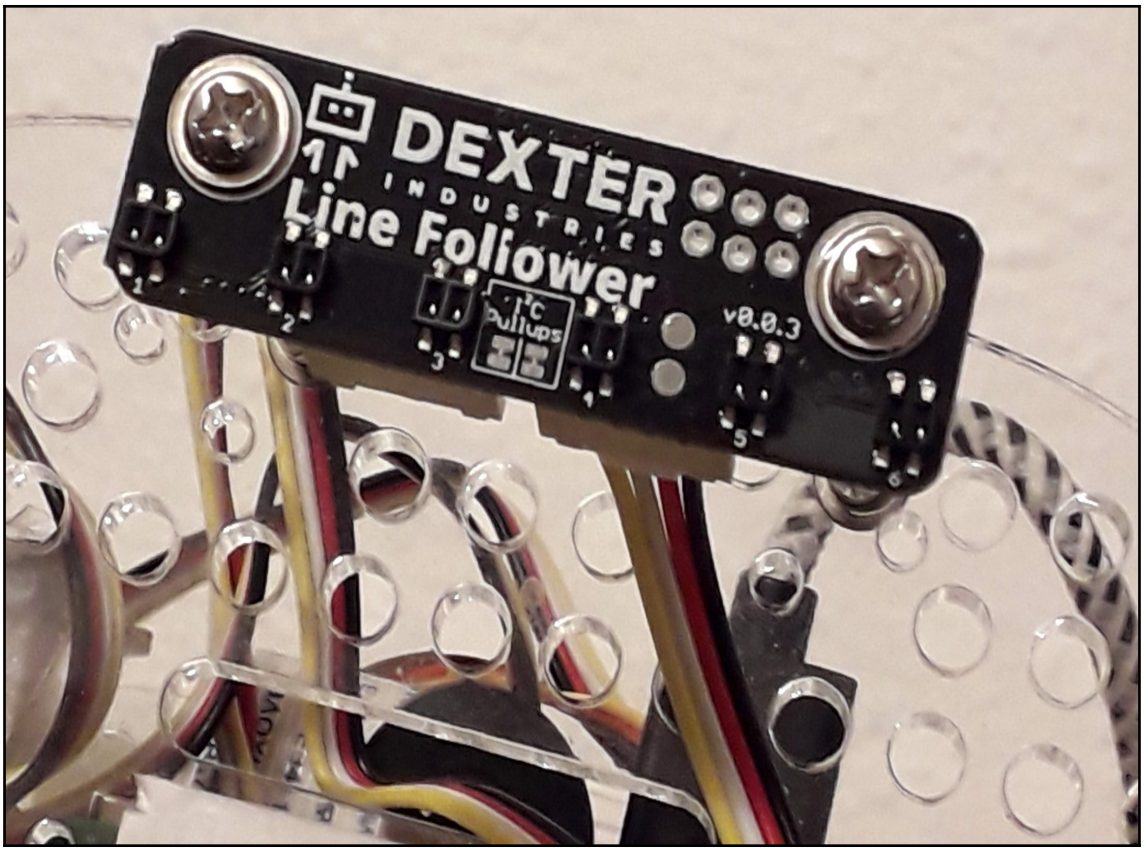

GoPiGo3
Bottom Side
DEXTER
INDUSTRIES
Left LED
Raspberry Pi Header
Left Motor Port
Right Motor Port
Right LED
Camera Slot
Motor Left
Motor Right
9-12V DC
v3.1.3

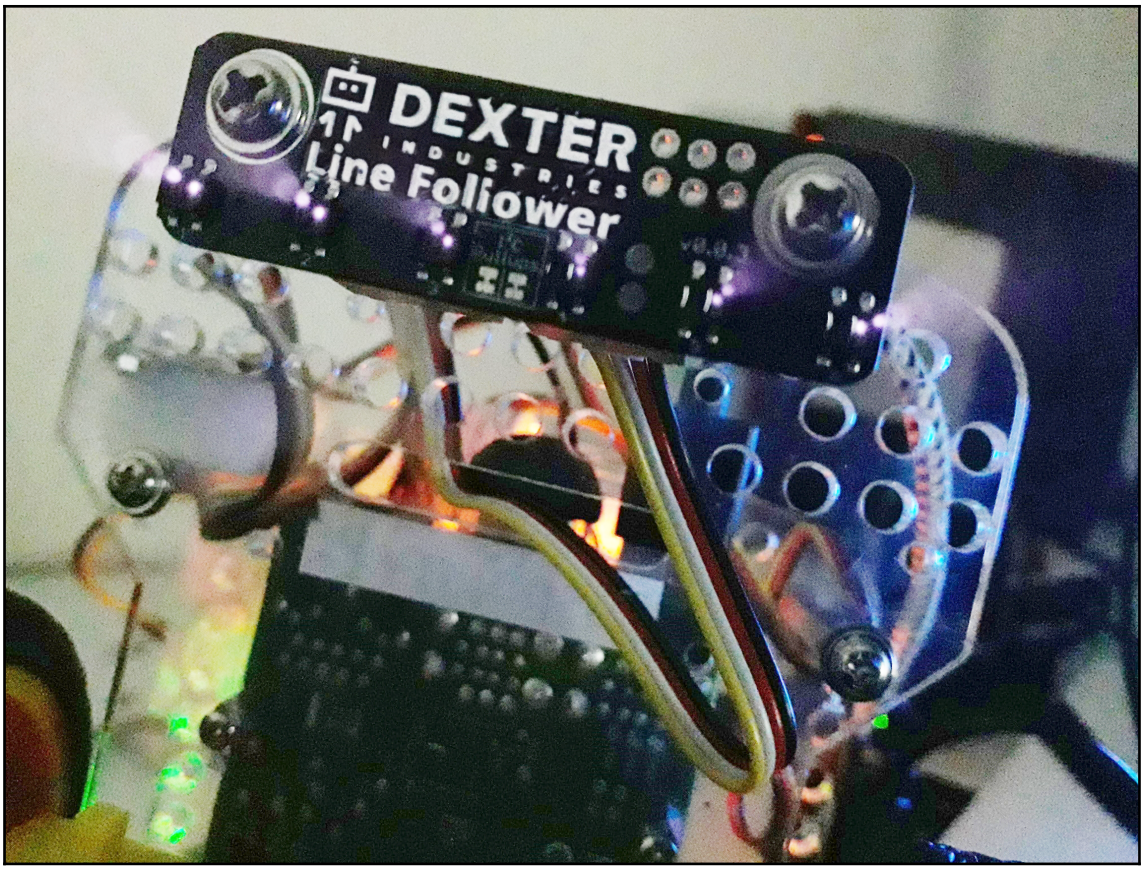

GoPiGo3
Top Side
DEXTER INDUSTRIES
Serial Port
Power LED
Power Button
Power Port
Servo Port 2
I2C Sensor Port
Analog Digital 2 Sensor Port
Analog Digital 1 Sensor Port
I2C Sensor Port
Servo Port 1
SIG
+5V
GND
Servo 2
Serial
Analog Digital 2
Analog Digital 1
Servo 1
DEXTER INDUSTRIES GoPiGo3
GND
VIN
9-12V from batteries
Right Motor Port
Raspberry Pi Header
Dex Antenna RGB LED
Dex Eye RGB LEDs


GPIO J8
Raspberry Pi 3 Model B+
© Raspberry Pi 2017
BROADCOM
BCM2837B0IFSBG
TA1738 P20
W39-01 N2 W
LAN7515
C000
ATCCN
1738TDJ
GCT
GCT
USB
USB
J11
J10
DISPLAY
HDMI
CAMERA
J3
J6
J4
PWR ACT
J1 PWR IN
HDMI
A/V
J7
PoE
PEN
RUN
Made in the UK

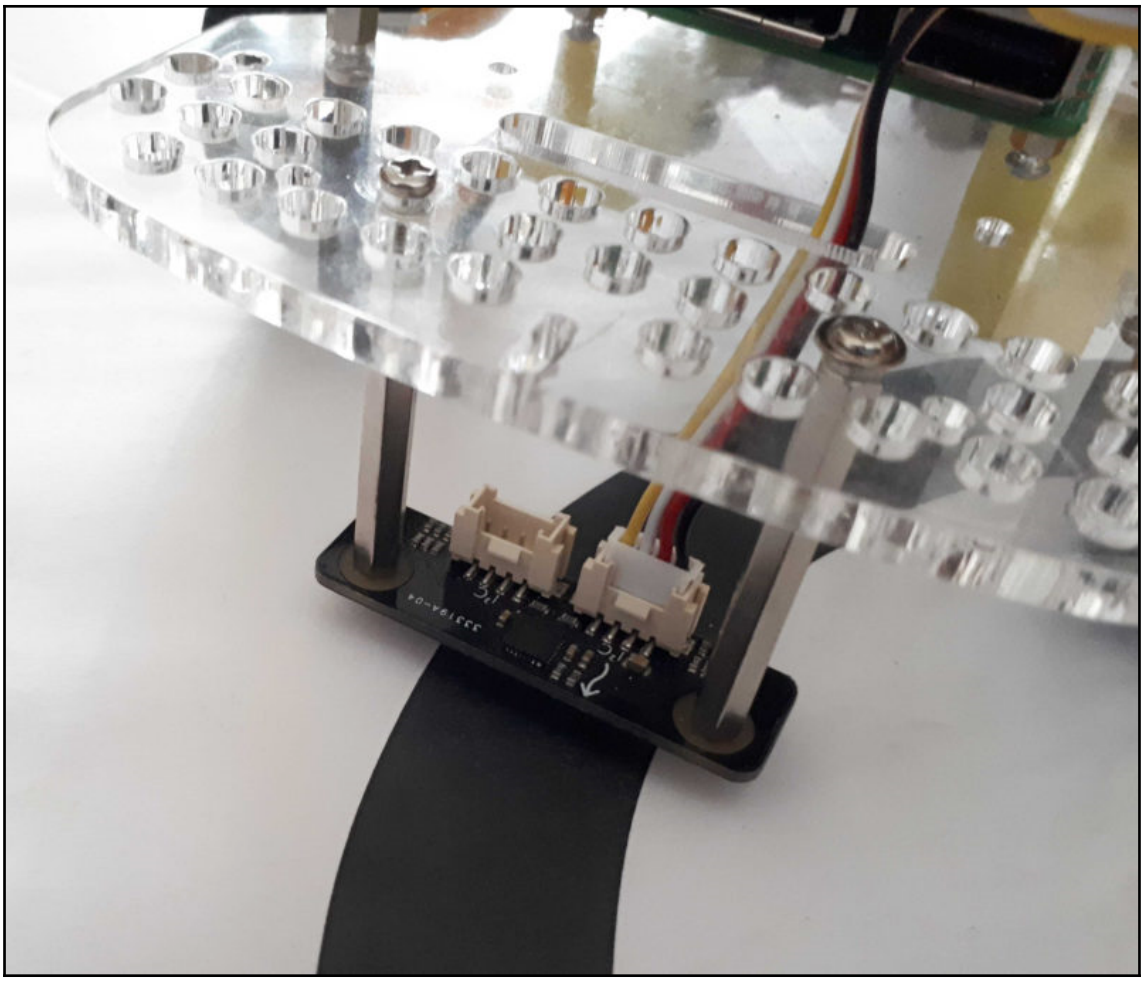




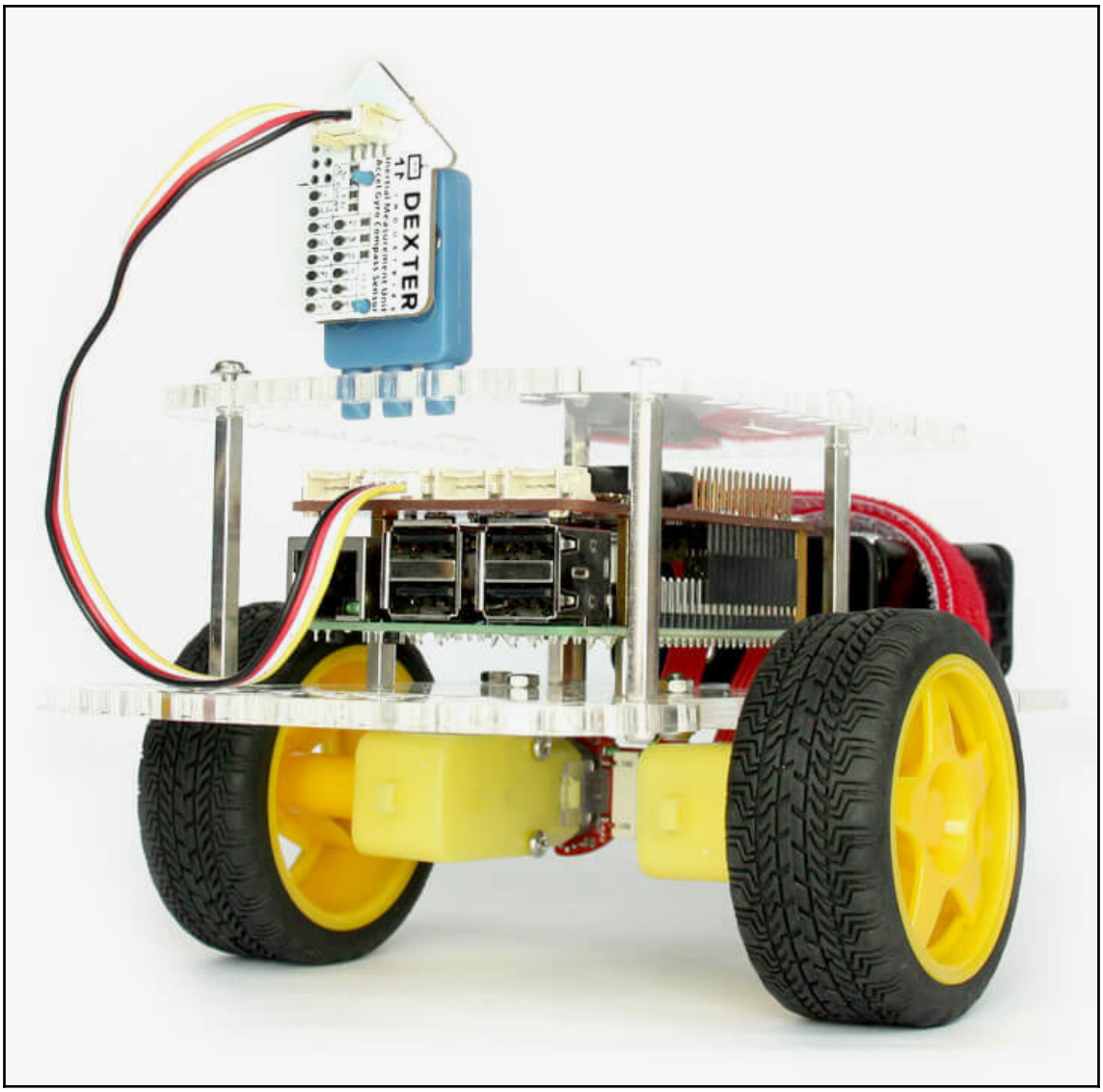

DEXTER
INDUSTRIES
Line Follower
I²C
Pullups
v0.0.3

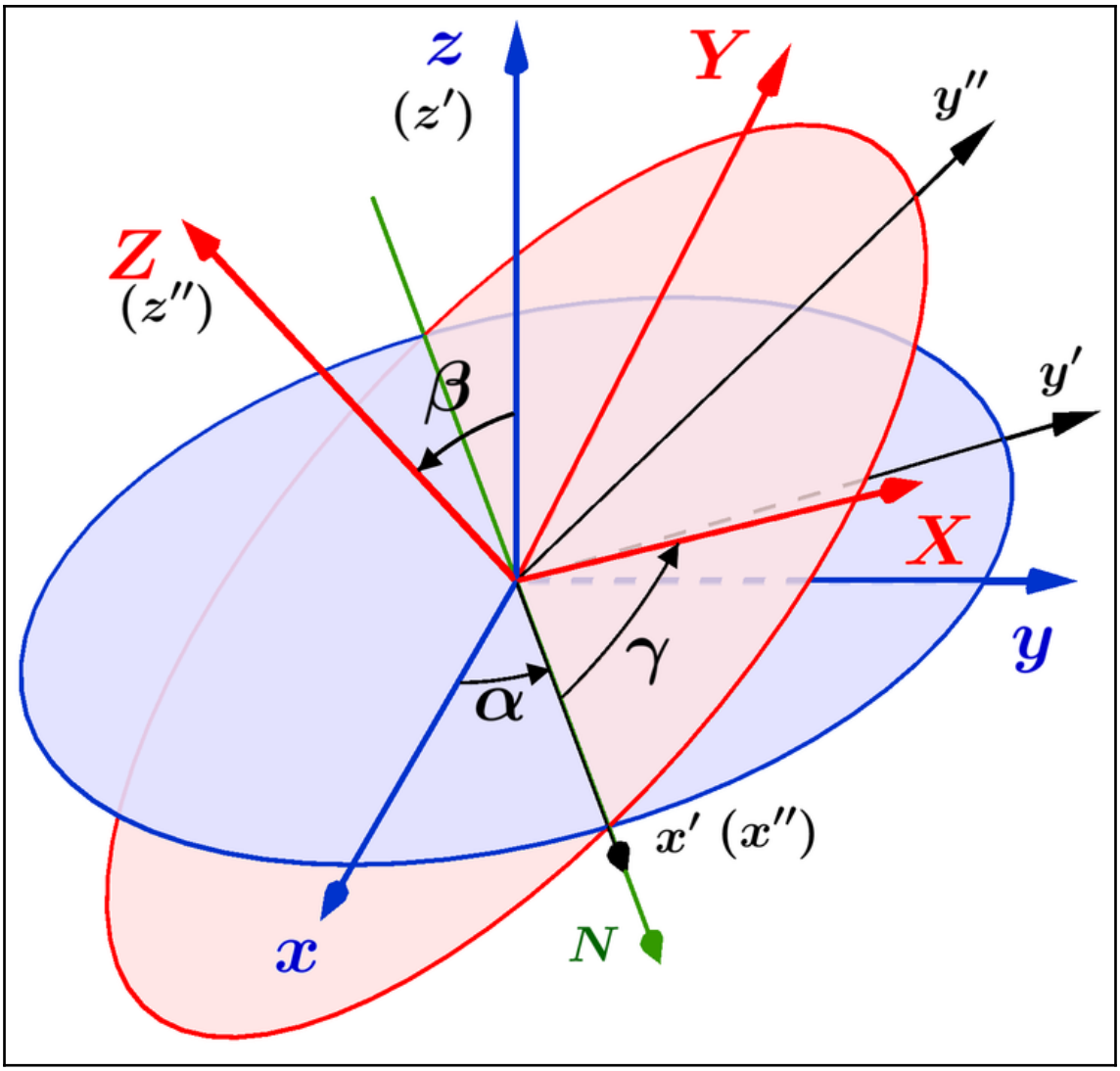

DEXTER
INDUSTRIES
Line Follower

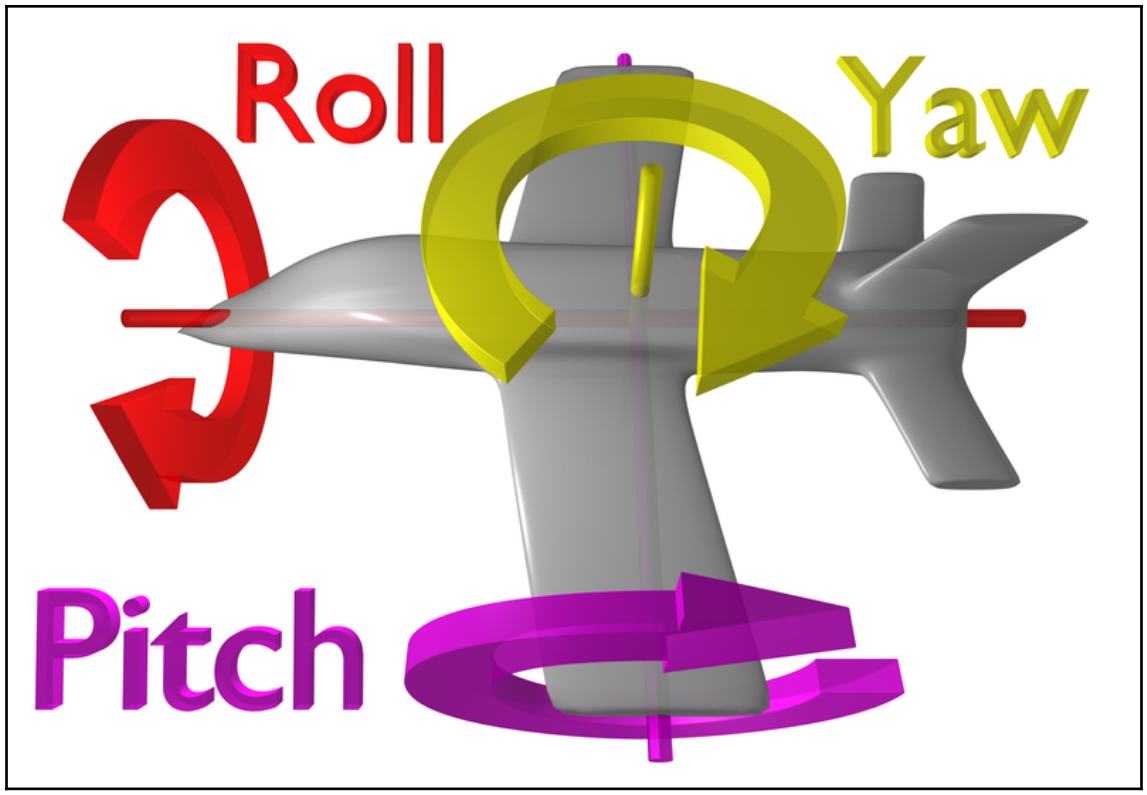

DEXTER
INDUSTRIES
Line Follower
v0.0.3
I²C
Pullups
1
2
3
4
5
6

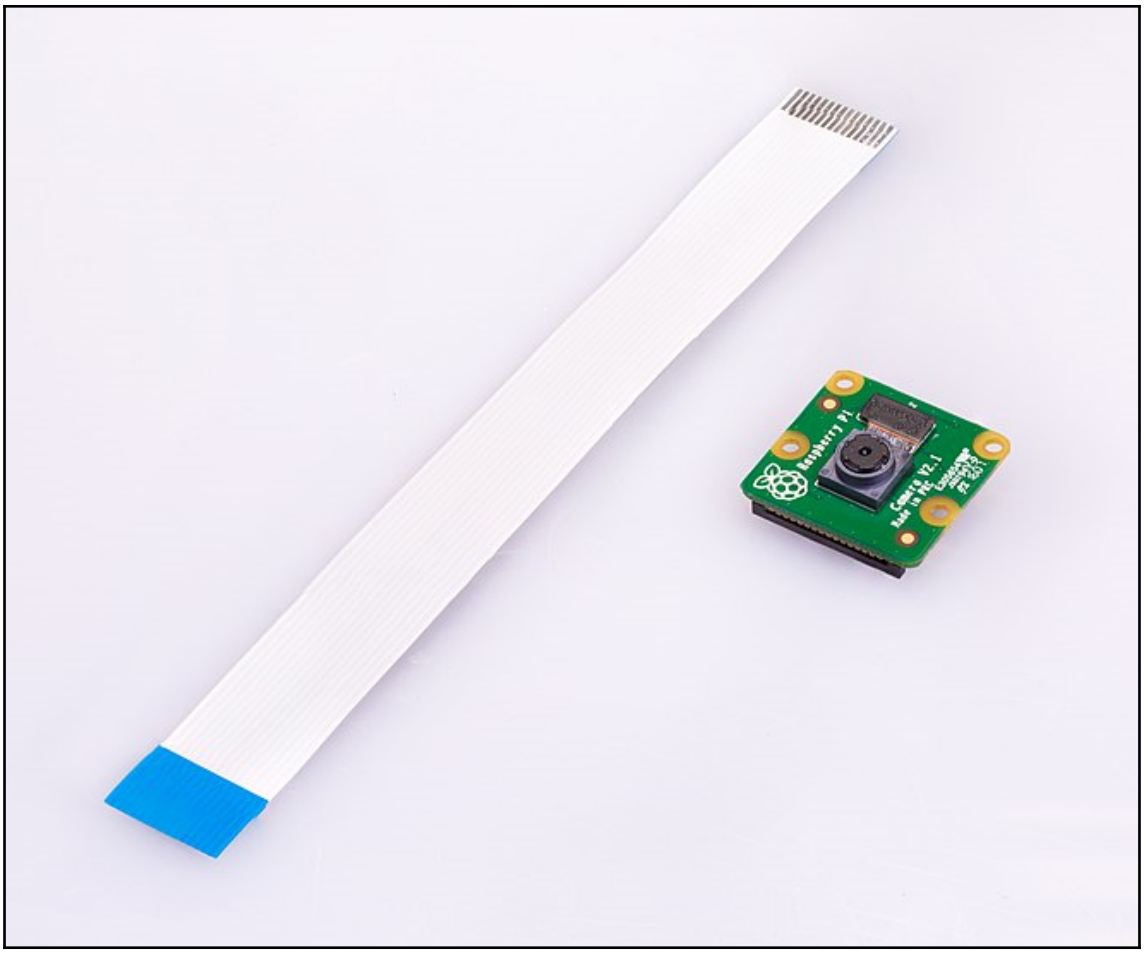


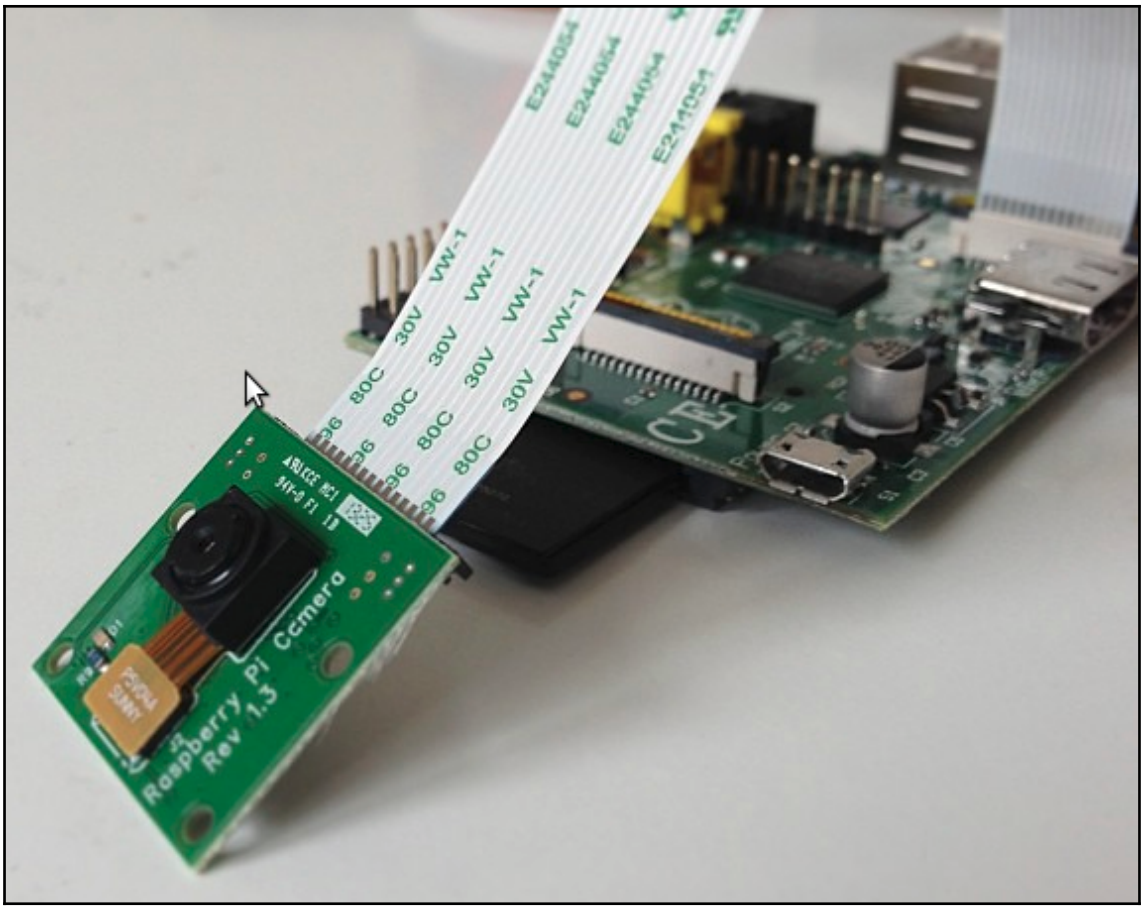

DEXTER
INDUSTRIES
Inertial Measurement Unit
Accel Gyro Compass Sensor
V1.1.1
+2.5v
I2C pullups
3.3v
CH3
PS0
PS1
BLP
BLI
PS2
5v
3.3v
GND
SCL
SDA
CH1
CH0
INT

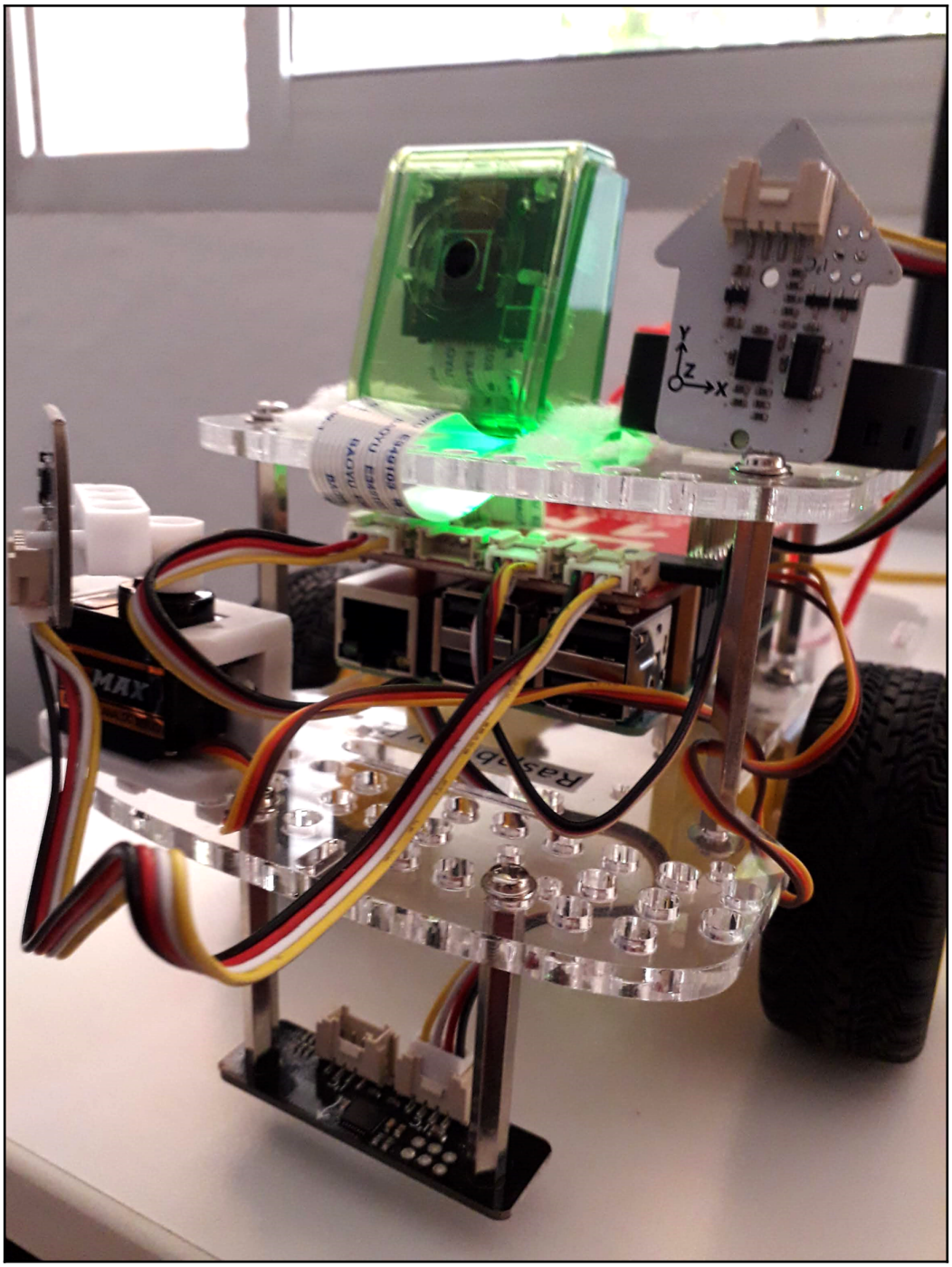

DEXTER

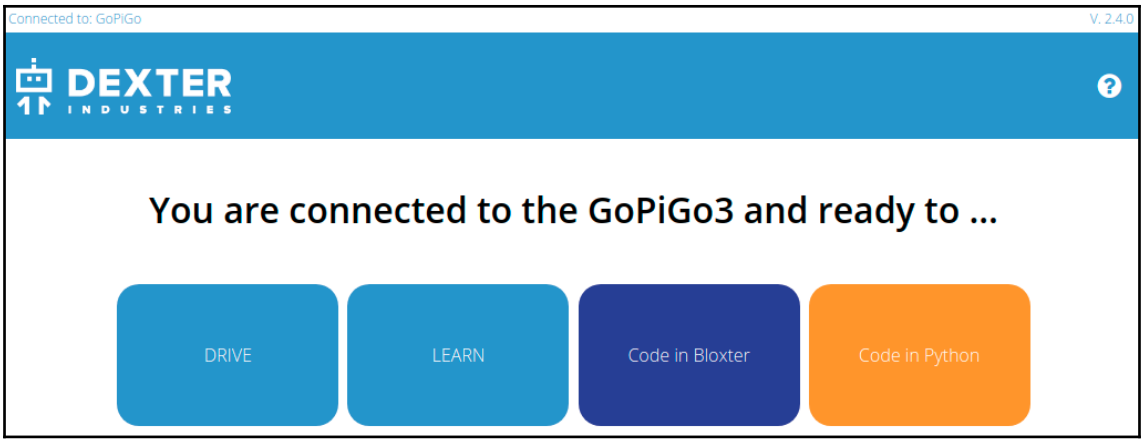

z
(z′)
Y
y″
Z
(z″)
β
y′
X
y
γ
α
x′ (x″)
x
N

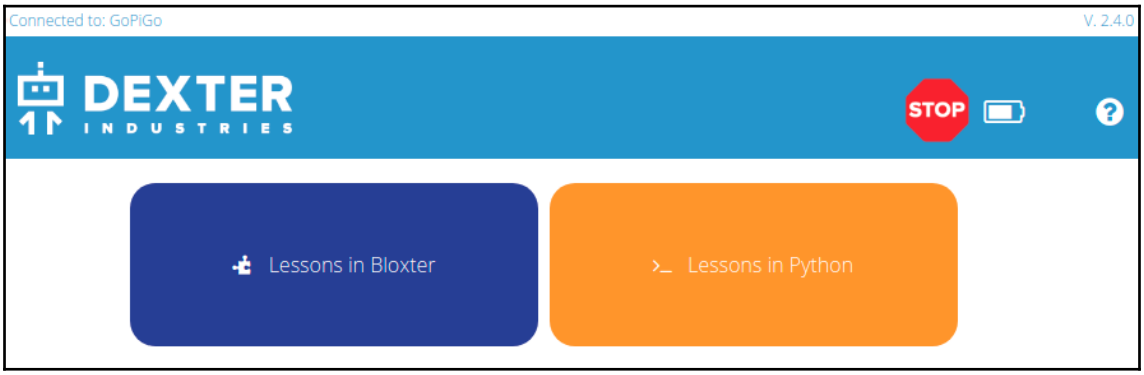

Roll
Yaw
Pitch

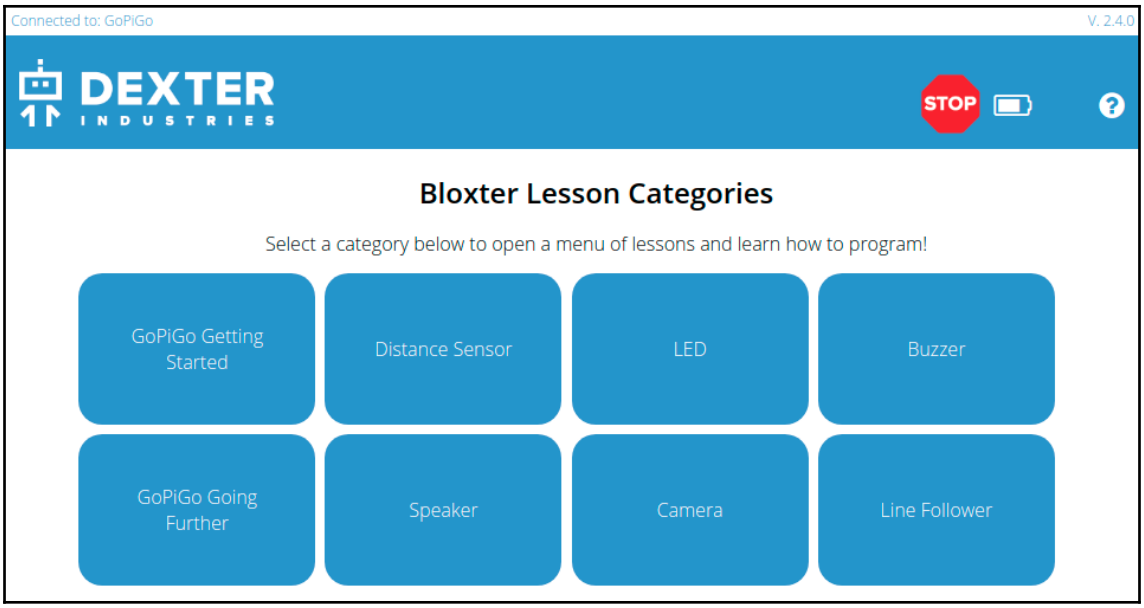

Raspberry Pi
Camera V2.1

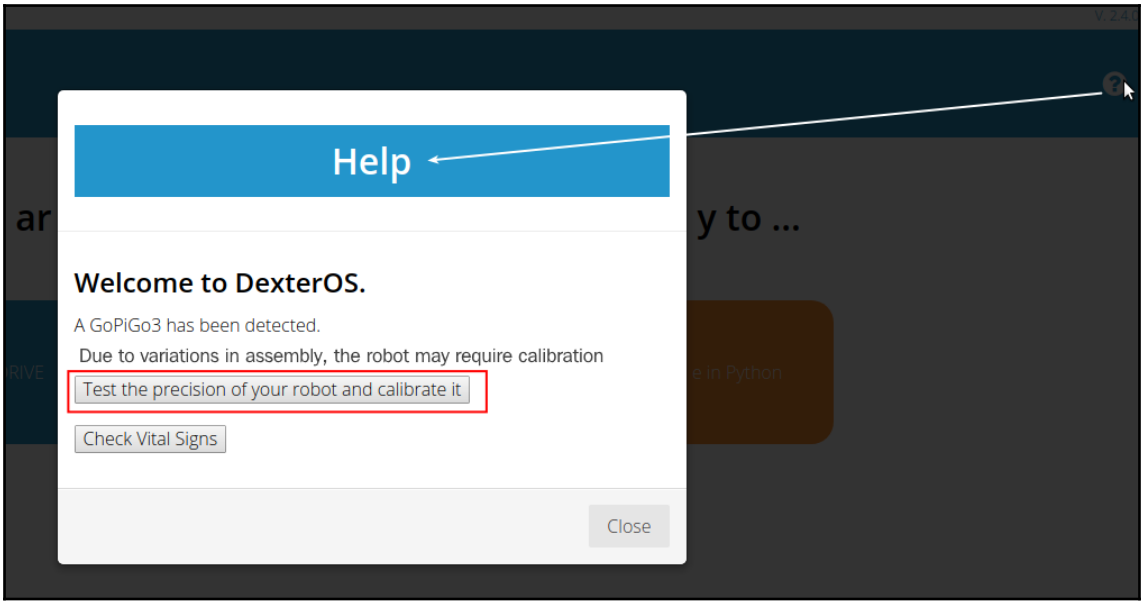

Raspberry Pi Camera
Rev 1.3

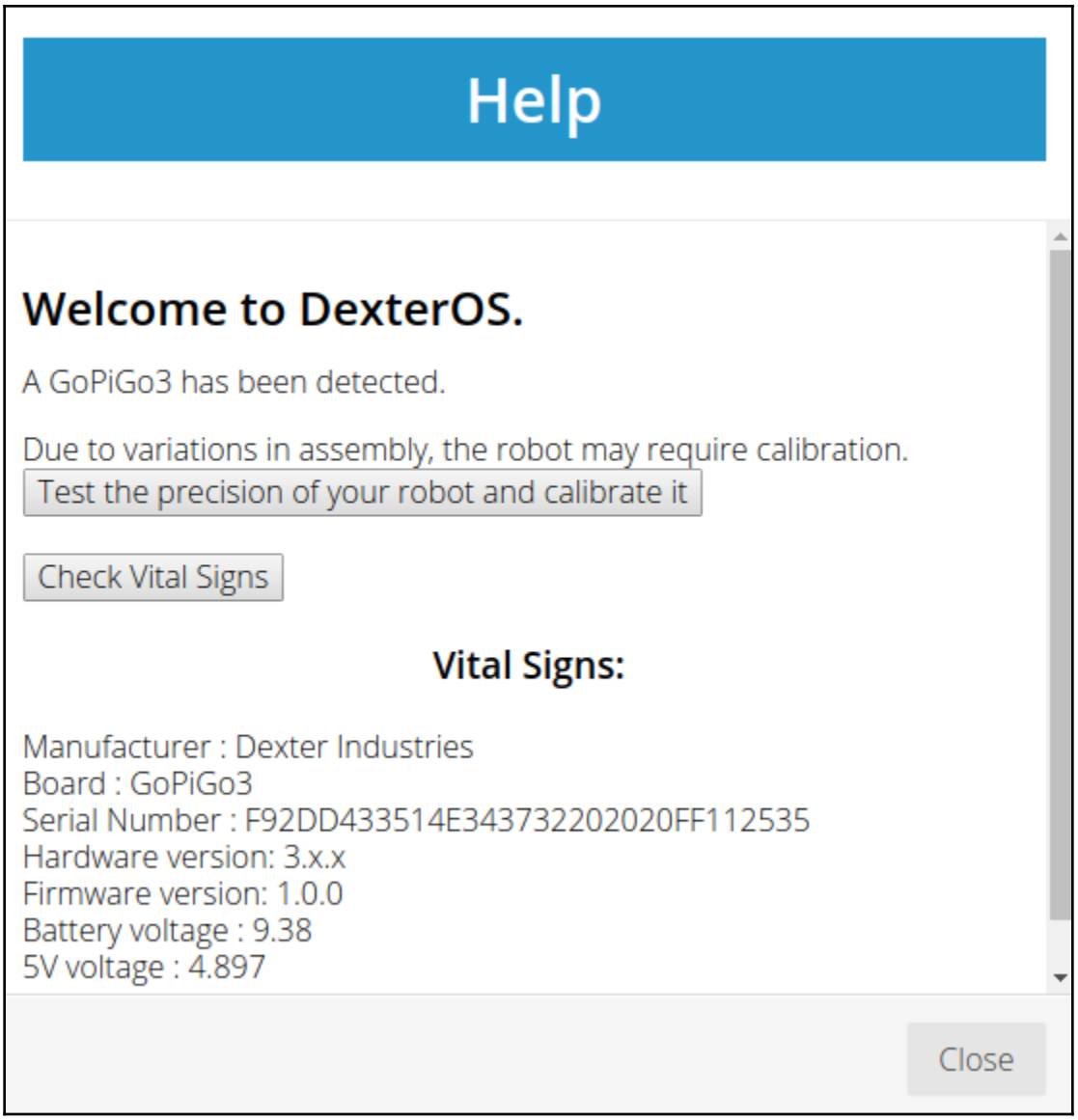

Y
Z
X

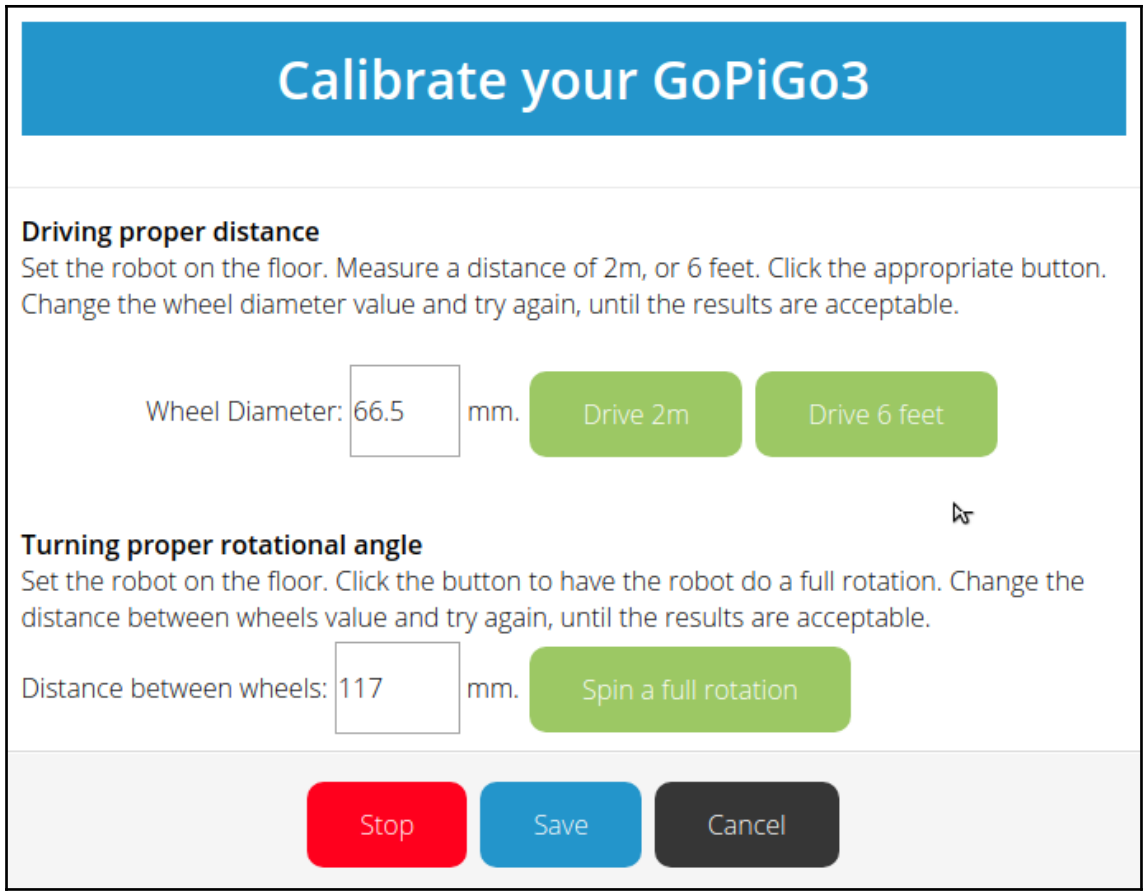

Connected to: GoPiGo
V. 2.4.0
DEXTER
INDUSTRIES
You are connected to the GoPiGo3 and ready to ...
DRIVE
LEARN
Code in Bloxter
Code in Python

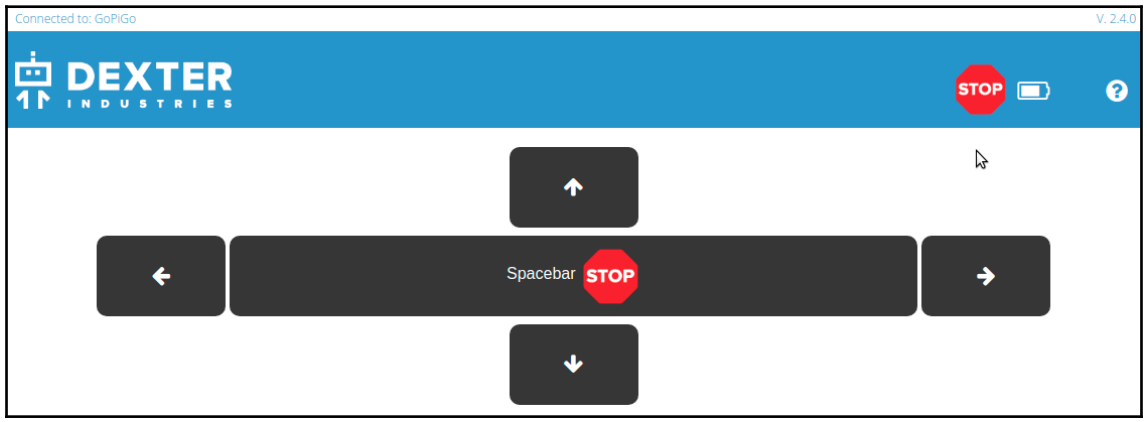

Connected to: GoPiGo
V. 2.4.0
DEXTER
INDUSTRIES
STOP
Lessons in Bloxter
Lessons in Python

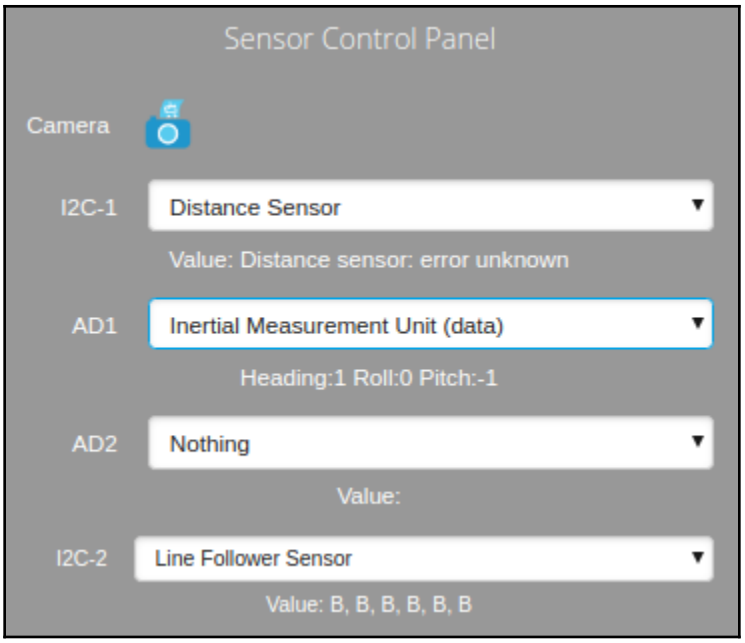

Connected to: GoPiGo
V. 2.4.0
DEXTER INDUSTRIES
STOP
Bloxter Lesson Categories
Select a category below to open a menu of lessons and learn how to program!
GoPiGo Getting Started
Distance Sensor
LED
Buzzer
GoPiGo Going Further
Speaker
Camera
Line Follower

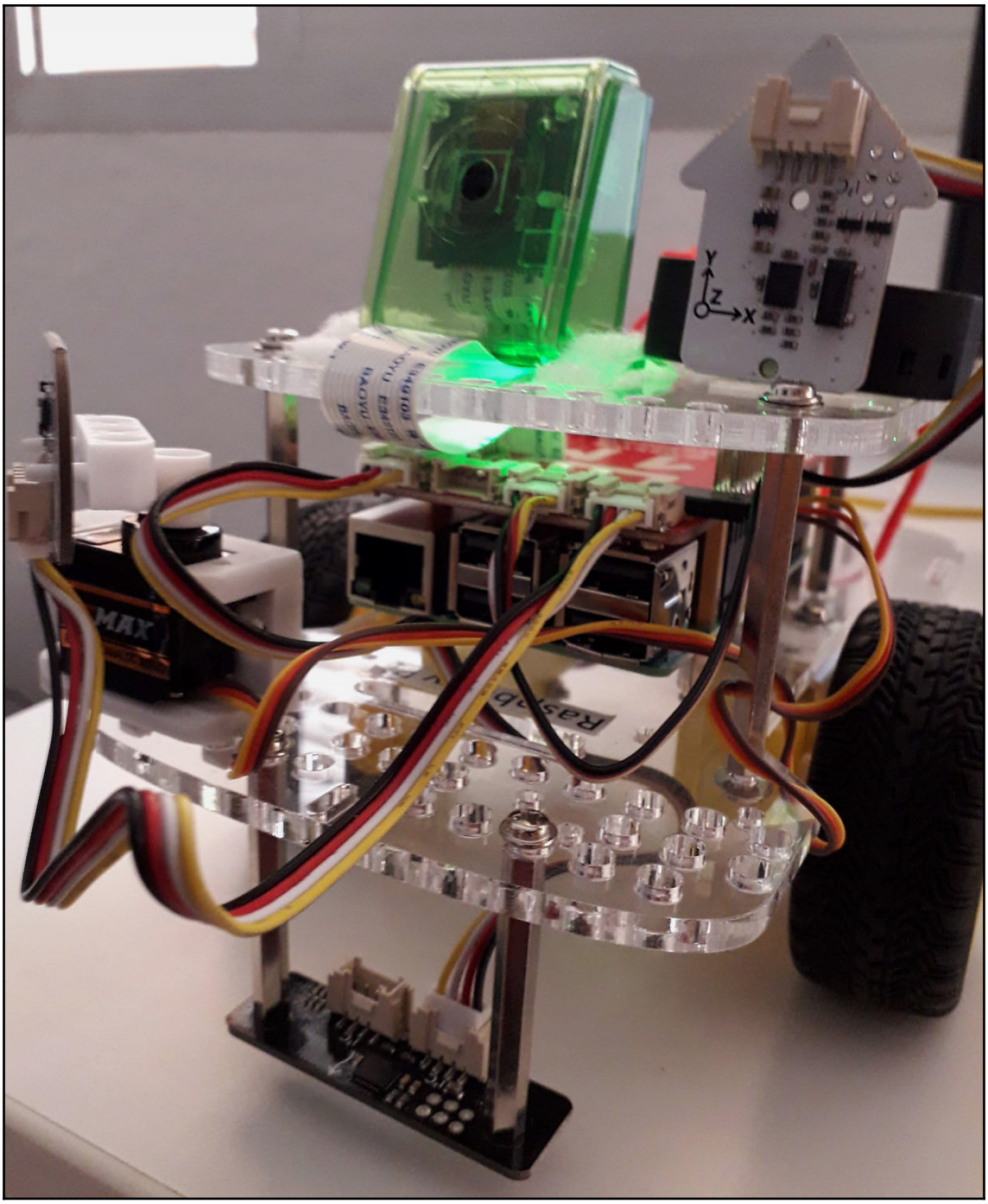

Help
Welcome to DexterOS.
A GoPiGo3 has been detected.
Due to variations in assembly, the robot may require calibration
Test the precision of your robot and calibrate it
Check Vital Signs
Close


Help
Welcome to DexterOS.
A GoPiGo3 has been detected.
Due to variations in assembly, the robot may require calibration.
Test the precision of your robot and calibrate it
Check Vital Signs
Vital Signs:
Manufacturer : Dexter Industries
Board : GoPiGo3
Serial Number : F92DD433514E343732202020FF112535
Hardware version: 3.x.x
Firmware version: 1.0.0
Battery voltage : 9.38
5V voltage : 4.897
Close


Calibrate your GoPiGo3
Driving proper distance
Set the robot on the floor. Measure a distance of 2m, or 6 feet. Click the appropriate button.
Change the wheel diameter value and try again, until the results are acceptable.
Wheel Diameter: 66.5 mm.
Drive 2m
Drive 6 feet
Turning proper rotational angle
Set the robot on the floor. Click the button to have the robot do a full rotation. Change the
distance between wheels value and try again, until the results are acceptable.
Distance between wheels: 117 mm.
Spin a full rotation
Stop
Save
Cancel


Connected to: GoPiGo
V. 2.4.0
DEXTER
INDUSTRIES
STOP
Spacebar
STOP


Sensor Control Panel
Camera
I2C-1
Distance Sensor
Value: Distance sensor: error unknown
AD1
Inertial Measurement Unit (data)
Heading:1 Roll:0 Pitch:-1
AD2
Nothing
Value:
I2C-2
Line Follower Sensor
Value: B, B, B, B, B, B


Y
Z
X

Chapter 2: Unit Testing of GoPiGo3

Problem statement:

You want to read the distance sensor every 1 second and provide the real time output reading in three units: centimeters, milimeters and inches

Solution:

Import required Python modules

- **EasyDistanceSensor** for accessing the distance sensors readings
- **time** to set the interval between consecutive readings

```
from di_sensors.easy_distance_sensor import EasyDistanceSensor
from time import sleep
```

Instantiate the distance object

Create the object *my_sensor*, which is of the *EasyDistanceSensor* class

```
my_sensor = EasyDistanceSensor()
```

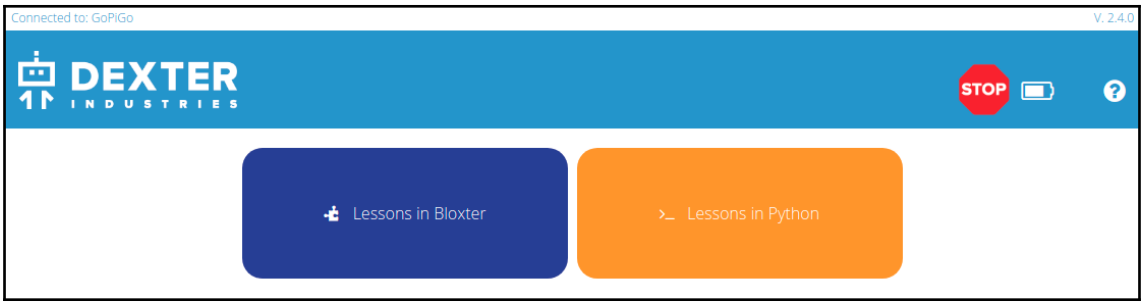
Read the sensor

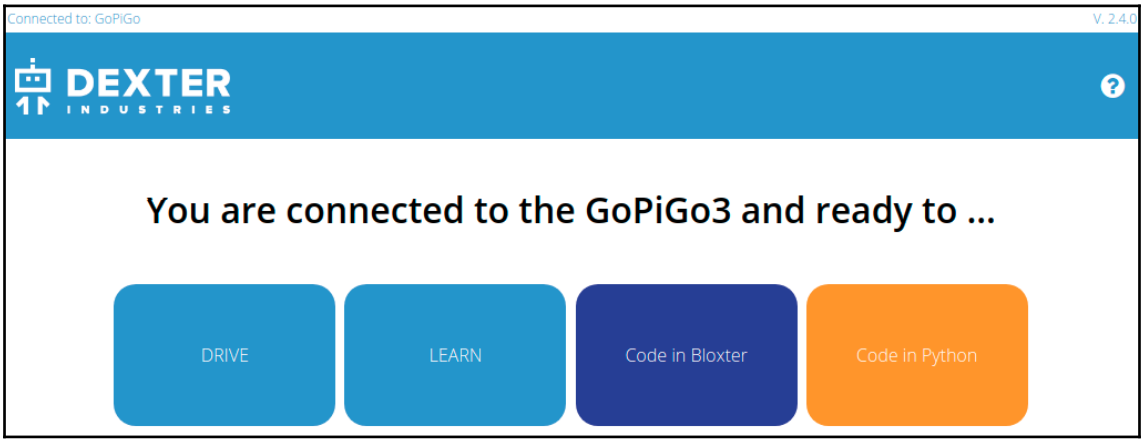
Launch an infinite loop that is executed one time per second. You use the 3 methods provided by the *EasyDistanceSensor* class to obtain the reading:

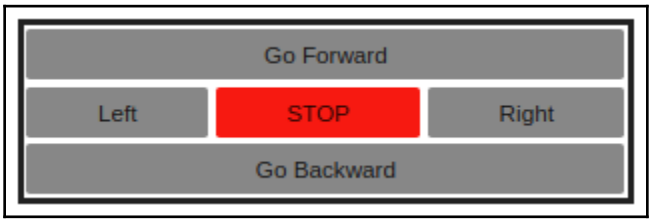
- *.read()* for centimeters
- *.read_mm()* for milimeters
- *.read_inches()* for inches

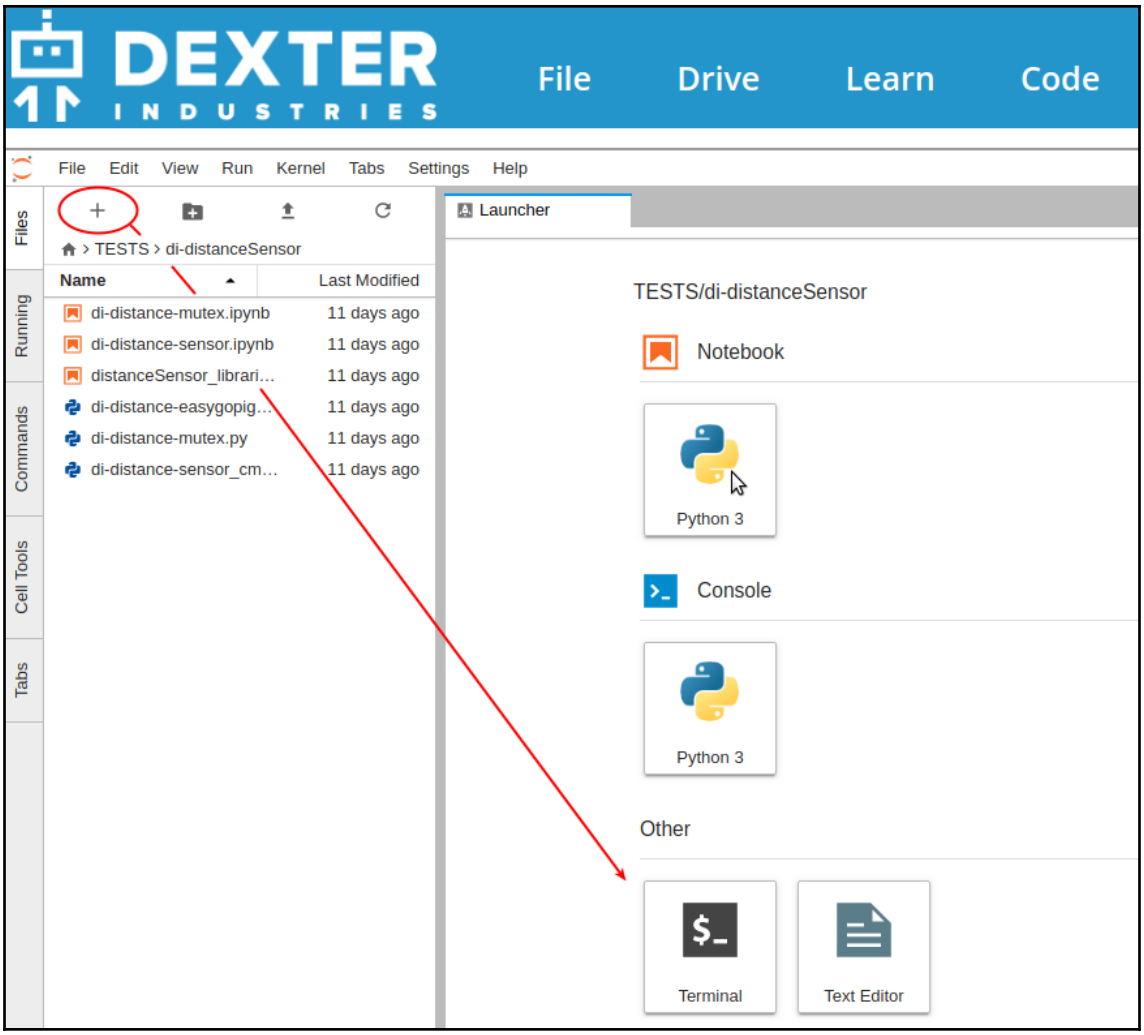
```
while True:
  read_distance = my_sensor.read()
  read_distance_mm = my_sensor.read_mm()
  read_distance_inch = my_sensor.read_inches()

  print("distance from object: {} cm or {} mm or {} in".format(read_distance,read_distance_mm,read_distance_inch))

  sleep(1)
```

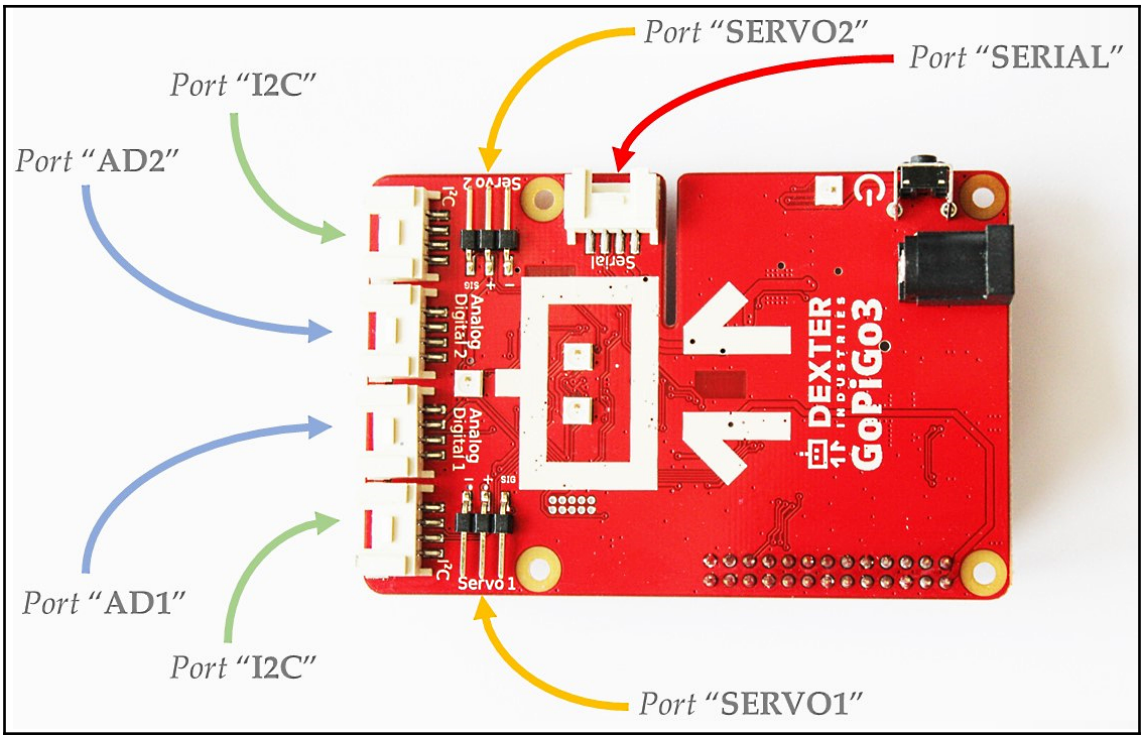
```
distance from object: 15 cm or 149 mm or 5.5 in
distance from object: 9 cm or 90 mm or 3.5 in
distance from object: 14 cm or 146 mm or 5.9 in
distance from object: 20 cm or 213 mm or 8.7 in
```

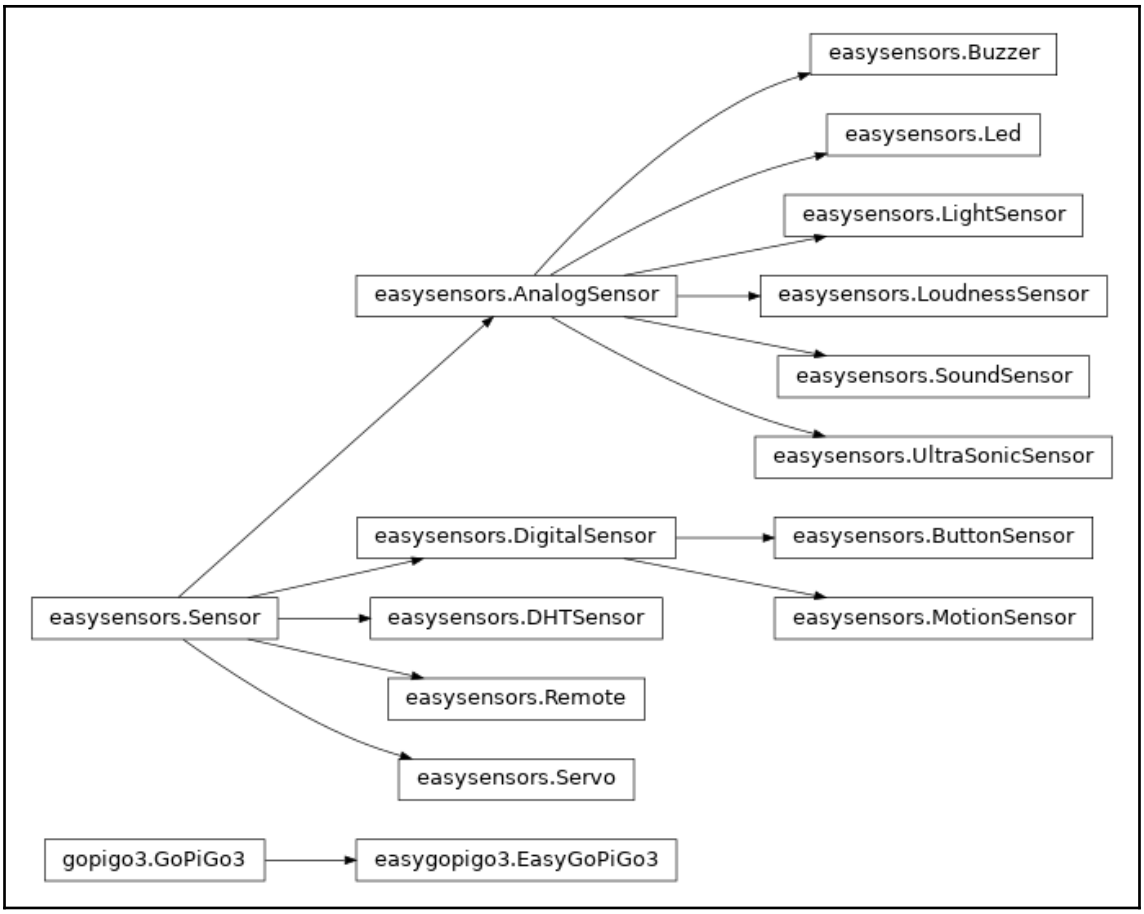

Connected to: GoPiGo
V. 2.4.0
DEXTER
INDUSTRIES
STOP
Lessons in Bloxter
Lessons in Python

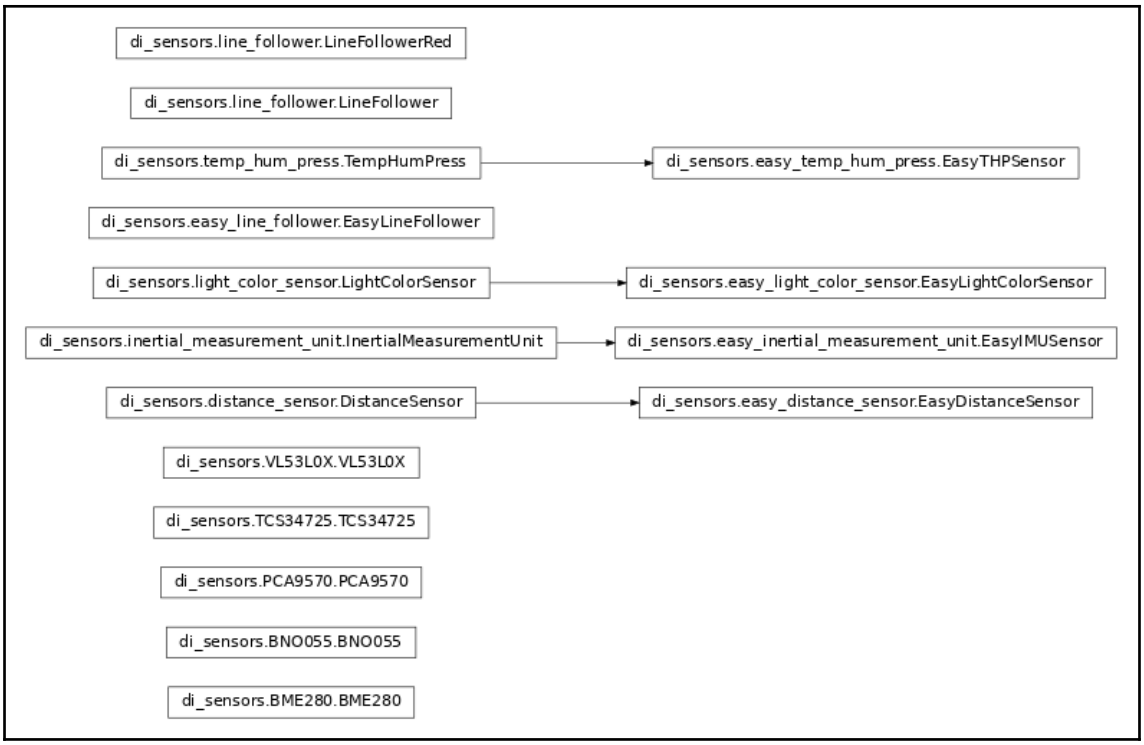

Connected to: GoPiGo
V. 2.4.0
DEXTER
INDUSTRIES
You are connected to the GoPiGo3 and ready to ...
DRIVE
LEARN
Code in Bloxter
Code in Python

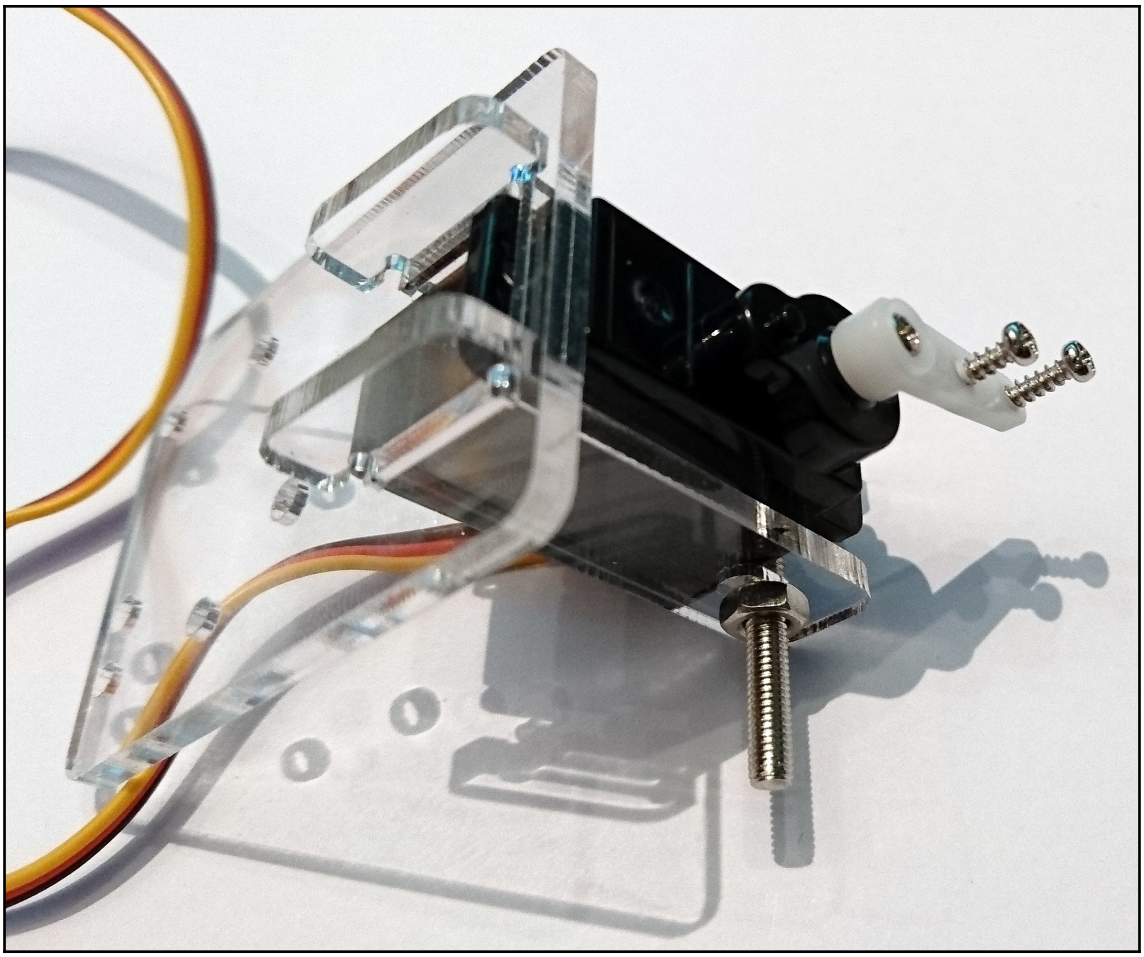

Go Forward
Left
STOP
Right
Go Backward

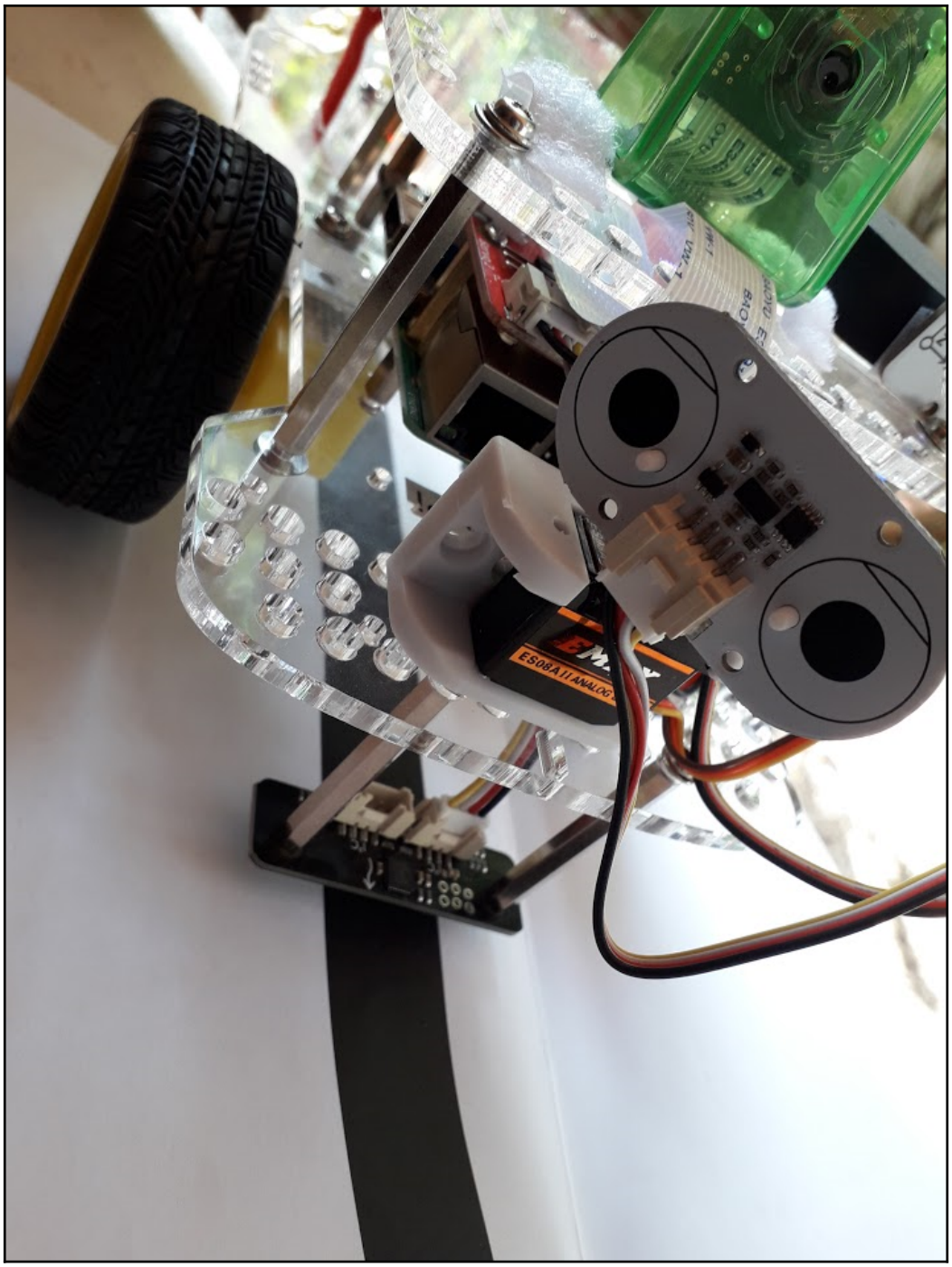

DEXTER INDUSTRIES
File
Drive
Learn
Code
File Edit View Run Kernel Tabs Settings Help
Files
Running
Commands
Cell Tools
Tabs
TESTS › di-distanceSensor
Name
Last Modified
di-distance-mutex.ipynb 11 days ago
di-distance-sensor.ipynb 11 days ago
distanceSensor_librari... 11 days ago
di-distance-easygopig... 11 days ago
di-distance-mutex.py 11 days ago
di-distance-sensor_cm... 11 days ago
Launcher
TESTS/di-distanceSensor
Notebook
Python 3
Console
Python 3
Other
Terminal
Text Editor

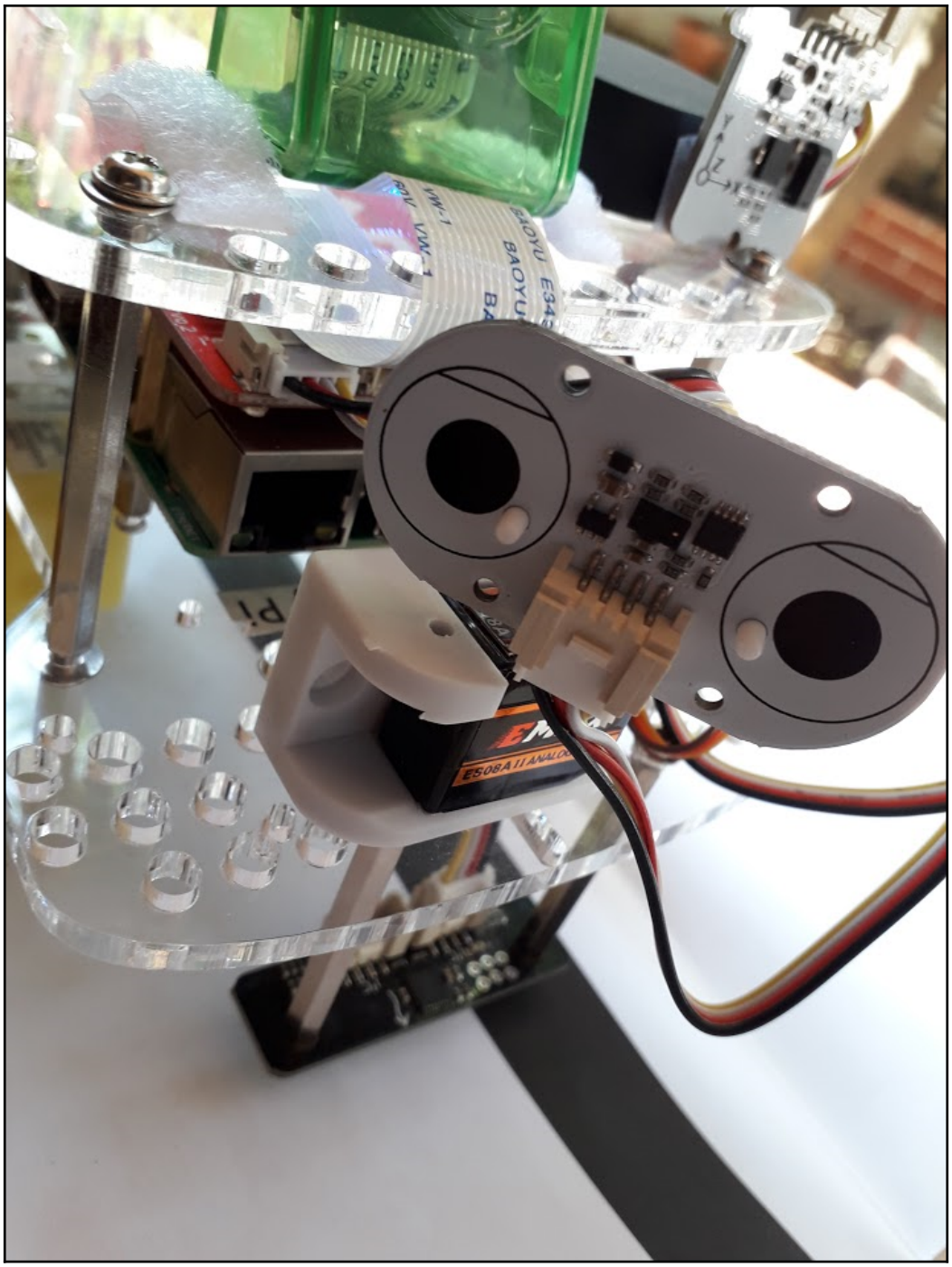

Port "SERVO2"
Port "SERIAL"
Port "I2C"
Port "AD2"
Port "AD1"
Port "I2C"
Port "SERVO1"
Servo 2
Serial
Analog Digital 2
Analog Digital 1
Servo 1
DEXTER INDUSTRIES
GoPiGo3

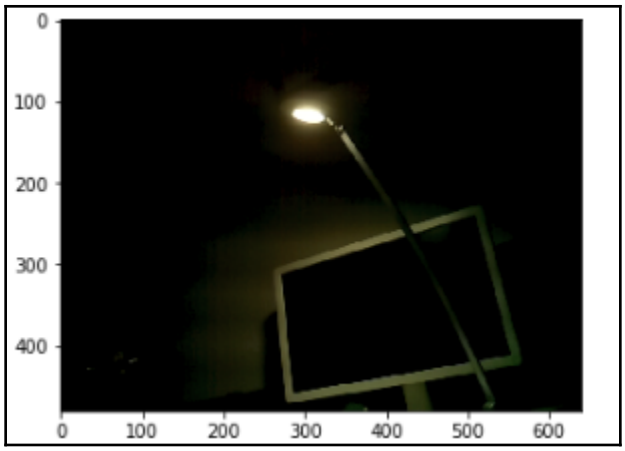

easysensors.Buzzer
easysensors.Led
easysensors.LightSensor
easysensors.AnalogSensor
easysensors.LoudnessSensor
easysensors.SoundSensor
easysensors.UltraSonicSensor
easysensors.DigitalSensor
easysensors.ButtonSensor
easysensors.Sensor
easysensors.DHTSensor
easysensors.MotionSensor
easysensors.Remote
easysensors.Servo
gopigo3.GoPiGo3
easygopigo3.EasyGoPiGo3

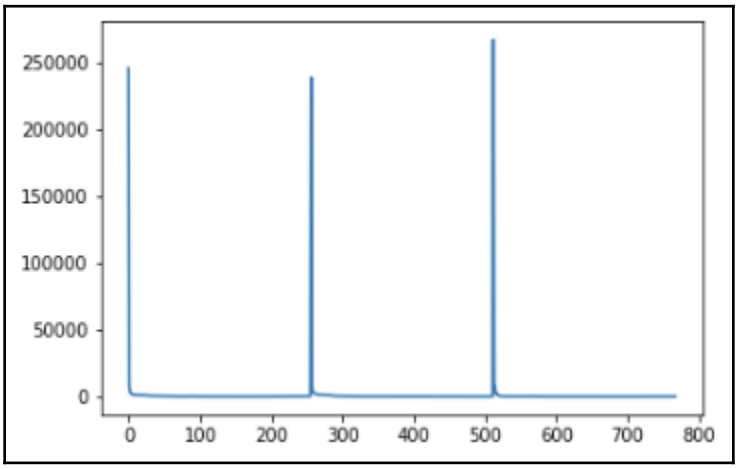

di_sensors.line_follower.LineFollowerRed
di_sensors.line_follower.LineFollower
di_sensors.temp_hum_press.TempHumPress
di_sensors.easy_temp_hum_press.EasyTHPSensor
di_sensors.easy_line_follower.EasyLineFollower
di_sensors.light_color_sensor.LightColorSensor
di_sensors.easy_light_color_sensor.EasyLightColorSensor
di_sensors.inertial_measurement_unit.InertialMeasurementUnit
di_sensors.easy_inertial_measurement_unit.EasyIMUSensor
di_sensors.distance_sensor.DistanceSensor
di_sensors.easy_distance_sensor.EasyDistanceSensor
di_sensors.VL53L0X.VL53L0X
di_sensors.TCS34725.TCS34725
di_sensors.PCA9570.PCA9570
di_sensors.BNO055.BNO055
di_sensors.BME280.BME280



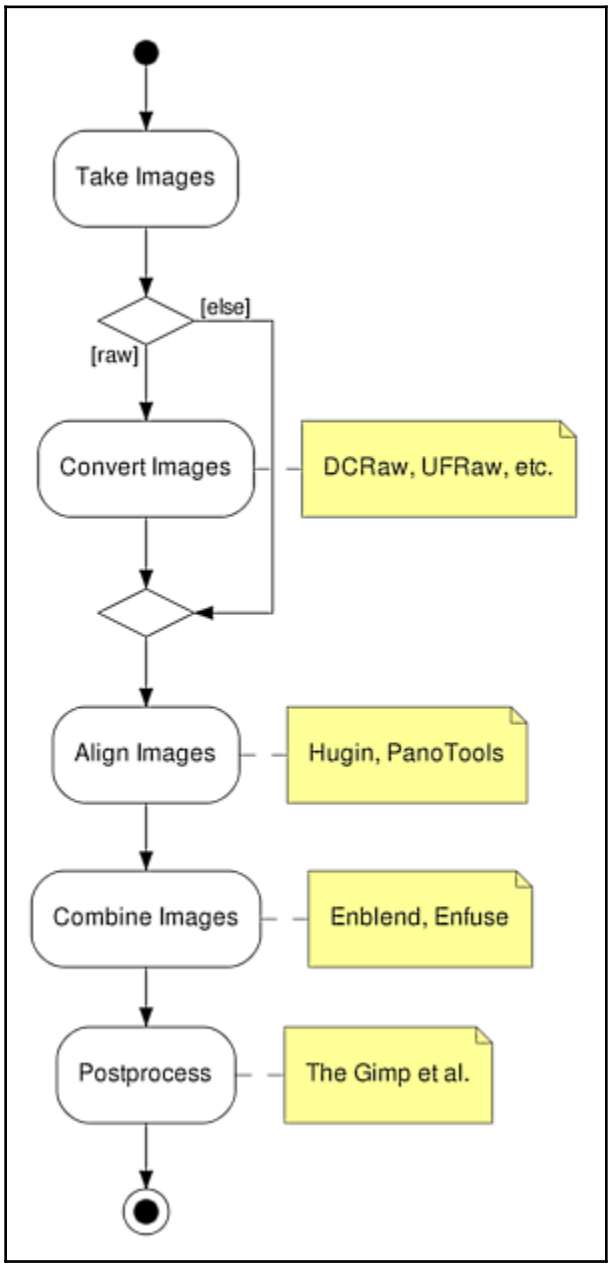

ES08A II ANALOG

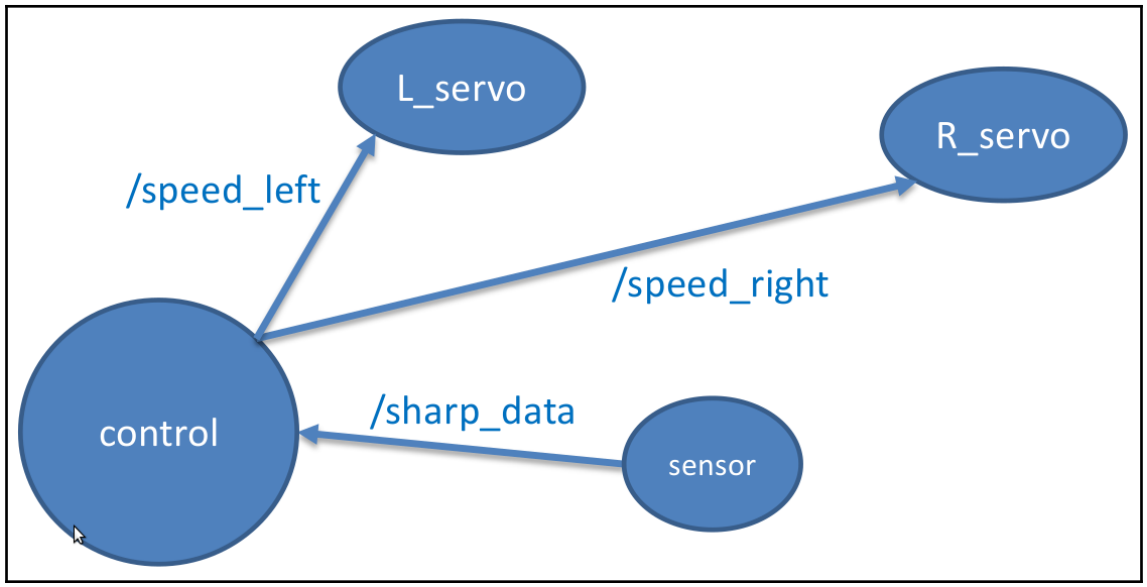

BAOYU E34
E508A II ANALO

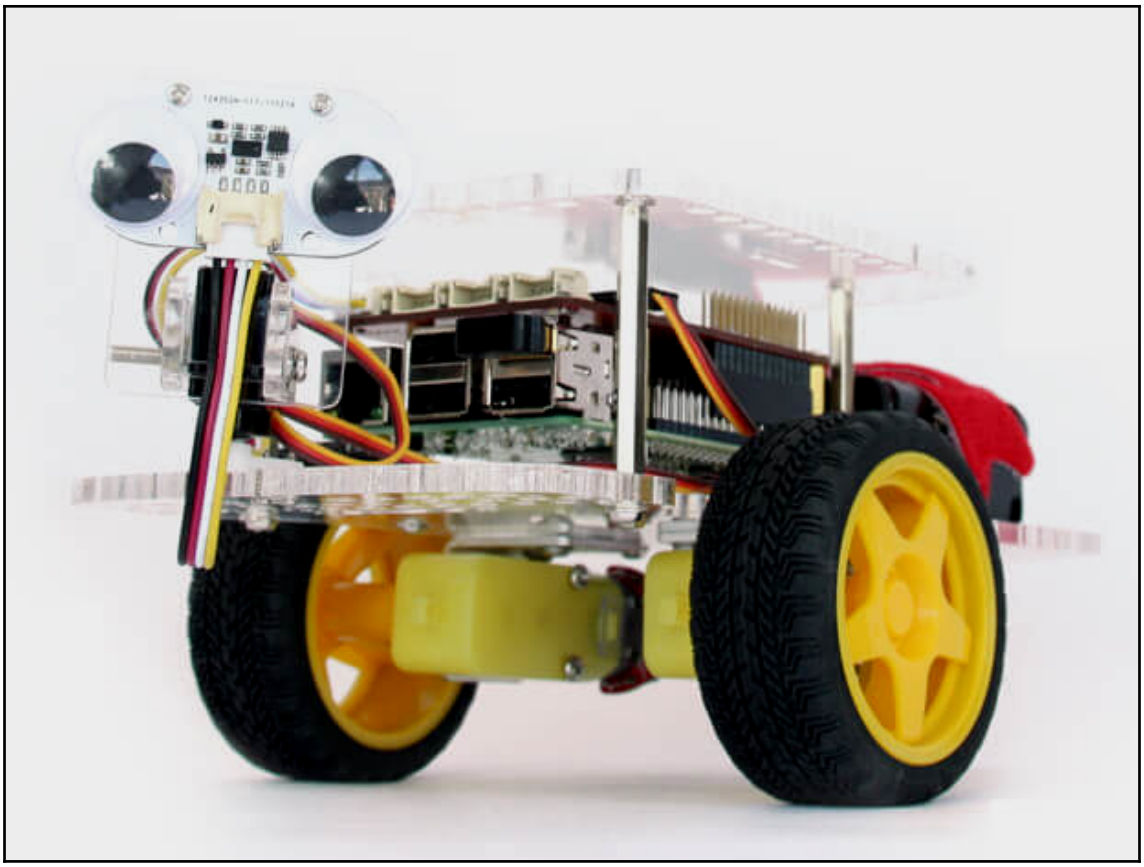

0
100
200
300
400
0
100
200
300
400
500
600

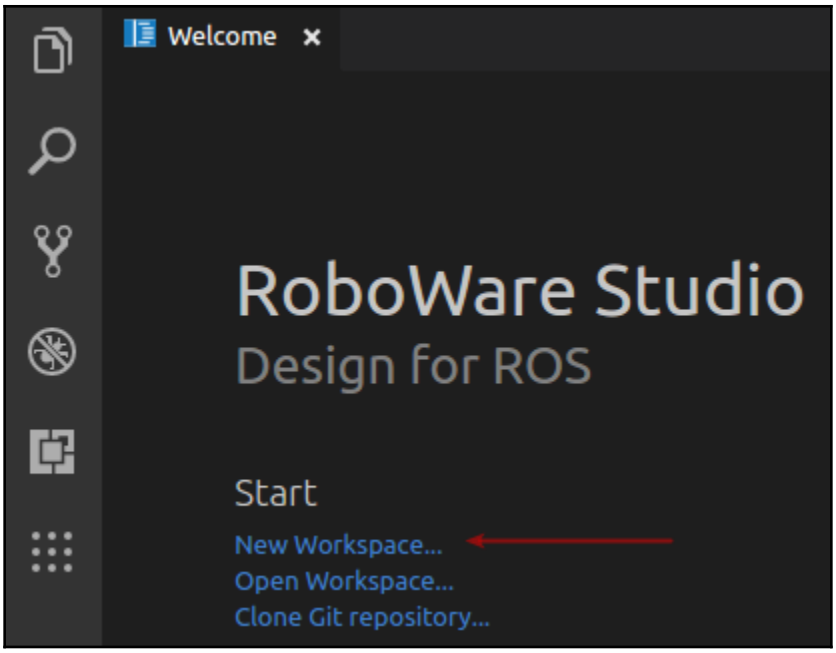

250000
200000
150000
100000
50000
0
0
100
200
300
400
500
600
700
800

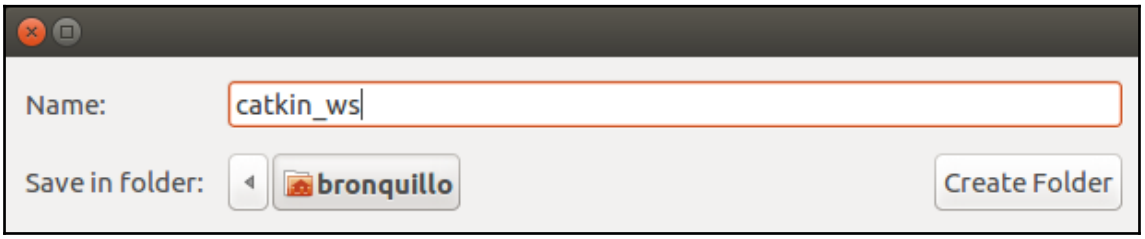
Chapter 3: Getting Started with ROS

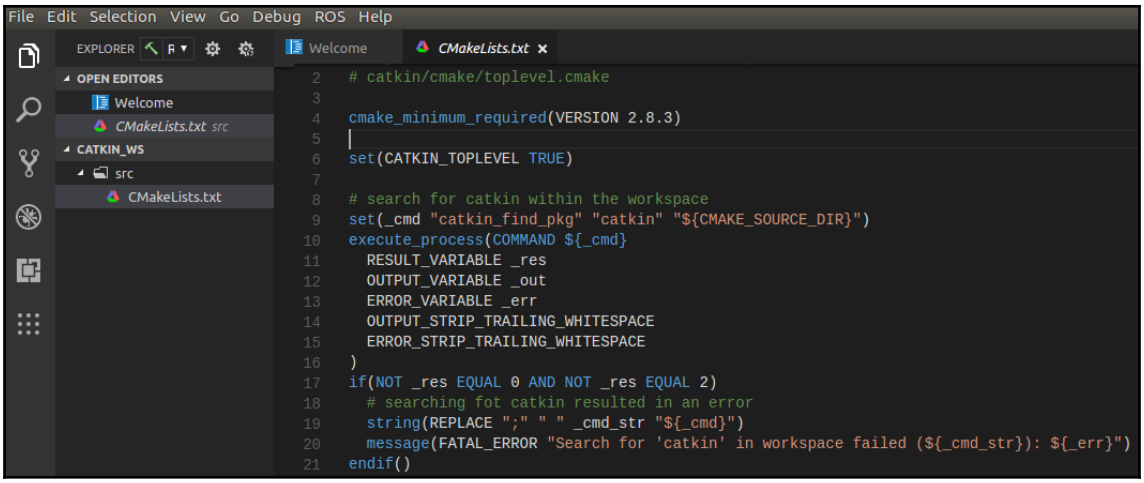



L_servo
R_servo
/speed_left
/speed_right
control
/sharp_data
sensor

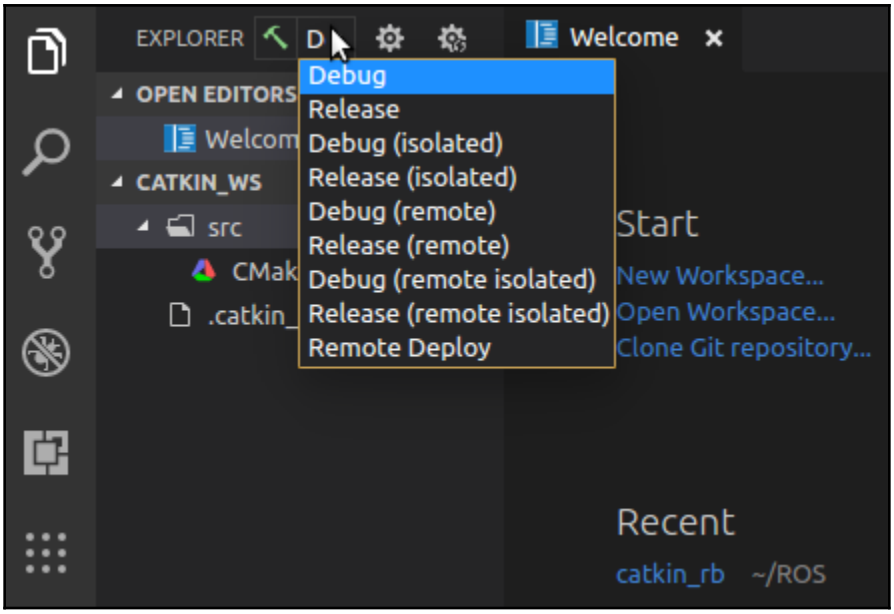


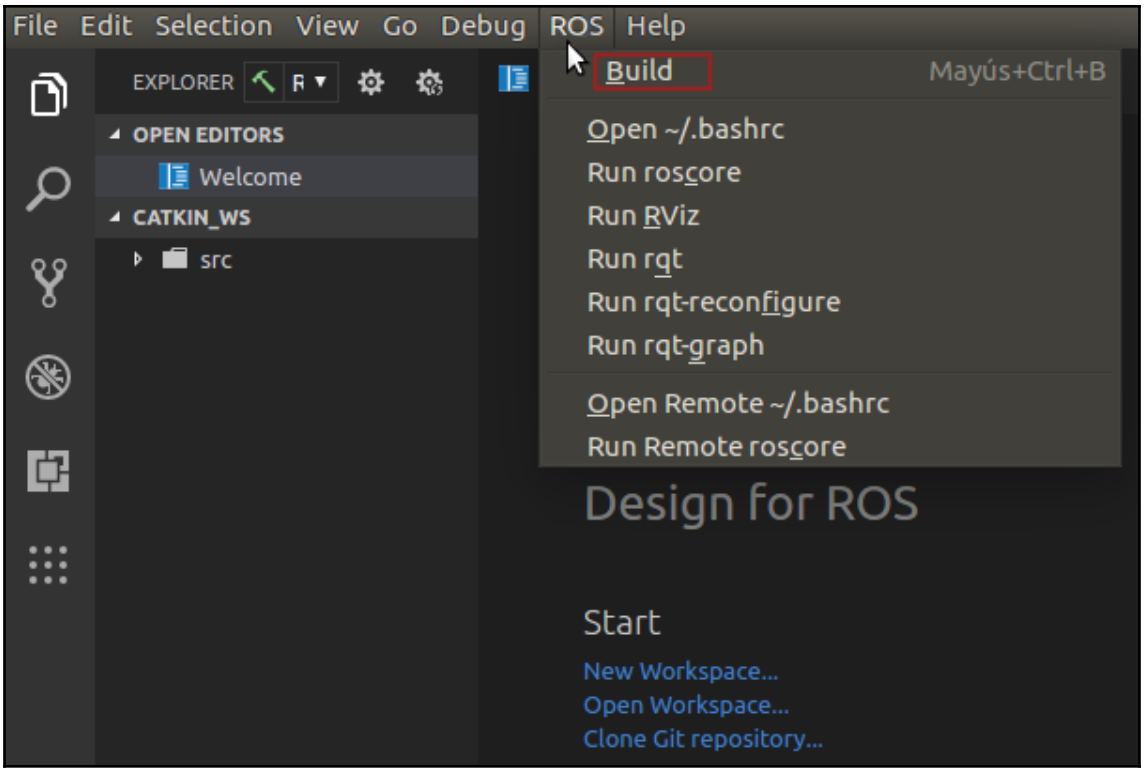

Welcome
RoboWare Studio
Design for ROS
Start
New Workspace...
Open Workspace...
Clone Git repository...


Name:
catkin_ws
Save in folder:
bronquillo
Create Folder



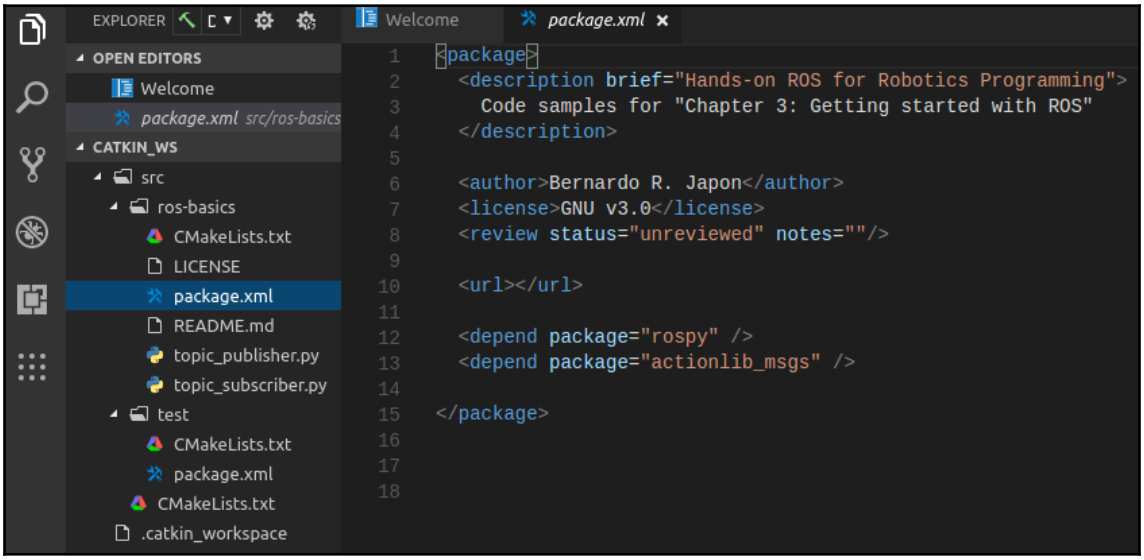

```
drwxrwxr-x 2 bronquillo bronquillo 4096 may 11 13:08 .
drwxrwxr-x 3 bronquillo bronquillo 4096 may 11 13:07 ..
lrwxrwxrwx 1 bronquillo bronquillo   50 may 11 13:08 CMakeLists.txt -> /opt/ros/kinetic/share/catkin/cmake/toplevel.cmake
```

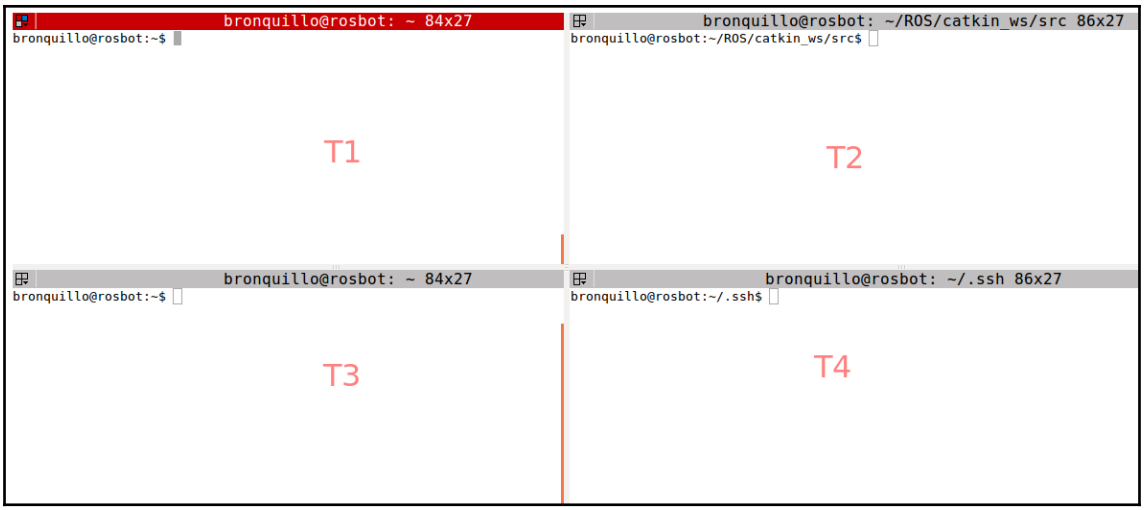



File Edit Selection View Go Debug ROS Help
EXPLORER
OPEN EDITORS
Welcome
CATKIN_WS
src
Build Mayús+Ctrl+B
Open ~/.bashrc
Run roscore
Run RViz
Run rqt
Run rqt-reconfigure
Run rqt-graph
Open Remote ~/.bashrc
Run Remote roscore
Design for ROS
Start
New Workspace...
Open Workspace...
Clone Git repository...

```
PROBLEMS    OUTPUT    DEBUG CONSOLE    TERMINAL
-- The C compiler identification is GNU 5.4.0
-- The CXX compiler identification is GNU 5.4.0
-- Check for working C compiler: /usr/bin/cc
-- Check for working C compiler: /usr/bin/cc -- works
-- Detecting C compiler ABI info
-- Detecting C compiler ABI info - done
-- Detecting C compile features
-- Detecting C compile features - done
-- Check for working CXX compiler: /usr/bin/c++
-- Check for working CXX compiler: /usr/bin/c++ -- works
-- Detecting CXX compiler ABI info
-- Detecting CXX compiler ABI info - done
-- Detecting CXX compile features
-- Detecting CXX compile features - done
-- Using CATKIN_DEVEL_PREFIX: /home/bronquillo/catkin_ws/devel
-- Using CMAKE_PREFIX_PATH: /home/bronquillo/ROS/catkin_qt/devel;/opt/ros/kinetic
-- This workspace overlays: /home/bronquillo/ROS/catkin_qt/devel;/opt/ros/kinetic
-- Found PythonInterp: /usr/bin/python (found version "2.7.12")
-- Using PYTHON_EXECUTABLE: /usr/bin/python
-- Using Debian Python package layout
-- Using empy: /usr/bin/empy
-- Using CATKIN_ENABLE_TESTING: ON
-- Call enable_testing()
-- Using CATKIN_TEST_RESULTS_DIR: /home/bronquillo/catkin_ws/build/test_results
-- Found gmock sources under '/usr/src/gmock': gmock will be built
-- Looking for pthread.h
-- Looking for pthread.h - found
-- Looking for pthread_create
-- Looking for pthread_create - not found
-- Looking for pthread_create in pthreads
-- Looking for pthread_create in pthreads - not found
-- Looking for pthread_create in pthread
-- Looking for pthread_create in pthread - found
-- Found Threads: TRUE
-- Found gtest sources under '/usr/src/gmock': gtests will be built
-- Using Python nosetests: /usr/bin/nosetests-2.7
-- catkin 0.7.14
-- BUILD_SHARED_LIBS is on
```

```
-- BUILD_SHARED_LIBS is on
-- Configuring done
-- Generating done
-- Build files have been written to: /home/bronquillo/catkin_ws/build
Base path: /home/bronquillo/catkin_ws
Source space: /home/bronquillo/catkin_ws/src
Build space: /home/bronquillo/catkin_ws/build
Devel space: /home/bronquillo/catkin_ws/devel
Install space: /home/bronquillo/catkin_ws/install
####
#### Running command: "cmake /home/bronquillo/catkin_ws/src -DCMAKE_BUILD_TYPE=Debug
-DCATKIN_DEVEL_PREFIX=/home/bronquillo/catkin_ws/devel -DCMAKE_INSTALL_PREFIX=/home/bronquillo/catkin_ws/install -G Unix
Makefiles" in "/home/bronquillo/catkin_ws/build"
####
####
#### Running command: "make -j8 -l8" in "/home/bronquillo/catkin_ws/build"
####
```






```
roscore http://rosbot:11311/ 84x27
... logging to /home/bronquillo/.ros/log/01d977f2-7401-11e9-9b19-d46d6d44d91e/roslau
nch-rosbot-28763.log
Checking log directory for disk usage. This may take awhile.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://rosbot:45803/
ros_comm version 1.12.14


SUMMARY
========

PARAMETERS
 * /rosdistro: kinetic
 * /rosversion: 1.12.14

NODES

auto-starting new master
process[master]: started with pid [28775]
ROS_MASTER_URI=http://rosbot:11311/

setting /run_id to 01d977f2-7401-11e9-9b19-d46d6d44d91e
process[rosout-1]: started with pid [28788]
started core service [/rosout]
```

roscore http://rosbot:11311/ 85x27

```
... logging to /home/bronquillo/.ros/log/8bb946e6-740b-11e9-9b19-d46d6d44d91e/roslaun
ch-rosbot-9363.log
Checking log directory for disk usage. This may take awhile.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.

started roslaunch server http://rosbot:34137/
ros_comm version 1.12.14


SUMMARY
========

PARAMETERS
 * /rosdistro: kinetic
 * /rosversion: 1.12.14

NODES

auto-starting new master
process[master]: started with pid [9524]
ROS_MASTER_URI=http://rosbot:11311/

setting /run_id to 8bb946e6-740b-11e9-9b19-d46d6d44d91e
process[rosout-1]: started with pid [9597]
started core service [/rosout]
```

bronquillo@rosbot: ~ 85x27

```
bronquillo@rosbot:~$ rosrun ros_basics topic_publisher.py
[WARN] [1557593158.533532]: Inbound TCP/IP connection failed: connection from sender
terminated before handshake header received. 0 bytes were received. Please check send
er for additional details.
[WARN] [1557593435.081999]: Inbound TCP/IP connection failed: connection from sender
terminated before handshake header received. 0 bytes were received. Please check send
er for additional details.
```

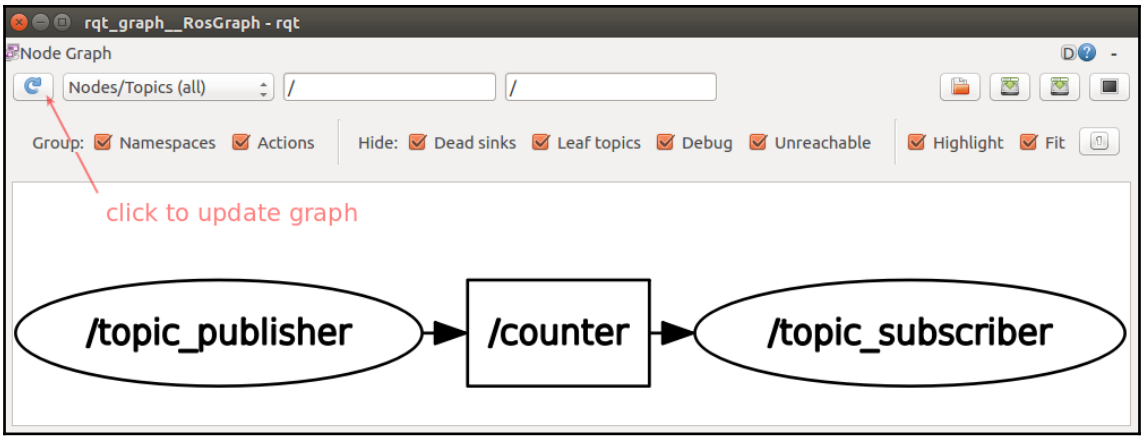
bronquillo@rosbot: ~ 85x27

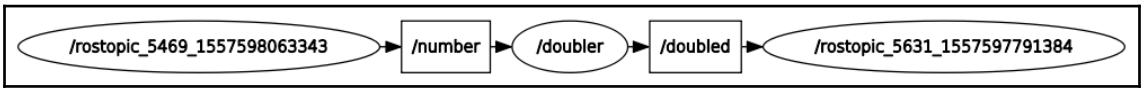
```
        min: 0.497s max: 0.503s std dev: 0.00034s window: 283
average rate: 2.000
        min: 0.497s max: 0.503s std dev: 0.00034s window: 285
average rate: 2.000
        min: 0.497s max: 0.503s std dev: 0.00034s window: 287
average rate: 2.000
        min: 0.497s max: 0.503s std dev: 0.00034s window: 289
average rate: 2.000
        min: 0.497s max: 0.503s std dev: 0.00034s window: 291
average rate: 2.000
        min: 0.497s max: 0.503s std dev: 0.00034s window: 293
average rate: 2.000
        min: 0.497s max: 0.503s std dev: 0.00034s window: 295
average rate: 2.000
        min: 0.497s max: 0.503s std dev: 0.00042s window: 297
average rate: 2.000
        min: 0.497s max: 0.503s std dev: 0.00042s window: 299
average rate: 2.000
        min: 0.497s max: 0.503s std dev: 0.00042s window: 301
average rate: 2.000
        min: 0.497s max: 0.503s std dev: 0.00042s window: 303
average rate: 2.000
        min: 0.497s max: 0.503s std dev: 0.00042s window: 305
^Caverage rate: 2.000
        min: 0.497s max: 0.503s std dev: 0.00042s window: 306
bronquillo@rosbot:~$ rqt_graph
```

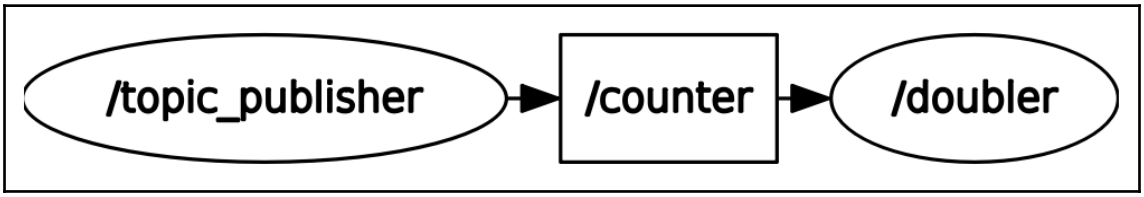
bronquillo@rosbot: ~ 85x27

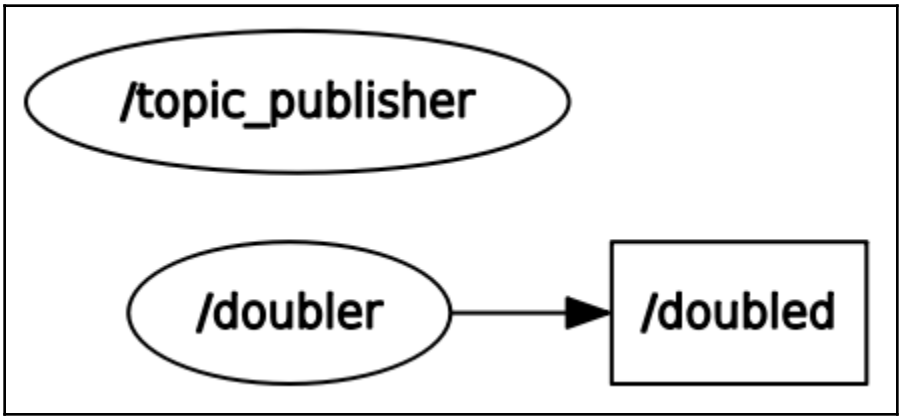
```
2388
[INFO] [1557594085.327848]: /topic_subscriberI heard 2388
2389
[INFO] [1557594085.827845]: /topic_subscriberI heard 2389
2390
[INFO] [1557594086.327244]: /topic_subscriberI heard 2390
2391
[INFO] [1557594086.827967]: /topic_subscriberI heard 2391
2392
[INFO] [1557594087.327888]: /topic_subscriberI heard 2392
2393
[INFO] [1557594087.827822]: /topic_subscriberI heard 2393
2394
[INFO] [1557594088.327761]: /topic_subscriberI heard 2394
2395
[INFO] [1557594088.827745]: /topic_subscriberI heard 2395
2396
[INFO] [1557594089.327579]: /topic_subscriberI heard 2396
2397
[INFO] [1557594089.827795]: /topic_subscriberI heard 2397
2398
[INFO] [1557594090.327794]: /topic_subscriberI heard 2398
2399
[INFO] [1557594090.827930]: /topic_subscriberI heard 2399
2400
[INFO] [1557594091.327660]: /topic_subscriberI heard 2400
```

live stream

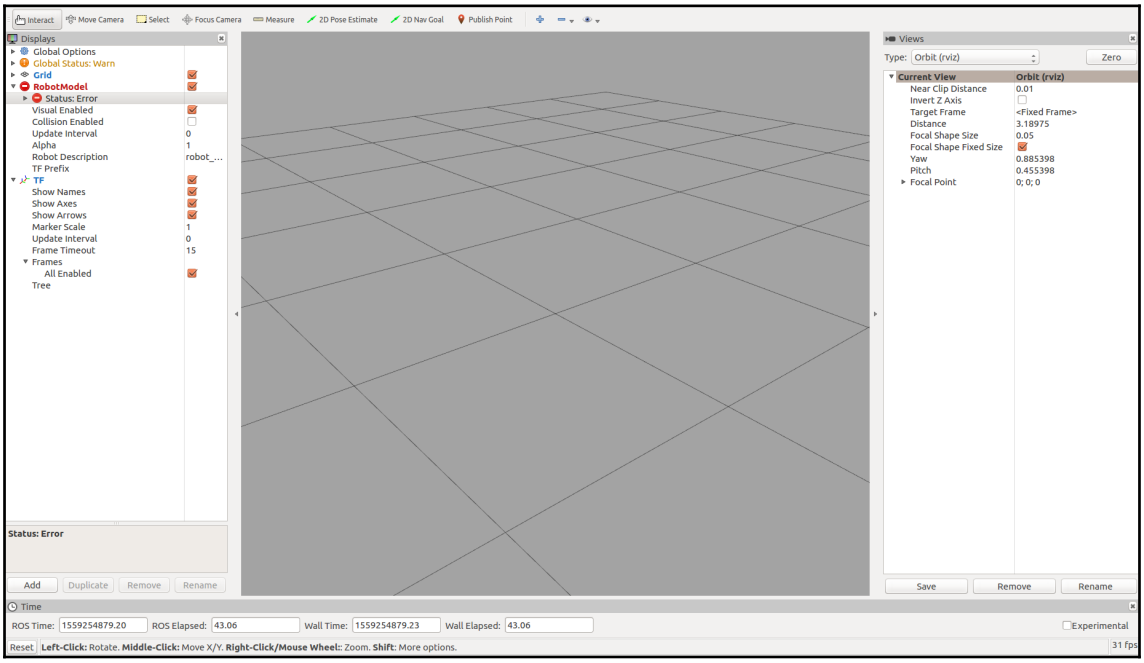

rqt_graph__RosGraph - rqt
Node Graph
Nodes/Topics (all)
/
/
Group:
Namespaces
Actions
Hide:
Dead sinks
Leaf topics
Debug
Unreachable
Highlight
Fit
click to update graph
/topic_publisher
/counter
/topic_subscriber

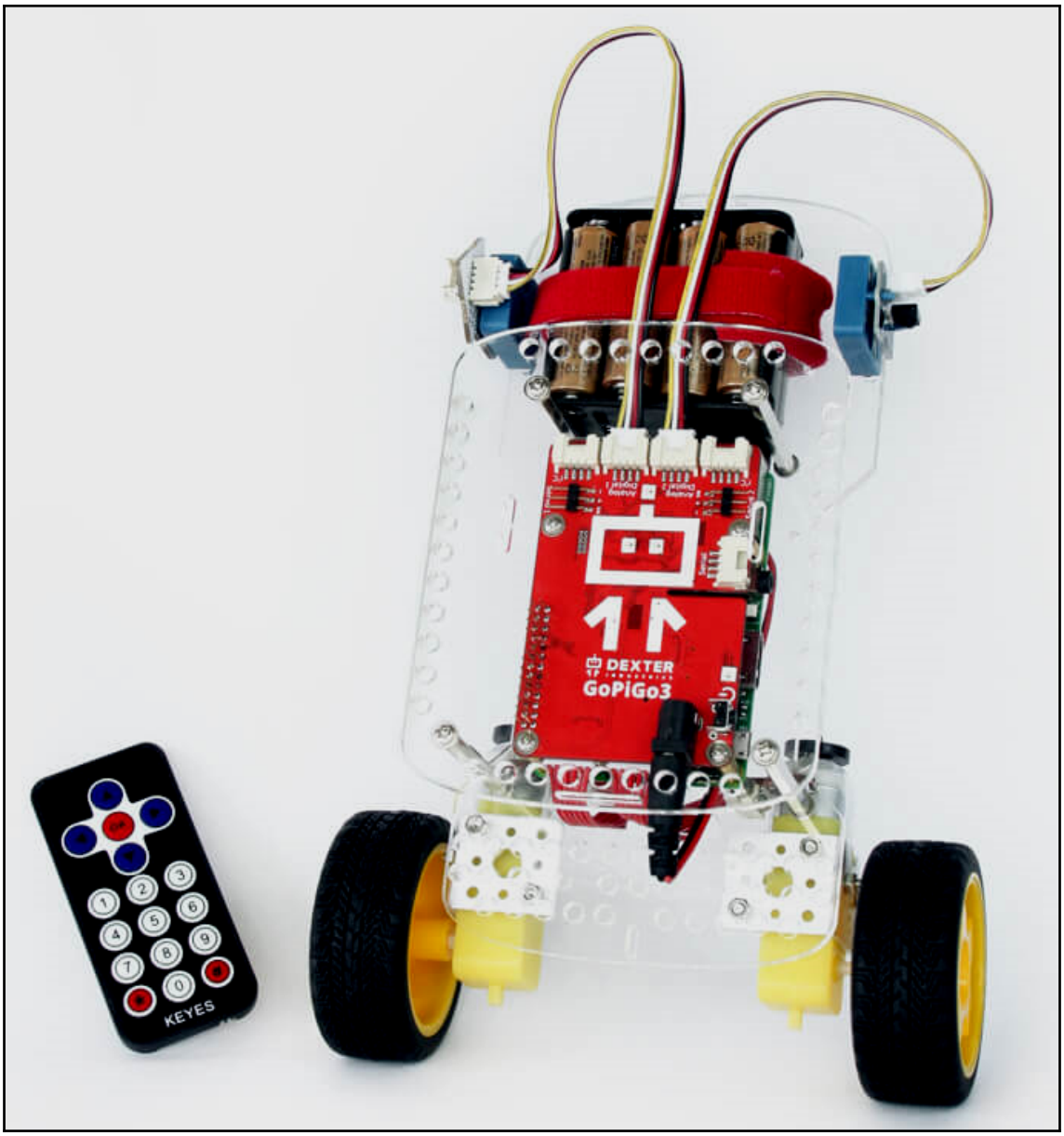

/rostopic_5469_1557598063343
/number
/doubler
/doubled
/rostopic_5631_1557597791384

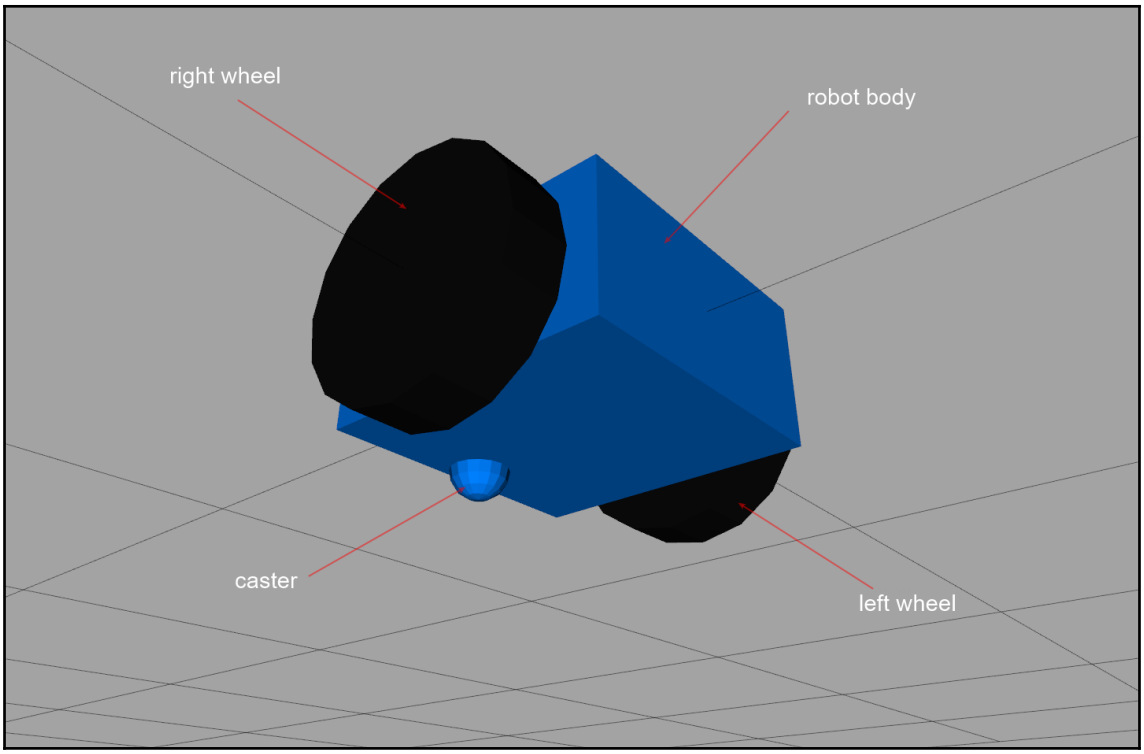

/topic_publisher
/counter
/doubler


/topic_publisher
/doubler
/doubled

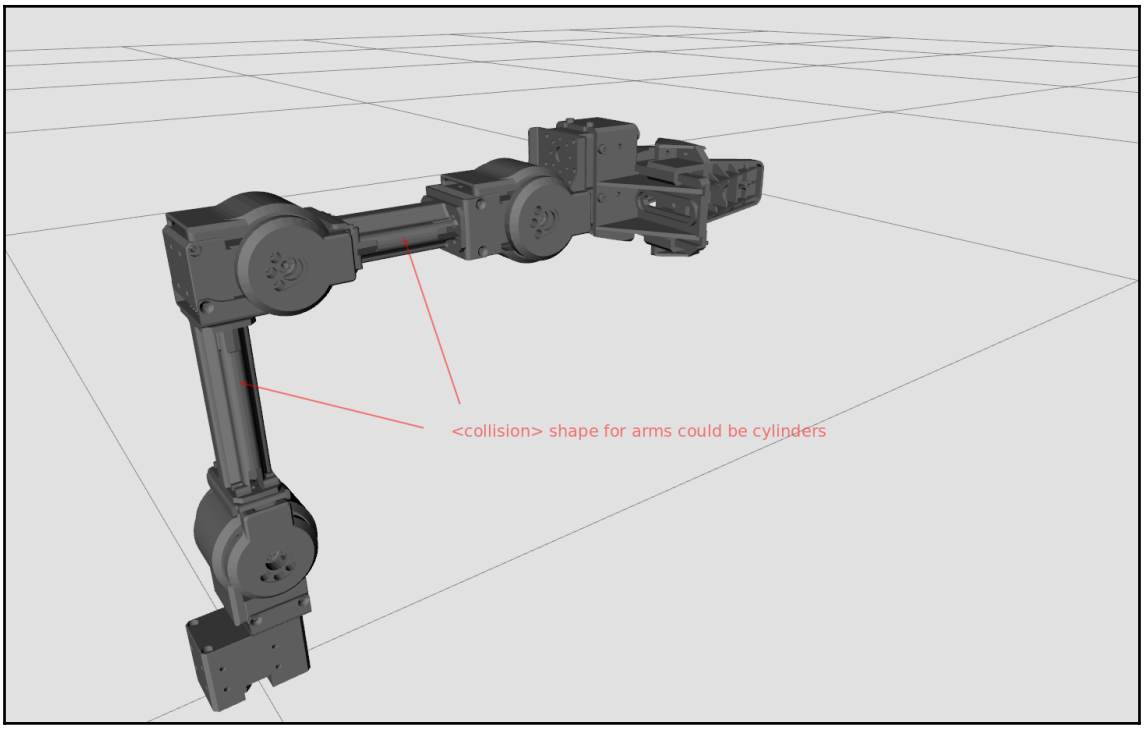
Chapter 4: Creating the Virtual Two-Wheeled ROS Robot

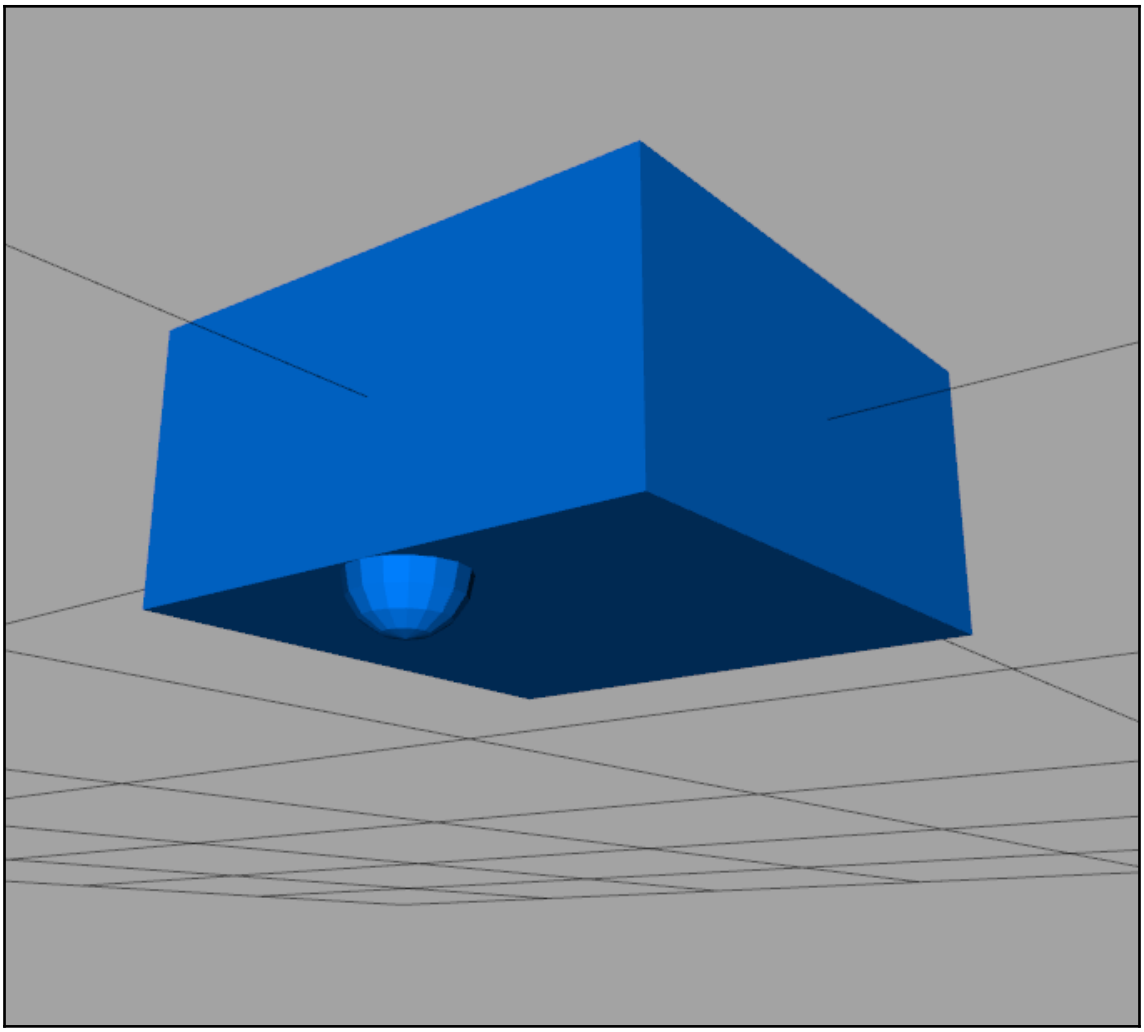


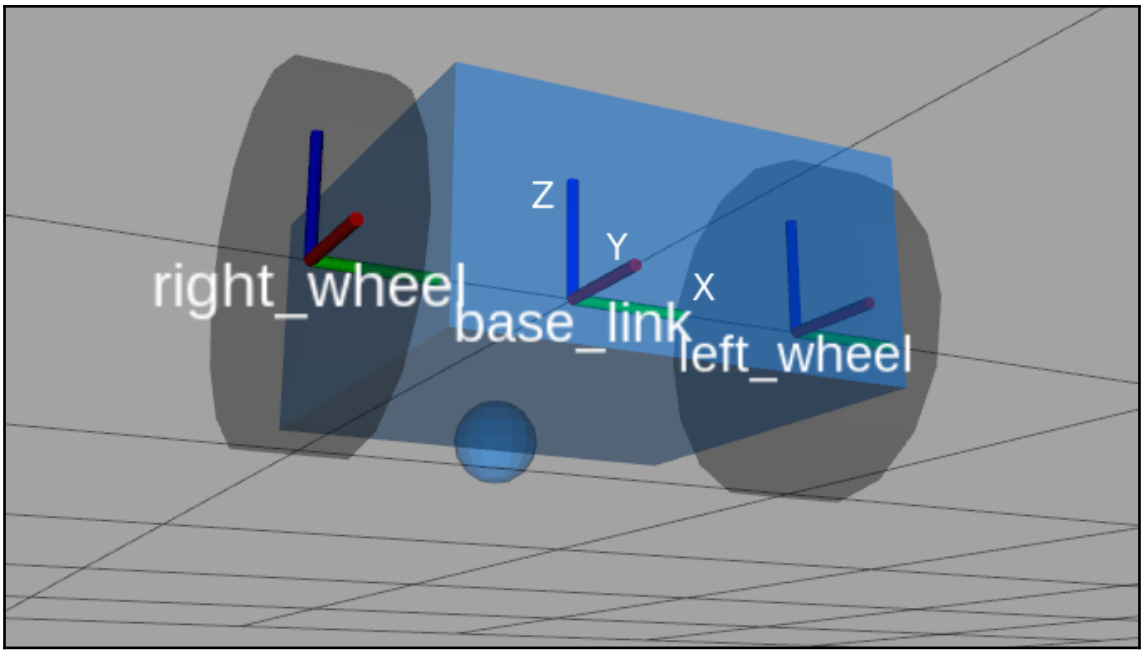

DEXTER
GoPiGo3
KEYES

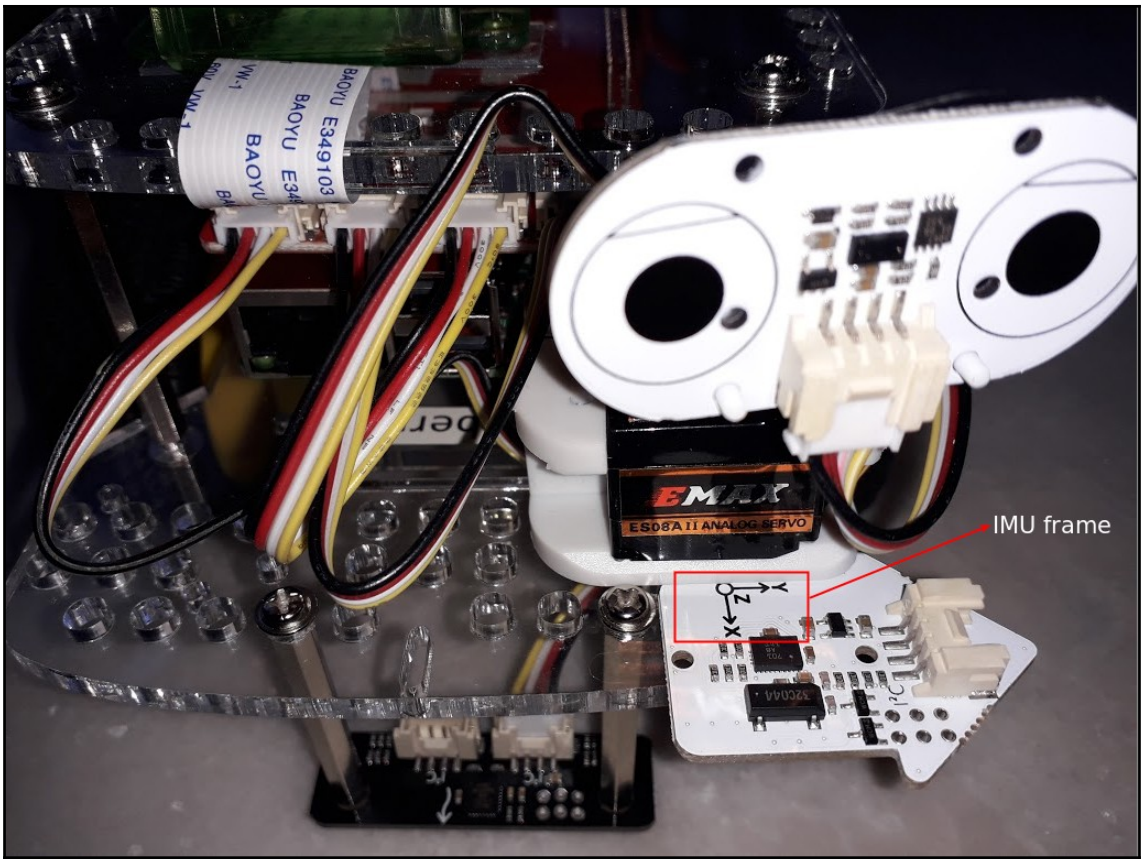

right wheel
robot body
caster
left wheel

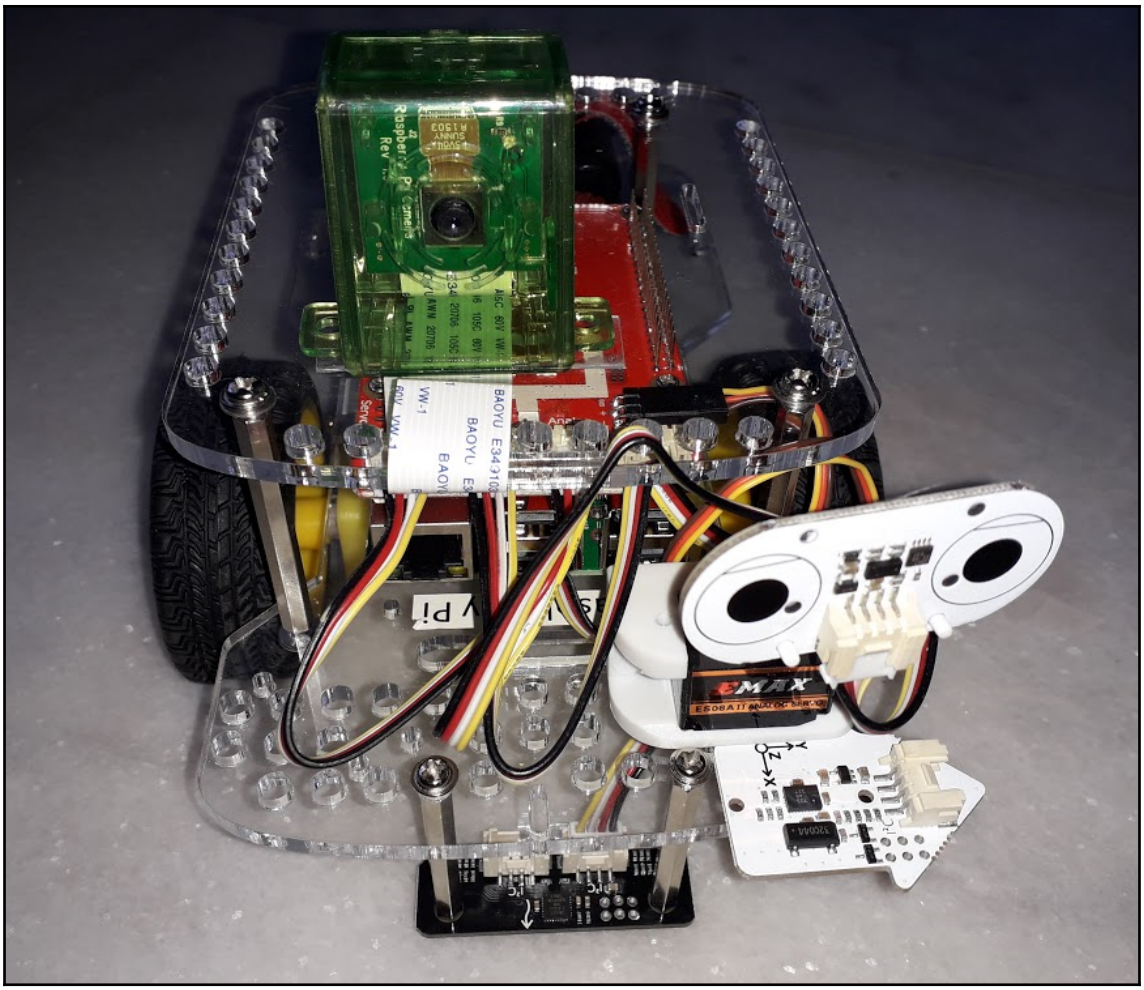
```
<?xml version='1.0'?>
<robot name="GoPiGo3">

  <!-- Base Link (robot body) -->
  <link name="base_link">
    <visual>…
    </visual>

    <!-- Caster -->
    <visual name="caster">…
    </visual>

  </link>

  <!-- Right Wheel -->
  <link name="right_wheel">…
  </link>

  <joint name="joint_right_wheel" type="continuous">…
  </joint>

  <!-- Left Wheel -->
  <link name="left_wheel">…
  </link>

  <joint name="joint_left_wheel" type="continuous">…
  </joint>
</robot>
```

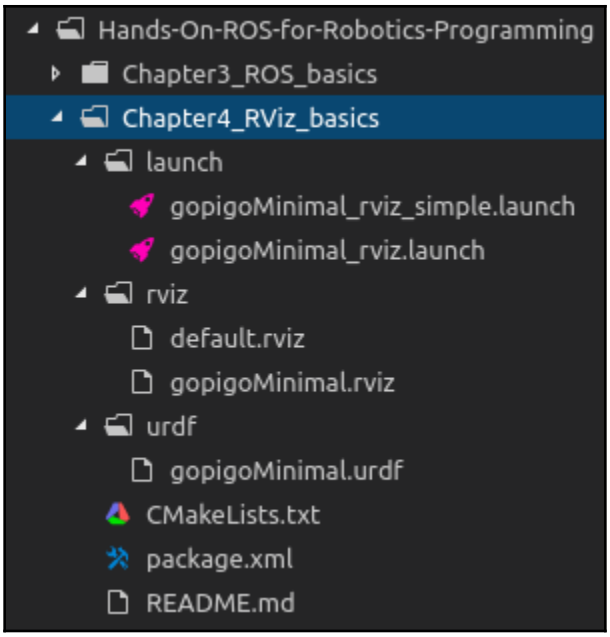

<collision> shape for arms could be cylinders

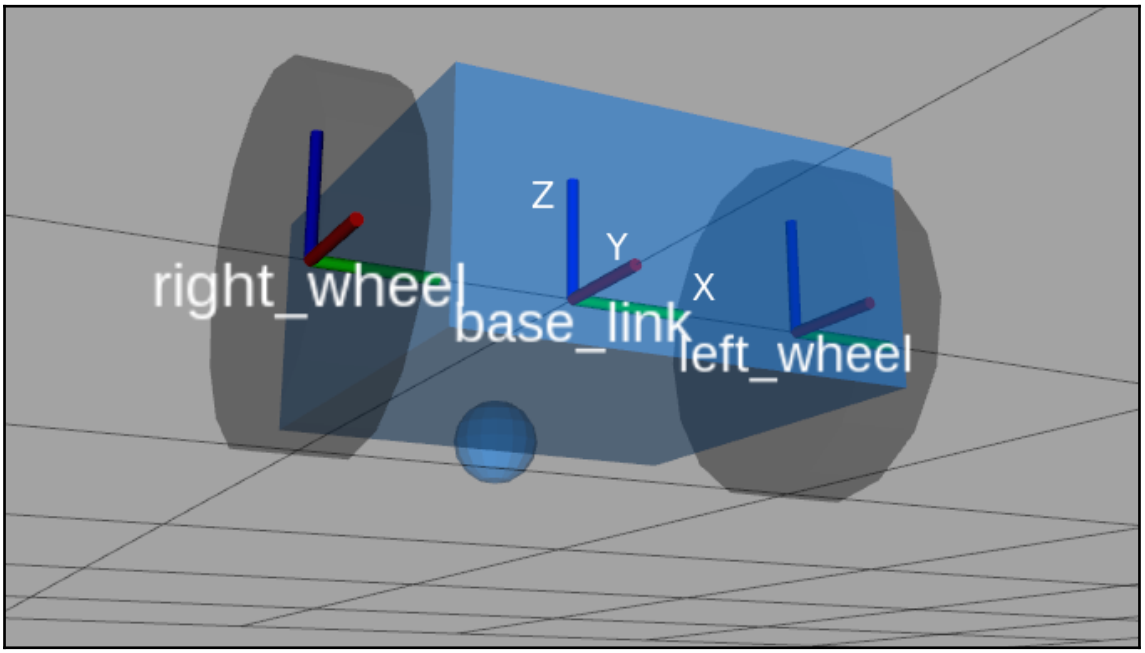


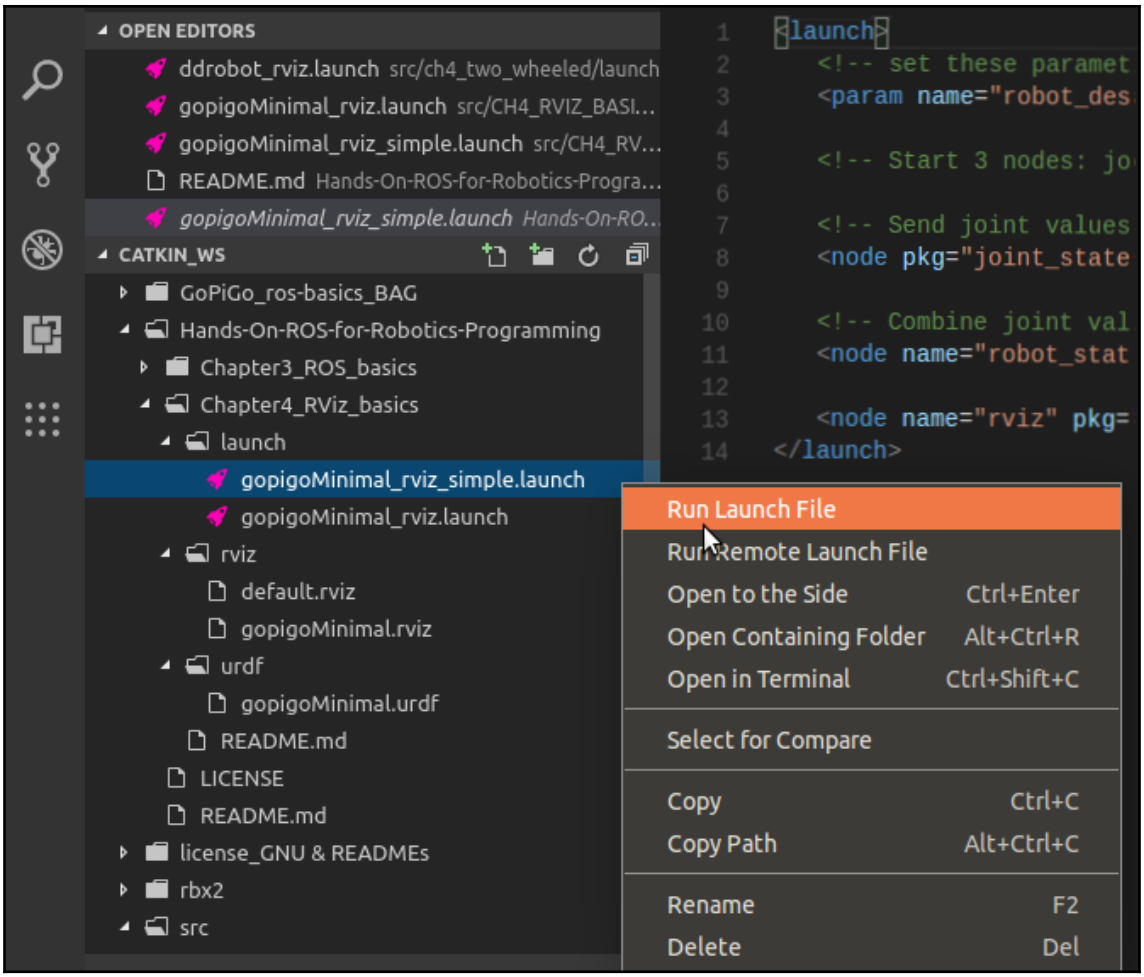

Z
Y
X
right_wheel
base_link
left_wheel

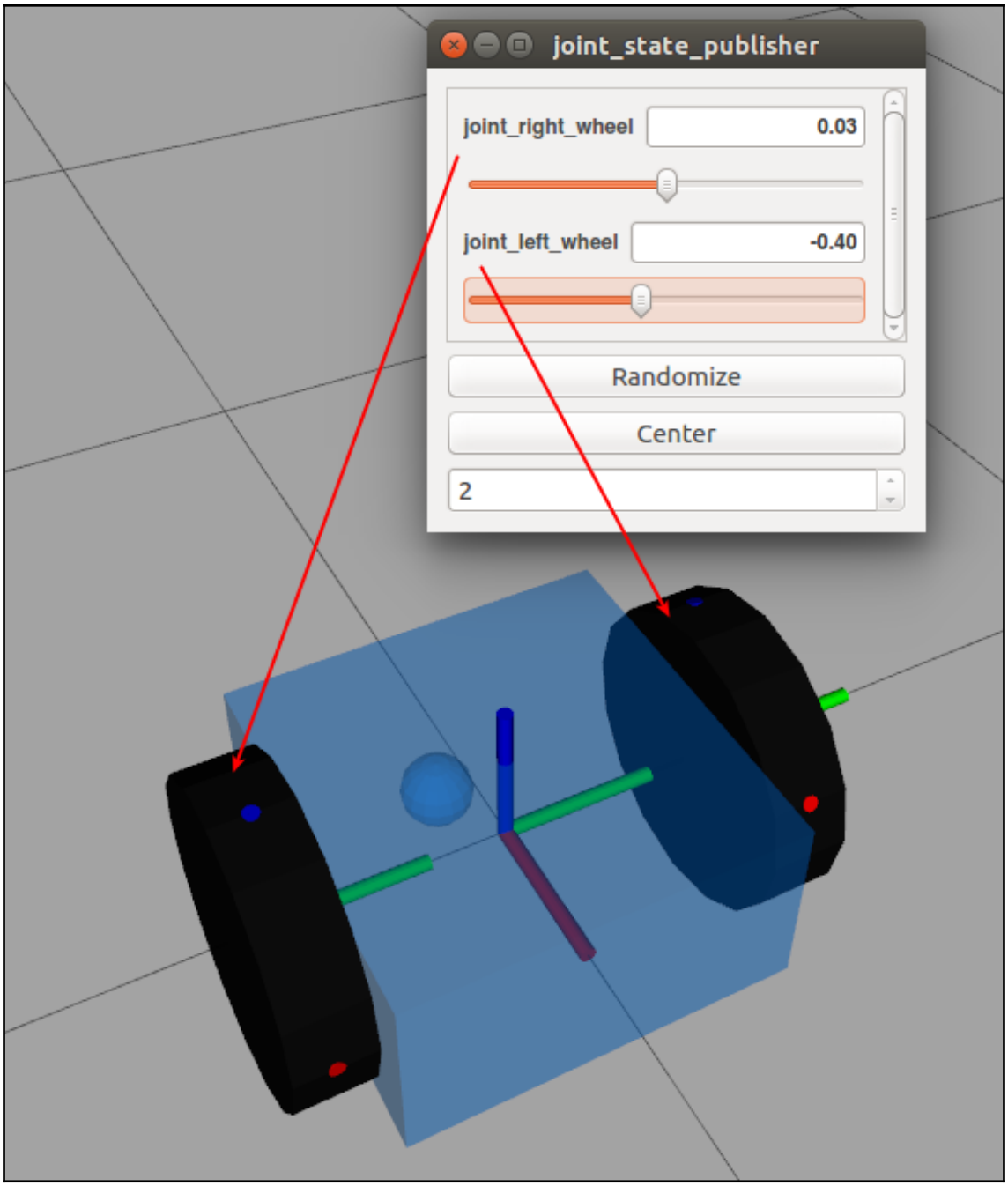

BAOYU E349103
BAOYU E34
BAOYU
VW-1
EMAX
ES08A II ANALOG SERVO
IMU frame
Y
Z
X

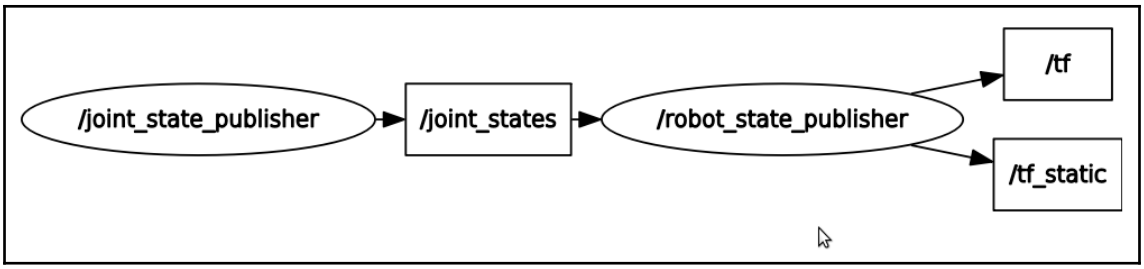

BAOYU
E34310
VW-1
EMAX

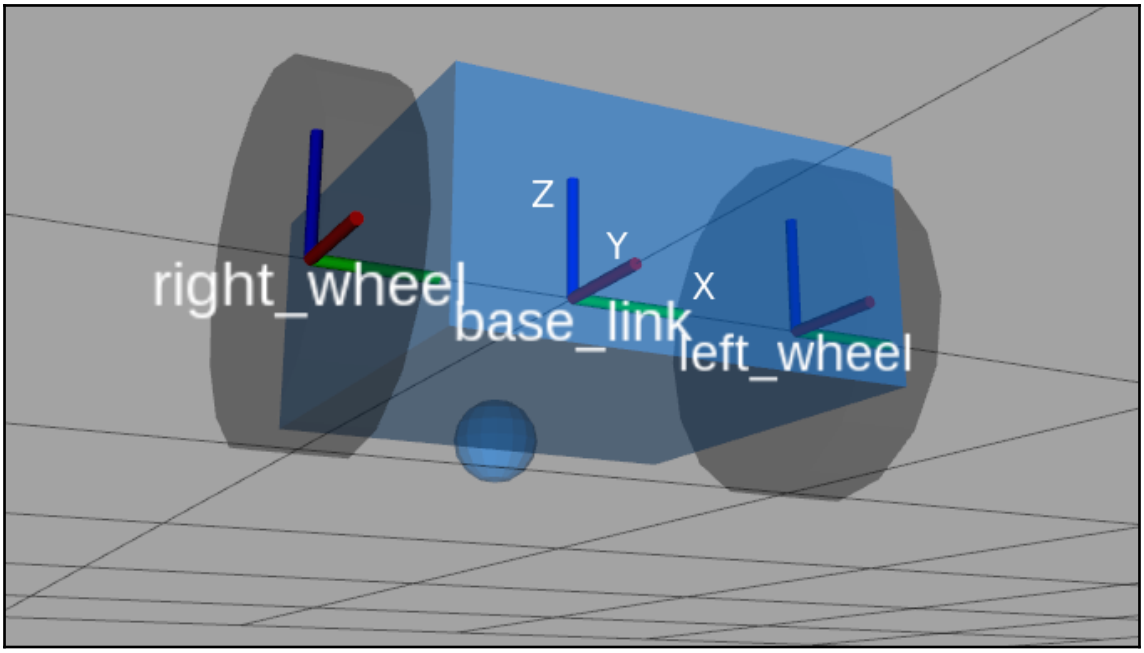

Hands-On-ROS-for-Robotics-Programming
Chapter3_ROS_basics
Chapter4_RViz_basics
launch
gopigoMinimal_rviz_simple.launch
gopigoMinimal_rviz.launch
rviz
default.rviz
gopigoMinimal.rviz
urdf
gopigoMinimal.urdf
CMakeLists.txt
package.xml
README.md

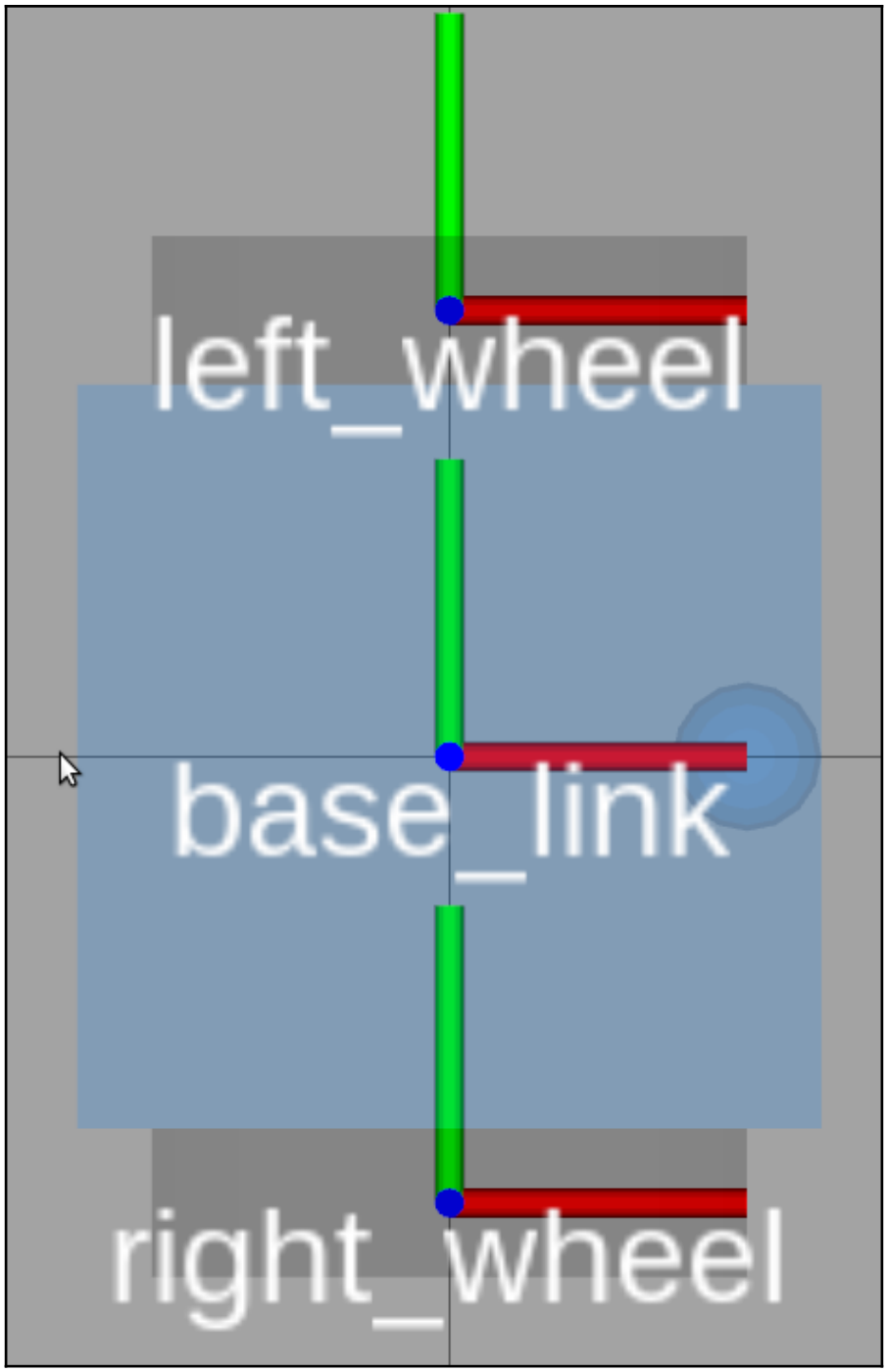

Z
Y
X
right_wheel
base_link
left_wheel

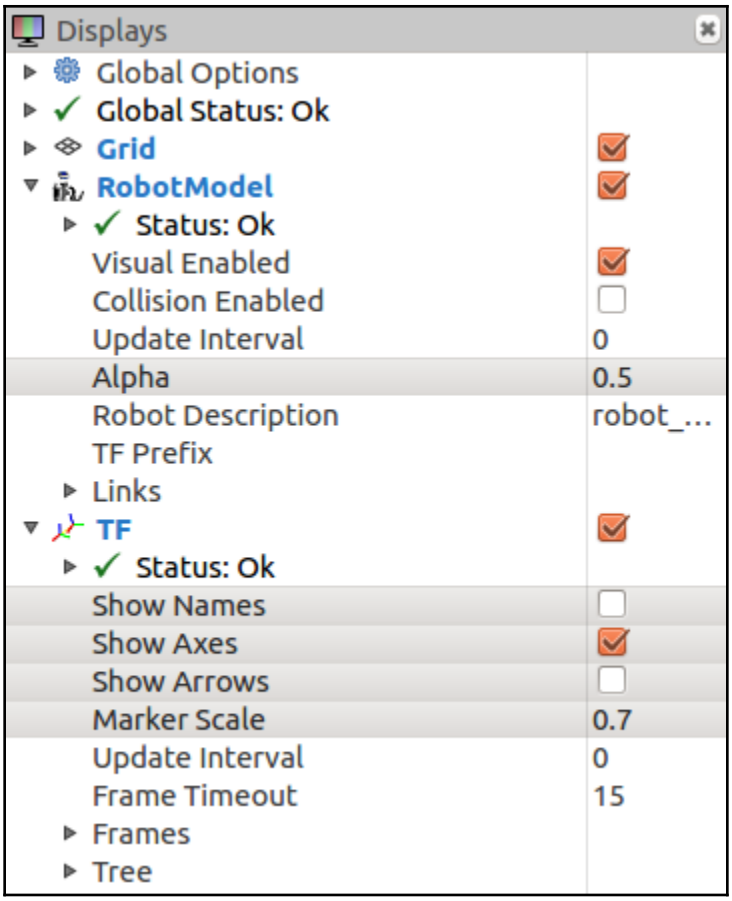

OPEN EDITORS
ddrobot_rviz.launch src/ch4_two_wheeled/launch
gopigoMinimal_rviz.launch src/CH4_RVIZ_BASI...
gopigoMinimal_rviz_simple.launch src/CH4_RV...
README.md Hands-On-ROS-for-Robotics-Progra...
gopigoMinimal_rviz_simple.launch Hands-On-RO...
CATKIN_WS
GoPiGo_ros-basics_BAG
Hands-On-ROS-for-Robotics-Programming
Chapter3_ROS_basics
Chapter4_RViz_basics
launch
gopigoMinimal_rviz_simple.launch
gopigoMinimal_rviz.launch
rviz
default.rviz
gopigoMinimal.rviz
urdf
gopigoMinimal.urdf
README.md
LICENSE
README.md
license_GNU & READMEs
rbx2
src
<launch>
<!-- set these paramet
<param name="robot_des
<!-- Start 3 nodes: jo
<!-- Send joint values
<node pkg="joint_state
<!-- Combine joint val
<node name="robot_stat
<node name="rviz" pkg=
</launch>
Run Launch File
Run Remote Launch File
Open to the Side Ctrl+Enter
Open Containing Folder Alt+Ctrl+R
Open in Terminal Ctrl+Shift+C
Select for Compare
Copy Ctrl+C
Copy Path Alt+Ctrl+C
Rename F2
Delete Del

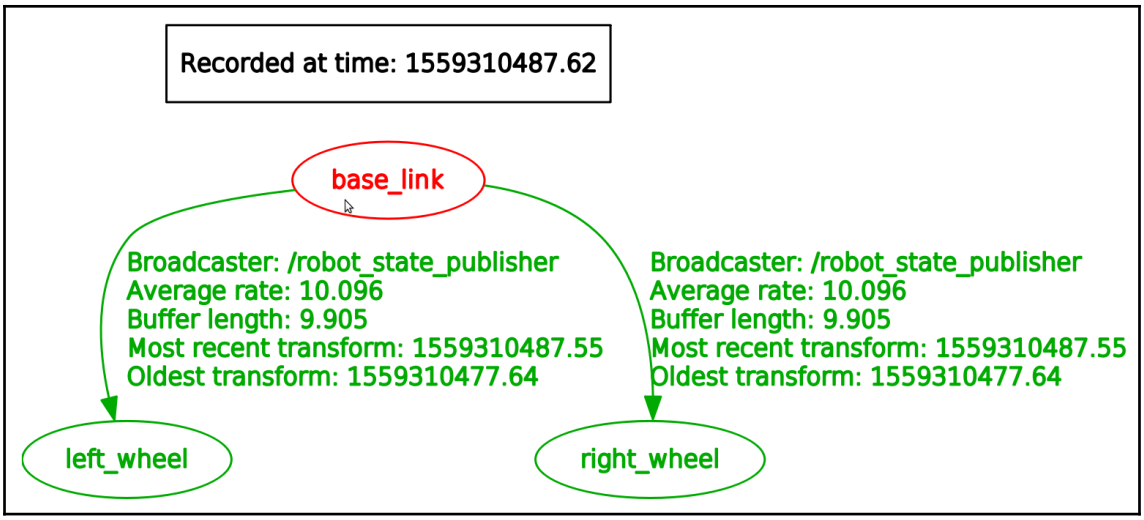

joint_state_publisher
joint_right_wheel
0.03
joint_left_wheel
-0.40
Randomize
Center
2


/joint_state_publisher
/joint_states
/robot_state_publisher
/tf
/tf_static

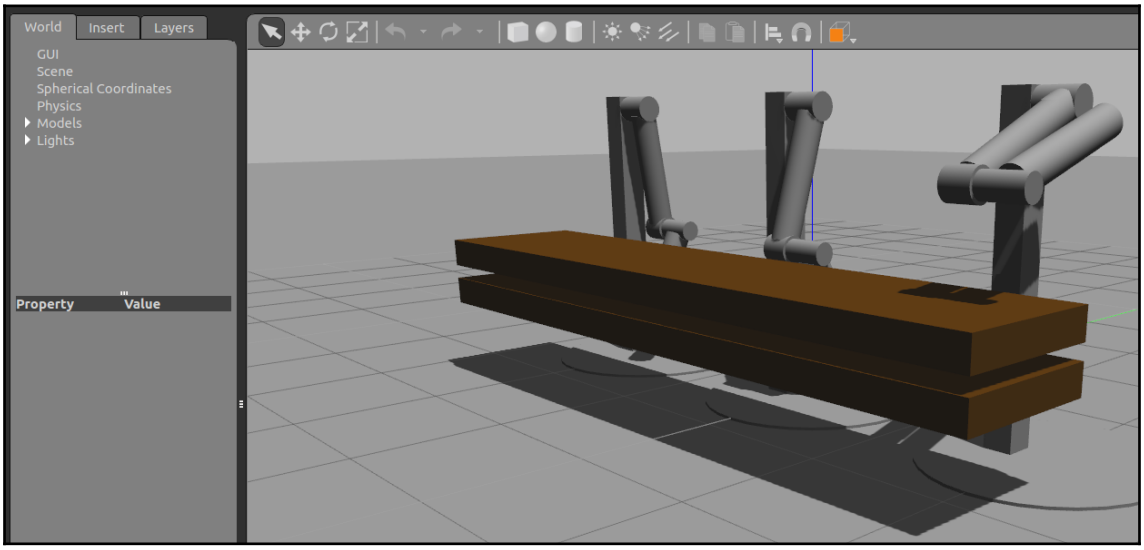

Z
Y
X
right_wheel
base_link
left_wheel

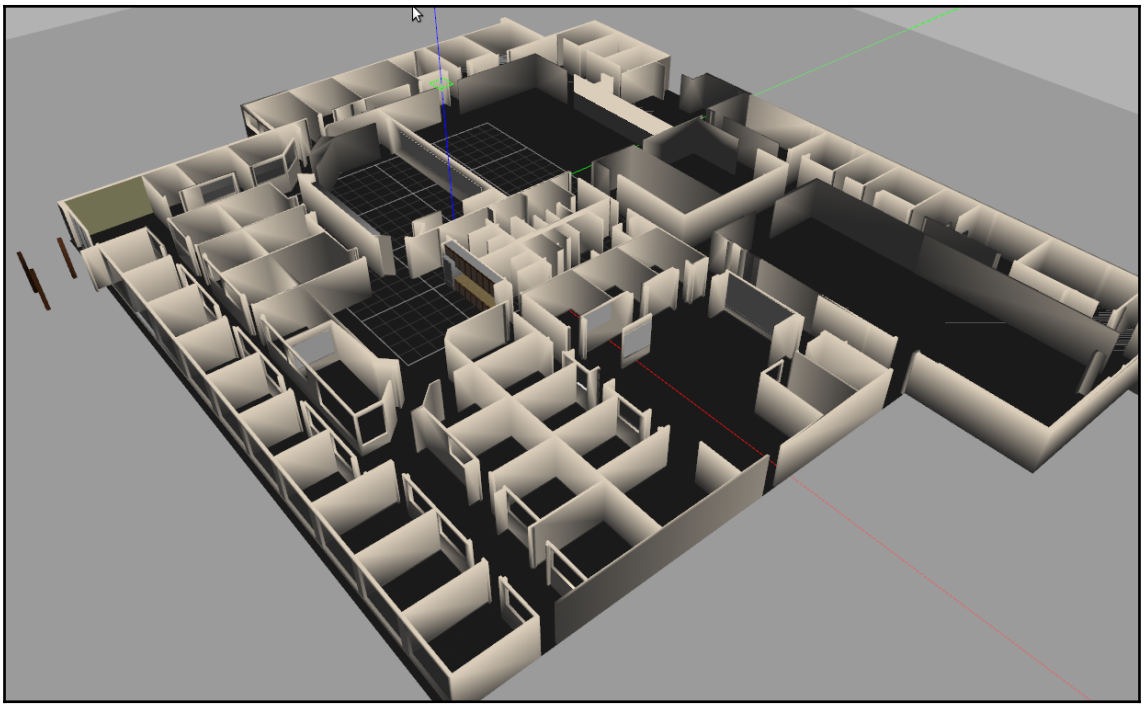

left_wheel
base_link
right_wheel

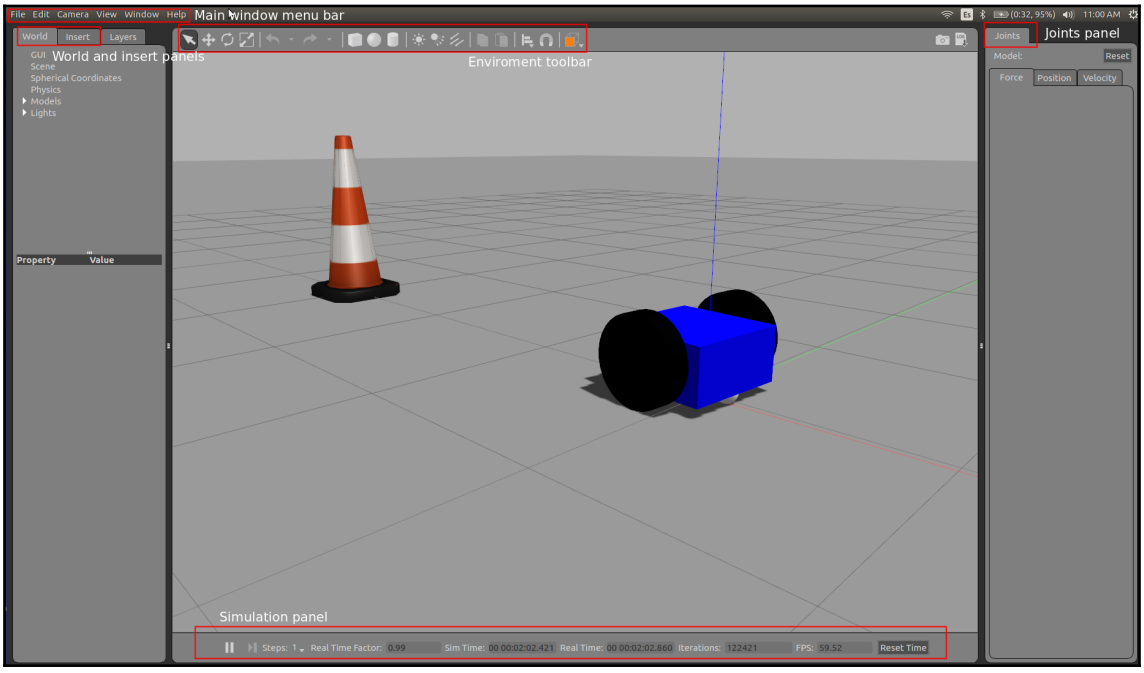

Displays
Global Options
Global Status: Ok
Grid
RobotModel
Status: Ok
Visual Enabled
Collision Enabled
Update Interval
0
Alpha
0.5
Robot Description
robot_...
TF Prefix
Links
TF
Status: Ok
Show Names
Show Axes
Show Arrows
Marker Scale
0.7
Update Interval
0
Frame Timeout
15
Frames
Tree

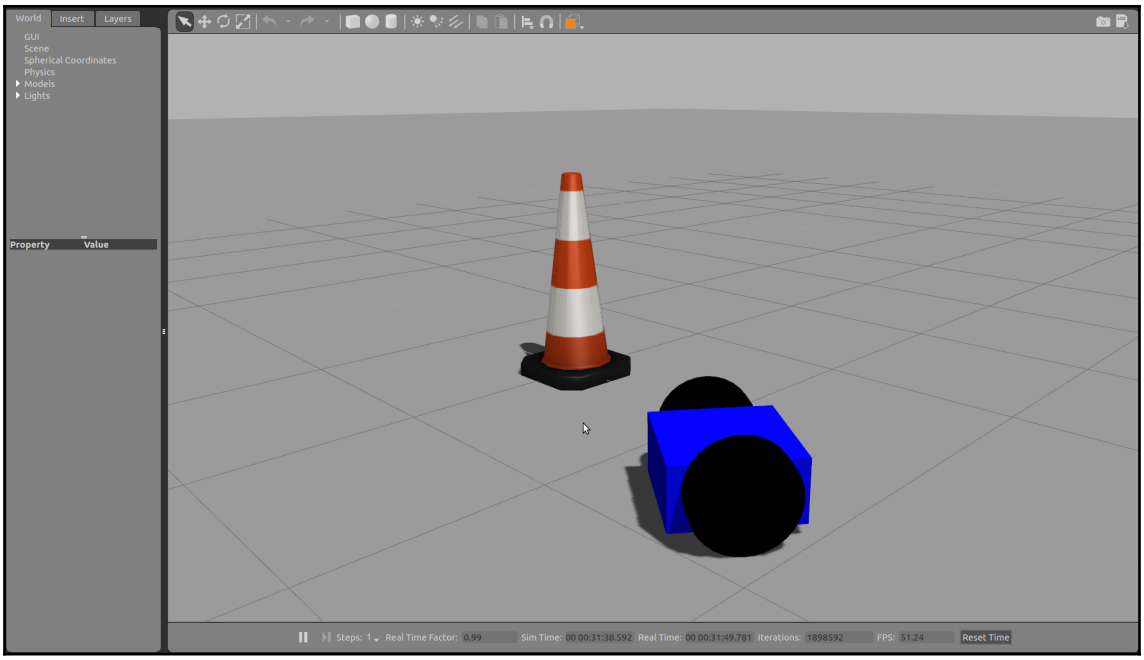

Recorded at time: 1559310487.62
base_link
Broadcaster: /robot_state_publisher
Average rate: 10.096
Buffer length: 9.905
Most recent transform: 1559310487.55
Oldest transform: 1559310477.64
Broadcaster: /robot_state_publisher
Average rate: 10.096
Buffer length: 9.905
Most recent transform: 1559310487.55
Oldest transform: 1559310477.64
left_wheel
right_wheel

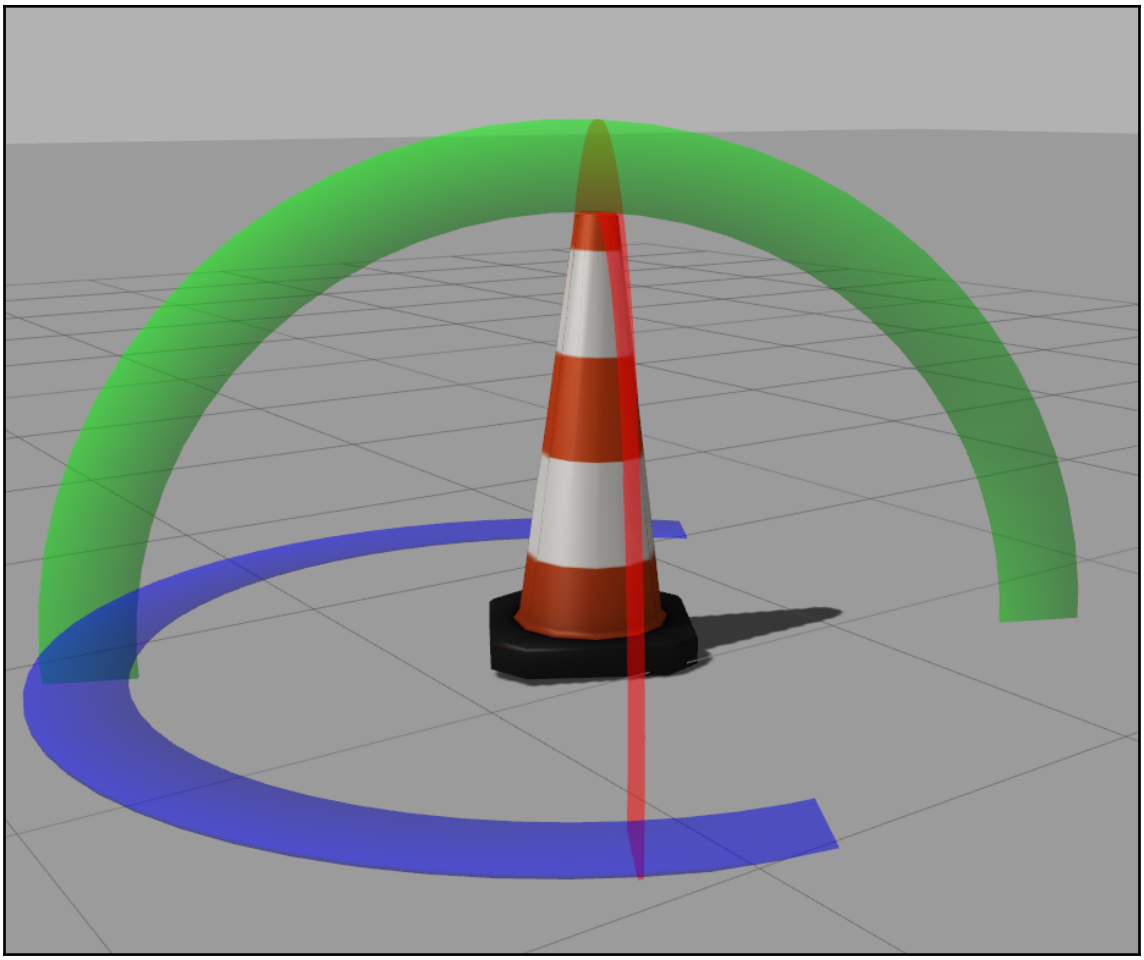
Chapter 5: Simulating Robot Behavior with Gazebo

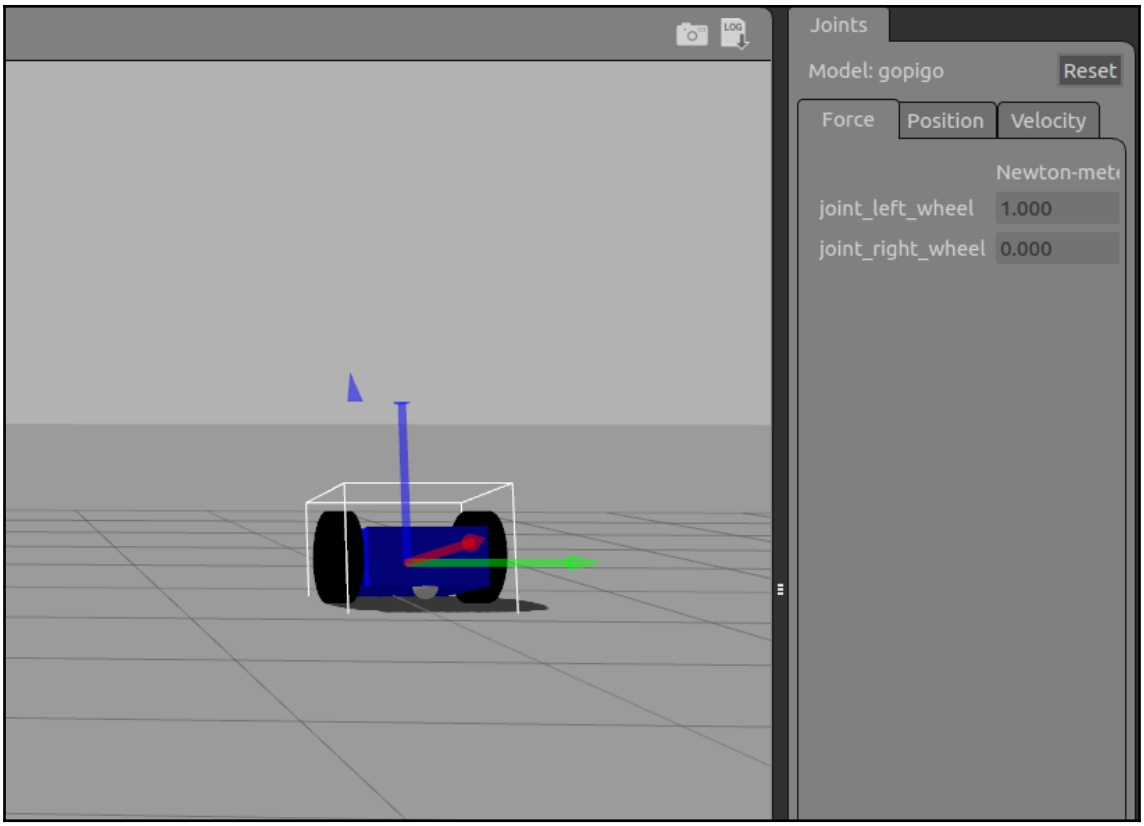




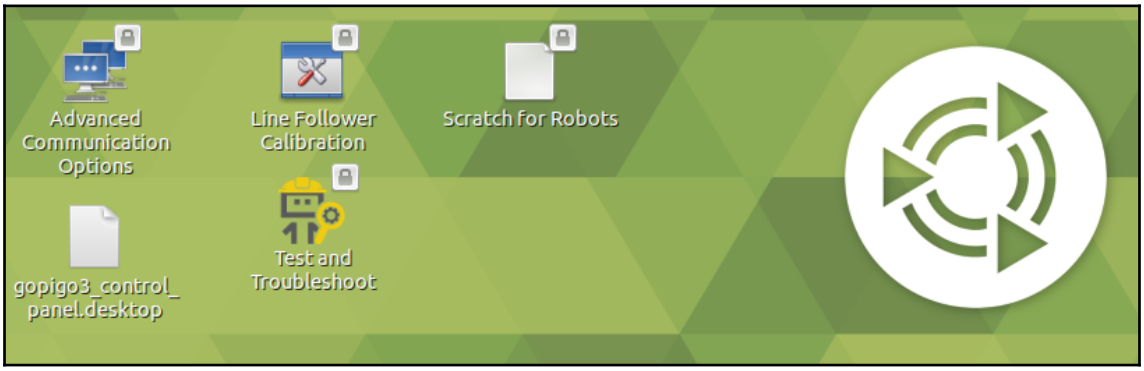

Main window menu bar
World and insert panels
Enviroment toolbar
Joints panel
Simulation panel

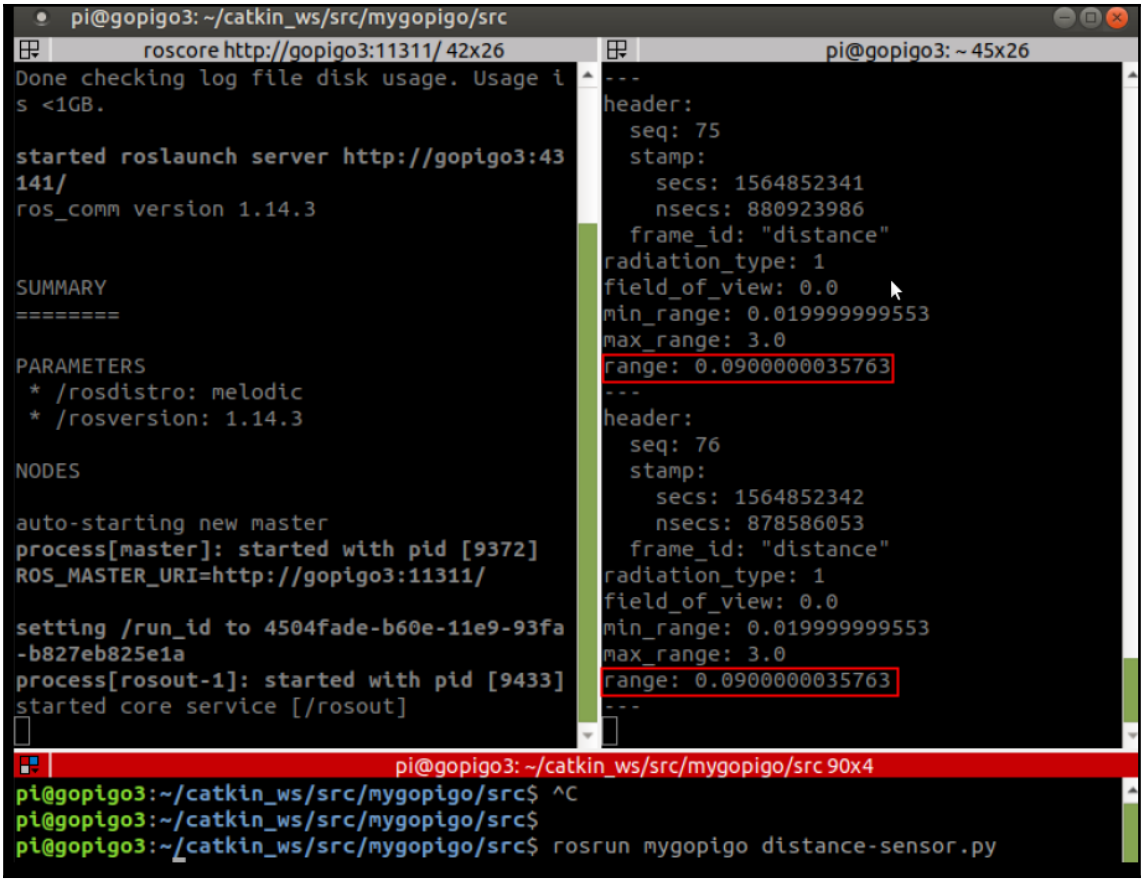

World
Insert
Layers
GUI
Scene
Spherical Coordinates
Physics
Models
Lights
Property
Value
Steps: 1
Real Time Factor: 0.99
Sim Time: 00 00:31:38.592
Real Time: 00 00:31:49.781
Iterations: 1898592
FPS: 51.24
Reset Time

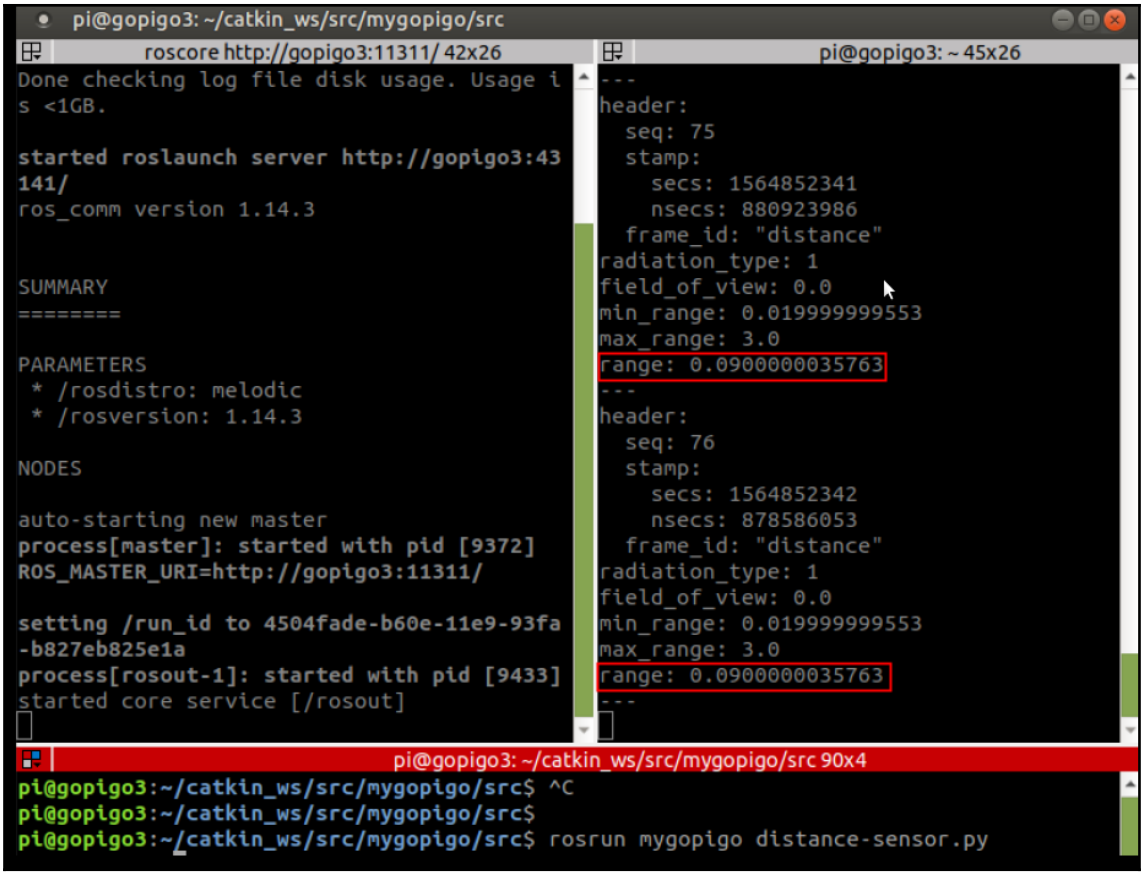


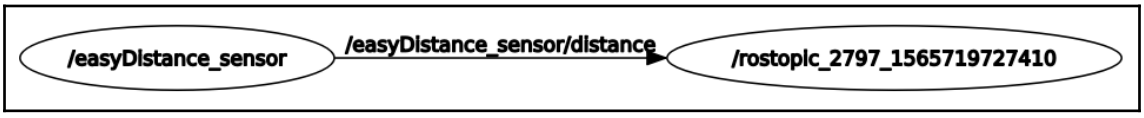

Joints
Model: gopigo
Reset
Force
Position
Velocity
Newton-met
joint_left_wheel
1.000
joint_right_wheel
0.000

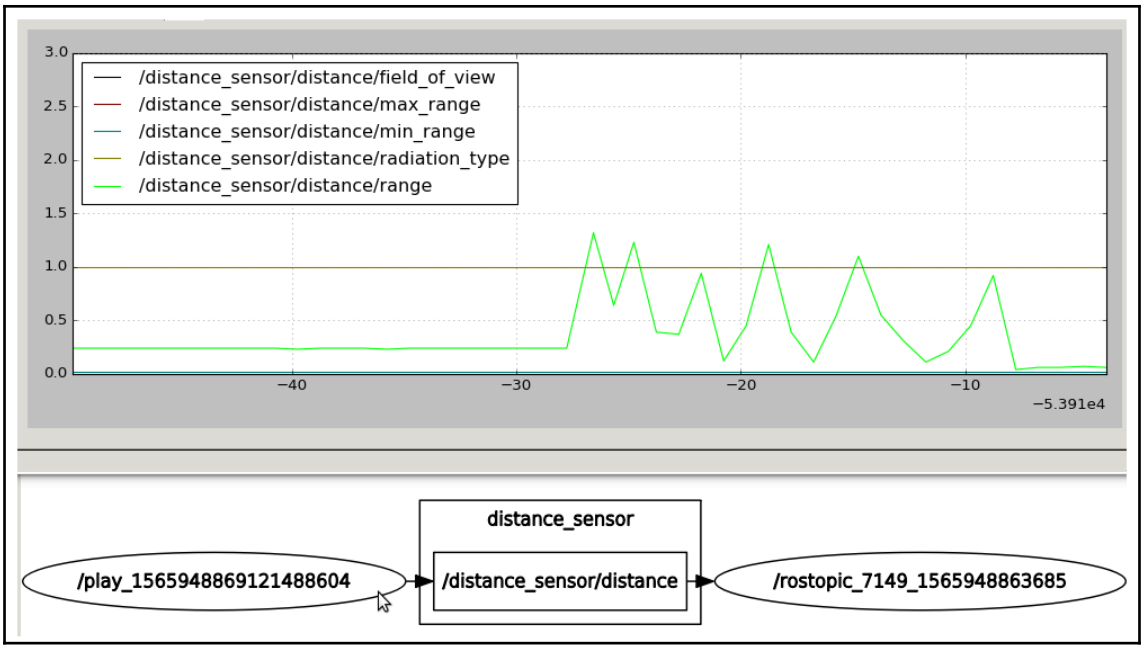
Chapter 6: Programming in ROS - Commands and Tools

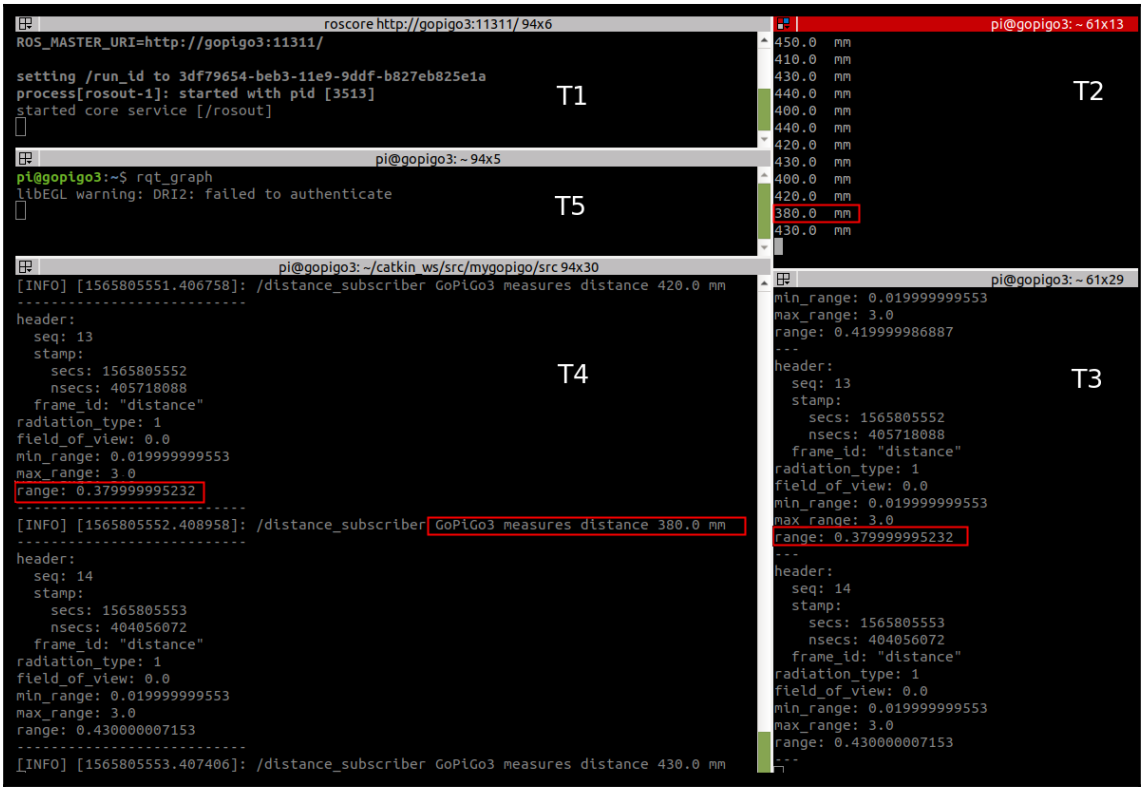


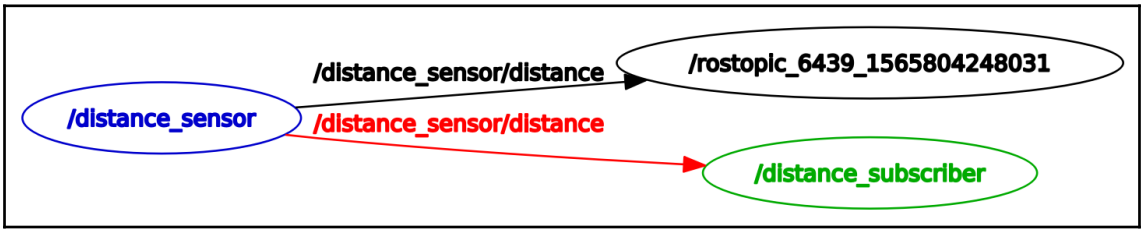

pi@gopigo3: ~/catkin_ws/src/mygopigo/src
roscore http://gopigo3:11311/ 42x26
Done checking log file disk usage. Usage is <1GB.
started roslaunch server http://gopigo3:43141/
ros_comm version 1.14.3
SUMMARY
========
PARAMETERS
* /rosdistro: melodic
* /rosversion: 1.14.3
NODES
auto-starting new master
process[master]: started with pid [9372]
ROS_MASTER_URI=http://gopigo3:11311/
setting /run_id to 4504fade-b60e-11e9-93fa-b827eb825e1a
process[rosout-1]: started with pid [9433]
started core service [/rosout]
pi@gopigo3: ~ 45x26
---
header:
seq: 75
stamp:
secs: 1564852341
nsecs: 880923986
frame_id: "distance"
radiation_type: 1
field_of_view: 0.0
min_range: 0.019999999553
max_range: 3.0
range: 0.0900000035763
---
header:
seq: 76
stamp:
secs: 1564852342
nsecs: 878586053
frame_id: "distance"
radiation_type: 1
field_of_view: 0.0
min_range: 0.019999999553
max_range: 3.0
range: 0.0900000035763
---
pi@gopigo3: ~/catkin_ws/src/mygopigo/src 90x4
pi@gopigo3:~/catkin_ws/src/mygopigo/src$ ^C
pi@gopigo3:~/catkin_ws/src/mygopigo/src$
pi@gopigo3:~/catkin_ws/src/mygopigo/src$ rosrun mygopigo distance-sensor.py

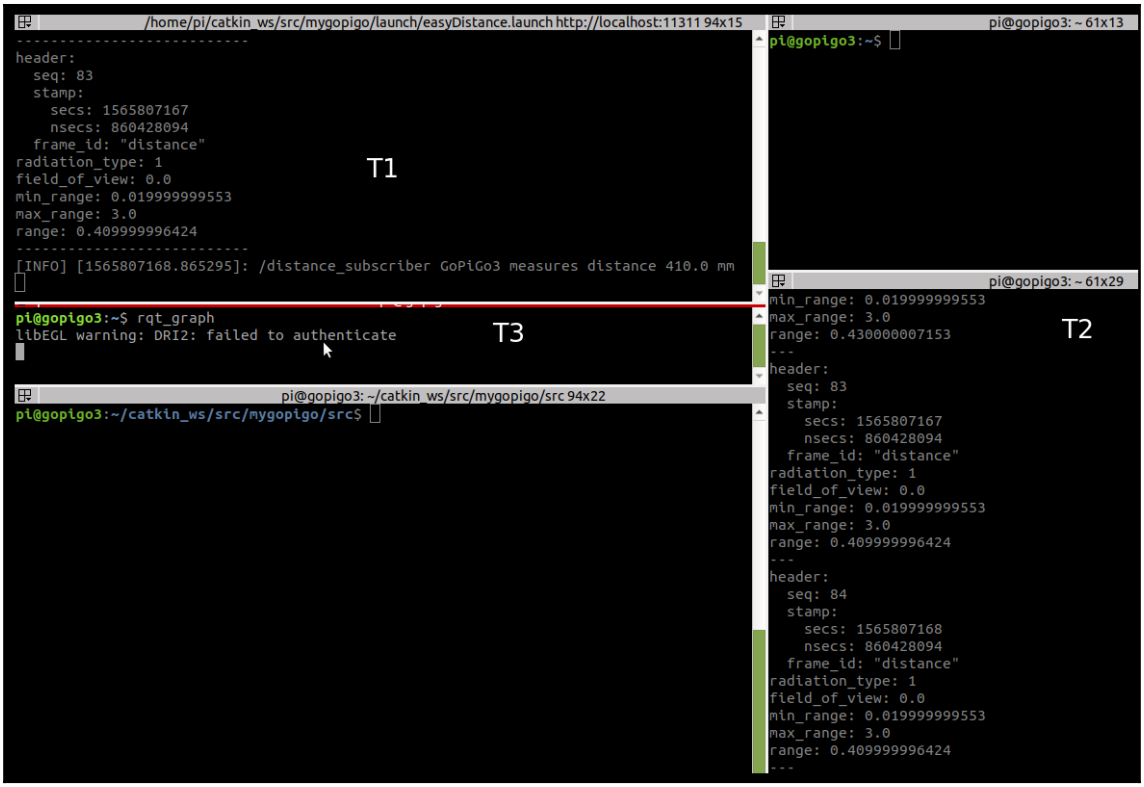

pi@gopigo3: ~/catkin_ws/src/mygopigo/src
roscore http://gopigo3:11311/ 42x26
Done checking log file disk usage. Usage i
s <1GB.
started roslaunch server http://gopigo3:43
141/
ros_comm version 1.14.3
SUMMARY
========
PARAMETERS
* /rosdistro: melodic
* /rosversion: 1.14.3
NODES
auto-starting new master
process[master]: started with pid [9372]
ROS_MASTER_URI=http://gopigo3:11311/
setting /run_id to 4504fade-b60e-11e9-93fa
-b827eb825e1a
process[rosout-1]: started with pid [9433]
started core service [/rosout]
pi@gopigo3: ~ 45x26
---
header:
seq: 75
stamp:
secs: 1564852341
nsecs: 880923986
frame_id: "distance"
radiation_type: 1
field_of_view: 0.0
min_range: 0.019999999553
max_range: 3.0
range: 0.0900000035763
---
header:
seq: 76
stamp:
secs: 1564852342
nsecs: 878586053
frame_id: "distance"
radiation_type: 1
field_of_view: 0.0
min_range: 0.019999999553
max_range: 3.0
range: 0.0900000035763
---
pi@gopigo3: ~/catkin_ws/src/mygopigo/src 90x4
pi@gopigo3:~/catkin_ws/src/mygopigo/src$ ^C
pi@gopigo3:~/catkin_ws/src/mygopigo/src$
pi@gopigo3:~/catkin_ws/src/mygopigo/src$ rosrun mygopigo distance-sensor.py


/easyDistance_sensor
/easyDistance_sensor/distance
/rostopic_2797_1565719727410

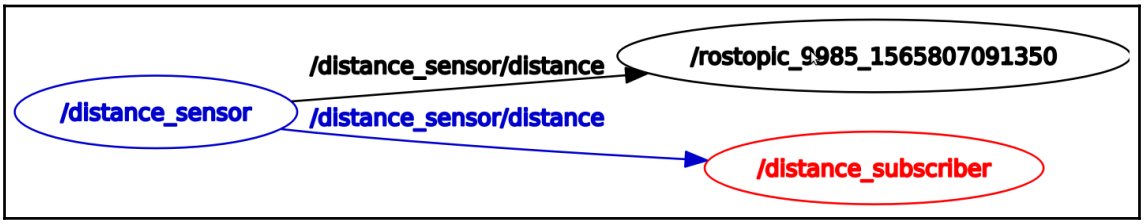

/distance_sensor/distance/field_of_view
/distance_sensor/distance/max_range
/distance_sensor/distance/min_range
/distance_sensor/distance/radiation_type
/distance_sensor/distance/range
3.0
2.5
2.0
1.5
1.0
0.5
0.0
−40
−30
−20
−10
−5.391e4
distance_sensor
/play_1565948869121488604
/distance_sensor/distance
/rostopic_7149_1565948863685

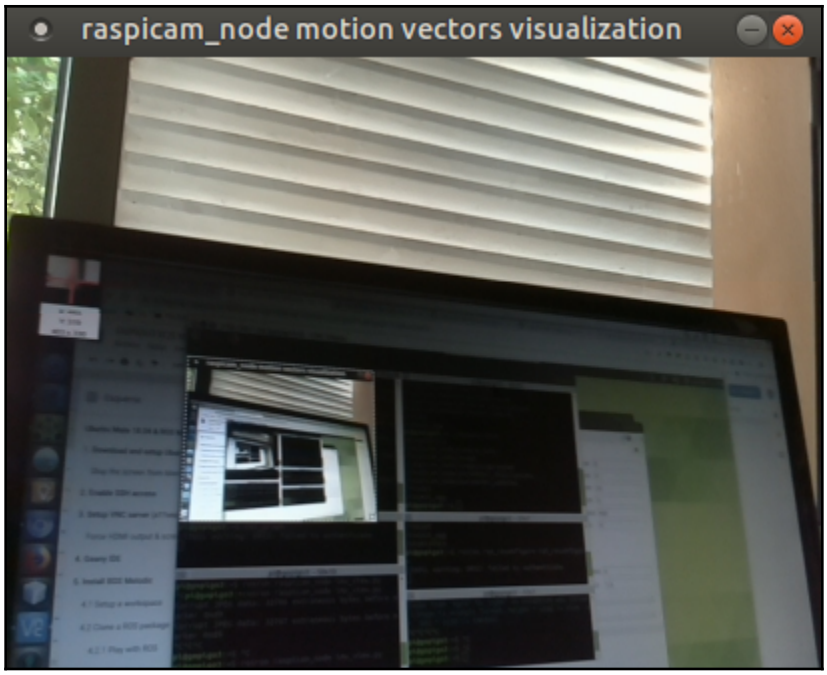

roscore http://gopigo3:11311/ 94x6
ROS_MASTER_URI=http://gopigo3:11311/
setting /run_id to 3df79654-beb3-11e9-9ddf-b827eb825e1a
process[rosout-1]: started with pid [3513]
started core service [/rosout]
T1
pi@gopigo3: ~ 94x5
pi@gopigo3:~$ rqt_graph
libEGL warning: DRI2: failed to authenticate
T5
pi@gopigo3: ~/catkin_ws/src/mygopigo/src 94x30
[INFO] [1565805551.406758]: /distance_subscriber GoPiGo3 measures distance 420.0 mm
header:
seq: 13
stamp:
secs: 1565805552
nsecs: 405718088
frame_id: "distance"
radiation_type: 1
field_of_view: 0.0
min_range: 0.019999999553
max_range: 3.0
range: 0.379999995232
[INFO] [1565805552.408958]: /distance_subscriber GoPiGo3 measures distance 380.0 mm
header:
seq: 14
stamp:
secs: 1565805553
nsecs: 404056072
frame_id: "distance"
radiation_type: 1
field_of_view: 0.0
min_range: 0.019999999553
max_range: 3.0
range: 0.430000007153
[INFO] [1565805553.407406]: /distance_subscriber GoPiGo3 measures distance 430.0 mm
T4
pi@gopigo3: ~ 61x13
450.0 mm
410.0 mm
430.0 mm
440.0 mm
400.0 mm
440.0 mm
420.0 mm
430.0 mm
400.0 mm
420.0 mm
380.0 mm
430.0 mm
T2
pi@gopigo3: ~ 61x29
min_range: 0.019999999553
max_range: 3.0
range: 0.419999986887
header:
seq: 13
stamp:
secs: 1565805552
nsecs: 405718088
frame_id: "distance"
radiation_type: 1
field_of_view: 0.0
min_range: 0.019999999553
max_range: 3.0
range: 0.379999995232
header:
seq: 14
stamp:
secs: 1565805553
nsecs: 404056072
frame_id: "distance"
radiation_type: 1
field_of_view: 0.0
min_range: 0.019999999553
max_range: 3.0
range: 0.430000007153
T3

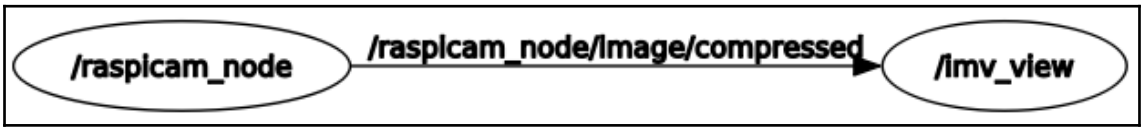

/distance_sensor/distance
/rostopic_6439_1565804248031
/distance_sensor
/distance_sensor/distance
/distance_subscriber

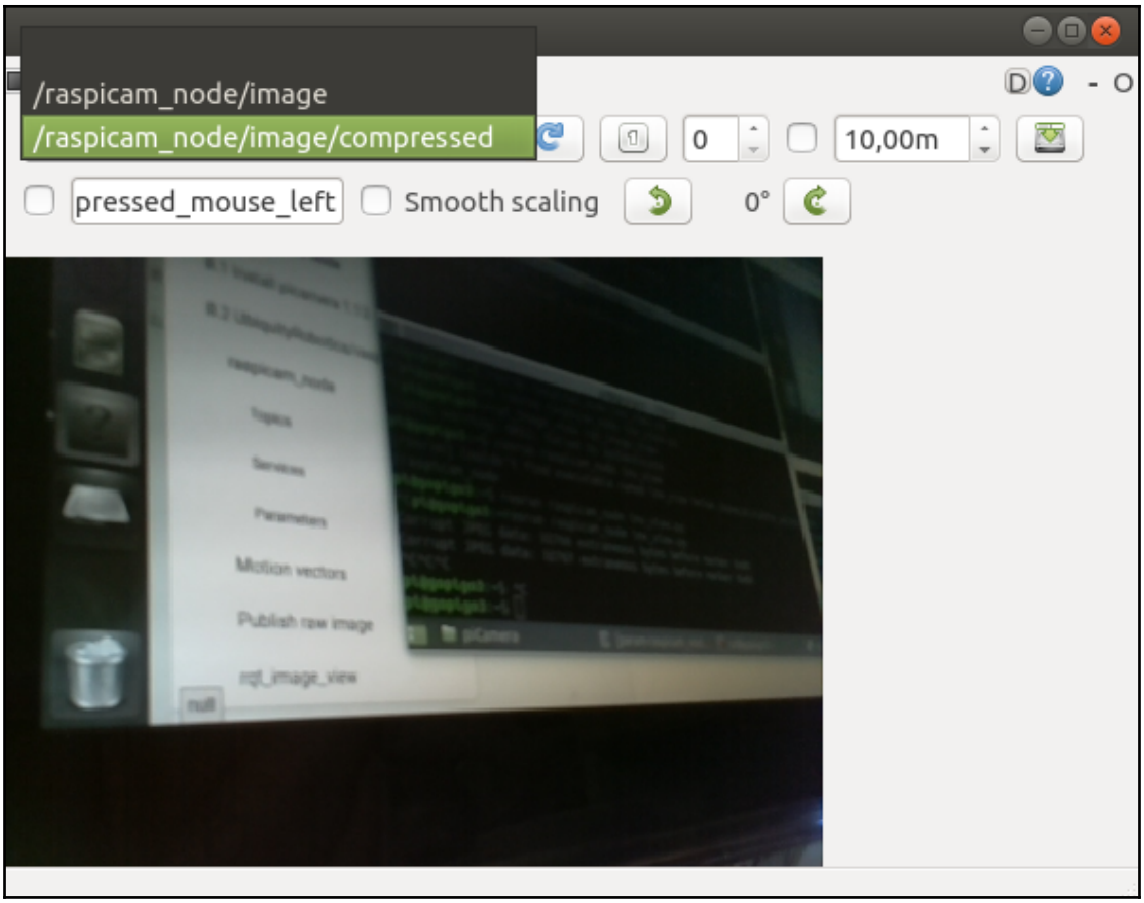

/home/pi/catkin_ws/src/mygopigo/launch/easyDistance.launch http://localhost:11311 94x15
header:
seq: 83
stamp:
secs: 1565807167
nsecs: 860428094
frame_id: "distance"
radiation_type: 1
field_of_view: 0.0
min_range: 0.019999999553
max_range: 3.0
range: 0.409999996424
[INFO] [1565807168.865295]: /distance_subscriber GoPiGo3 measures distance 410.0 mm
T1
pi@gopigo3:~$
pi@gopigo3: ~ 61x13
pi@gopigo3:~$ rqt_graph
libEGL warning: DRI2: failed to authenticate
T3
pi@gopigo3: ~/catkin_ws/src/mygopigo/src 94x22
pi@gopigo3:~/catkin_ws/src/mygopigo/src$
pi@gopigo3: ~ 61x29
min_range: 0.019999999553
max_range: 3.0
range: 0.430000007153
---
header:
seq: 83
stamp:
secs: 1565807167
nsecs: 860428094
frame_id: "distance"
radiation_type: 1
field_of_view: 0.0
min_range: 0.019999999553
max_range: 3.0
range: 0.409999996424
---
header:
seq: 84
stamp:
secs: 1565807168
nsecs: 860428094
frame_id: "distance"
radiation_type: 1
field_of_view: 0.0
min_range: 0.019999999553
max_range: 3.0
range: 0.409999996424

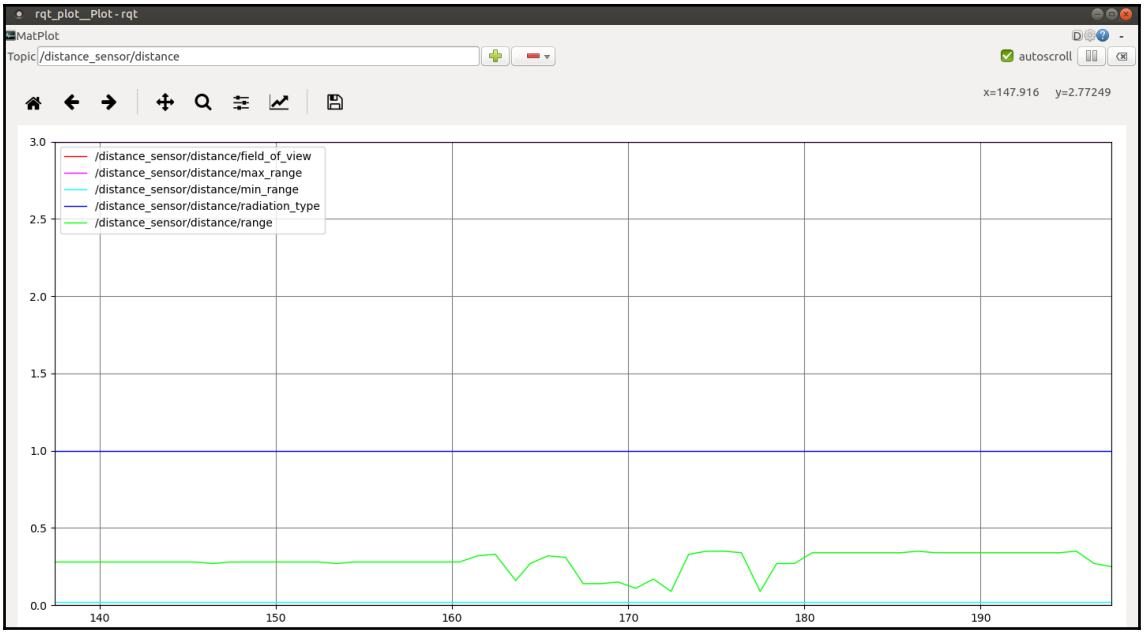
T2

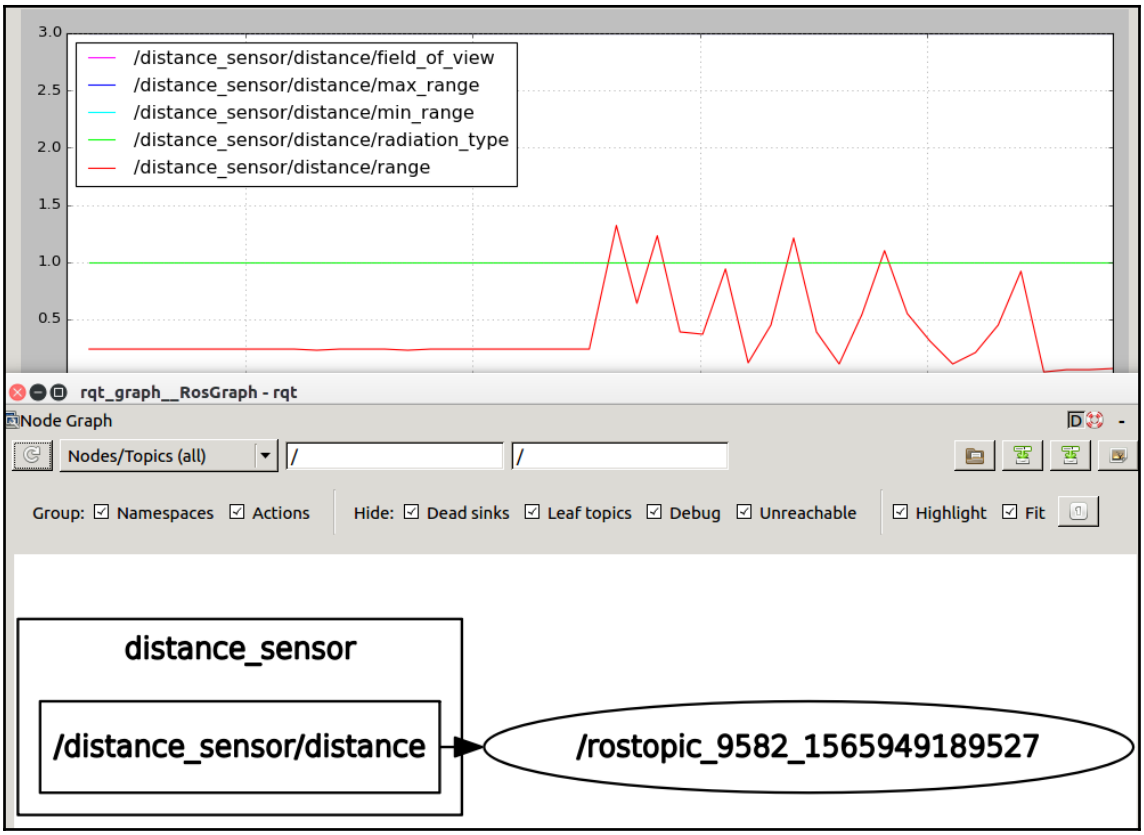

/distance_sensor/distance
/rostopic_9985_1565807091350
/distance_sensor
/distance_sensor/distance
/distance_subscriber

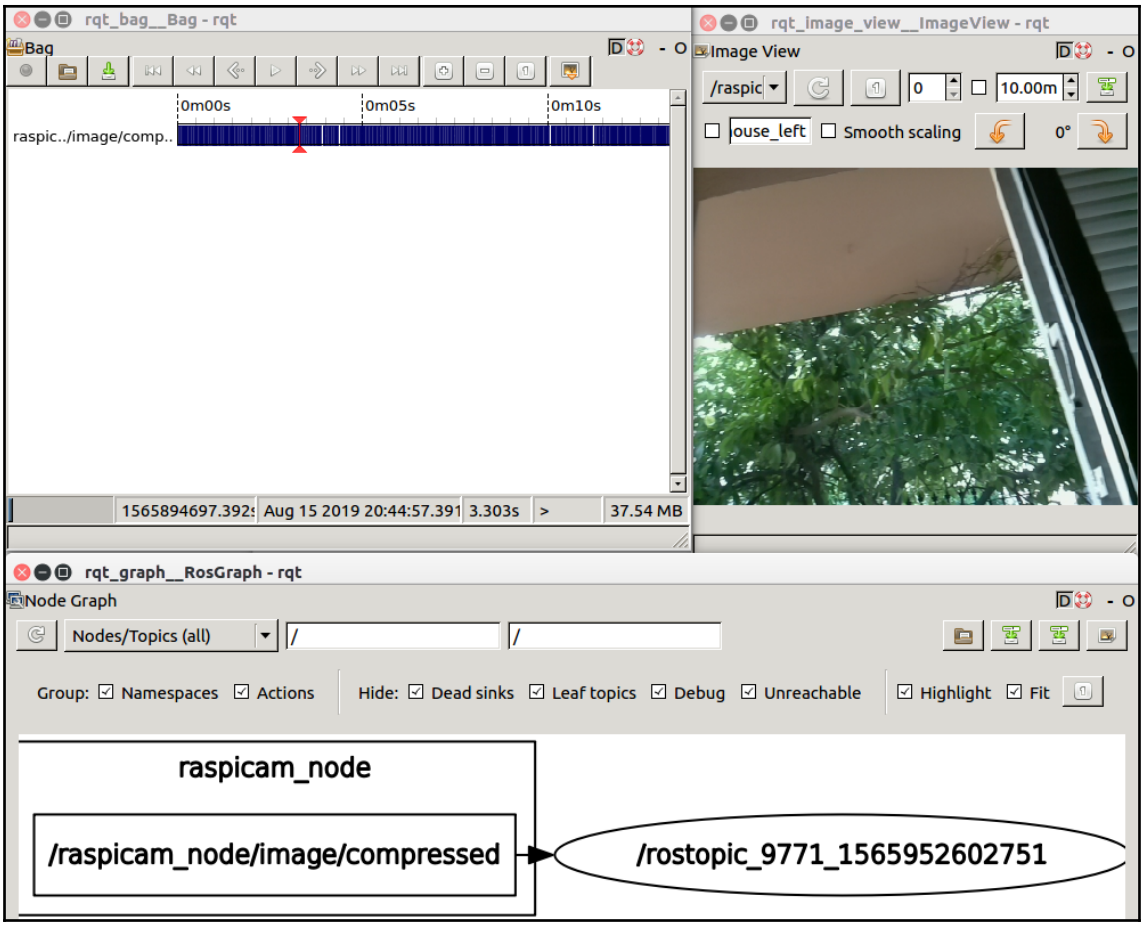

raspicam_node motion vectors visualization

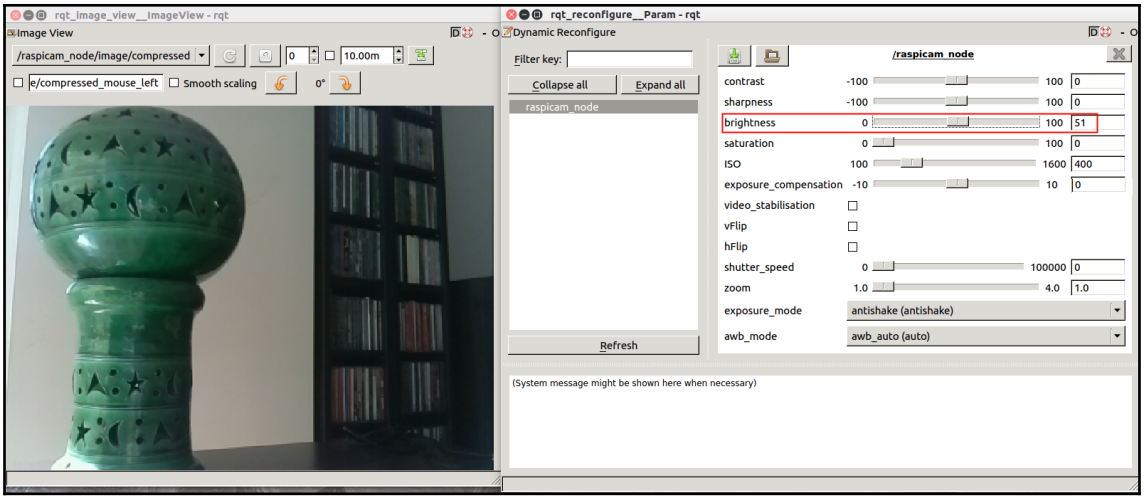

/raspicam_node
/raspicam_node/image/compressed
/imv_view

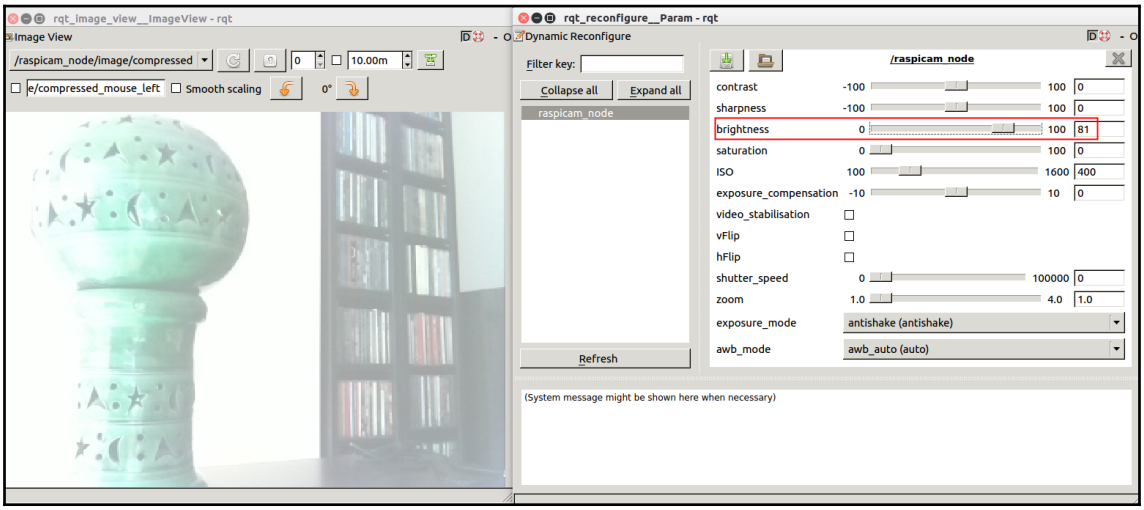

/raspicam_node/image
/raspicam_node/image/compressed
0
10,00m
pressed_mouse_left
Smooth scaling
0°


rqt_plot__Plot - rqt
MatPlot
Topic /distance_sensor/distance
autoscroll
x=147.916 y=2.77249
/distance_sensor/distance/field_of_view
/distance_sensor/distance/max_range
/distance_sensor/distance/min_range
/distance_sensor/distance/radiation_type
/distance_sensor/distance/range
3.0
2.5
2.0
1.5
1.0
0.5
0.0
140
150
160
170
180
190

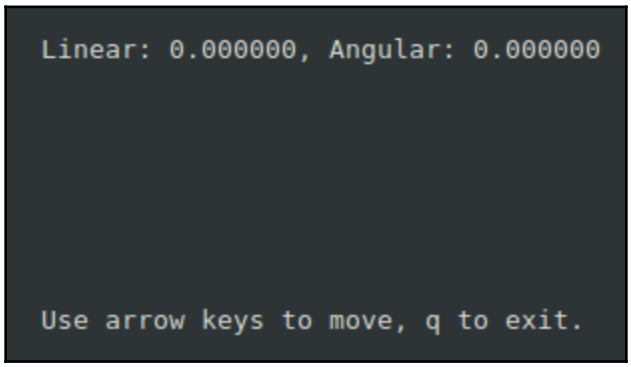

3.0
2.5
2.0
1.5
1.0
0.5
/distance_sensor/distance/field_of_view
/distance_sensor/distance/max_range
/distance_sensor/distance/min_range
/distance_sensor/distance/radiation_type
/distance_sensor/distance/range
rqt_graph__RosGraph - rqt
Node Graph
Nodes/Topics (all)
/
/
Group: Namespaces Actions
Hide: Dead sinks Leaf topics Debug Unreachable
Highlight Fit
distance_sensor
/distance_sensor/distance
/rostopic_9582_1565949189527

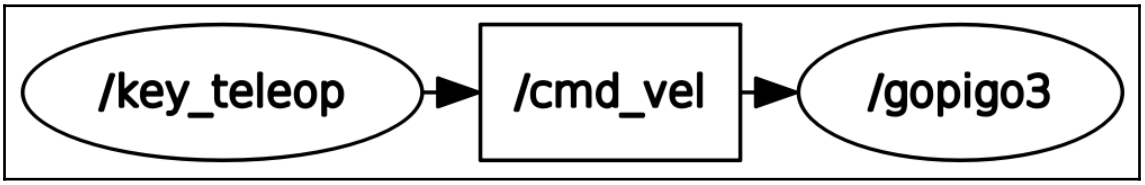

rqt_bag__Bag - rqt
Bag
0m00s
0m05s
0m10s
raspic../image/comp..
1565894697.392s
Aug 15 2019 20:44:57.391
3.303s
37.54 MB
rqt_image_view__ImageView - rqt
Image View
/raspic
0
10.00m
ouse_left
Smooth scaling
0°
rqt_graph__RosGraph - rqt
Node Graph
Nodes/Topics (all)
Group: Namespaces Actions
Hide: Dead sinks Leaf topics Debug Unreachable
Highlight Fit
raspicam_node
/raspicam_node/image/compressed
/rostopic_9771_1565952602751

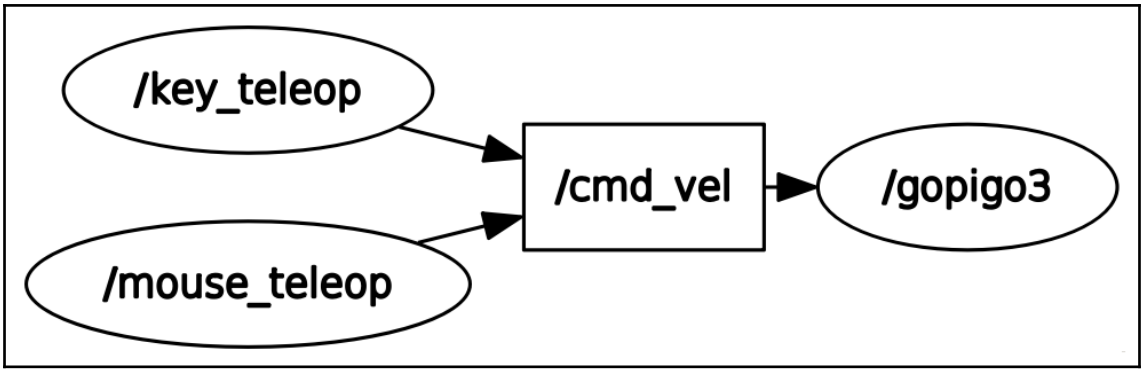

rqt_image_view__ImageView - rqt
Image View
/raspicam_node/image/compressed
10.00m
e/compressed_mouse_left
Smooth scaling
0°
rqt_reconfigure__Param - rqt
Dynamic Reconfigure
Filter key:
Collapse all
Expand all
raspicam_node
Refresh
/raspicam_node
contrast -100 100 0
sharpness -100 100 0
brightness 0 100 51
saturation 0 100 0
ISO 100 1600 400
exposure_compensation -10 10 0
video_stabilisation
vFlip
hFlip
shutter_speed 0 100000 0
zoom 1.0 4.0 1.0
exposure_mode antishake (antishake)
awb_mode awb_auto (auto)
(System message might be shown here when necessary)

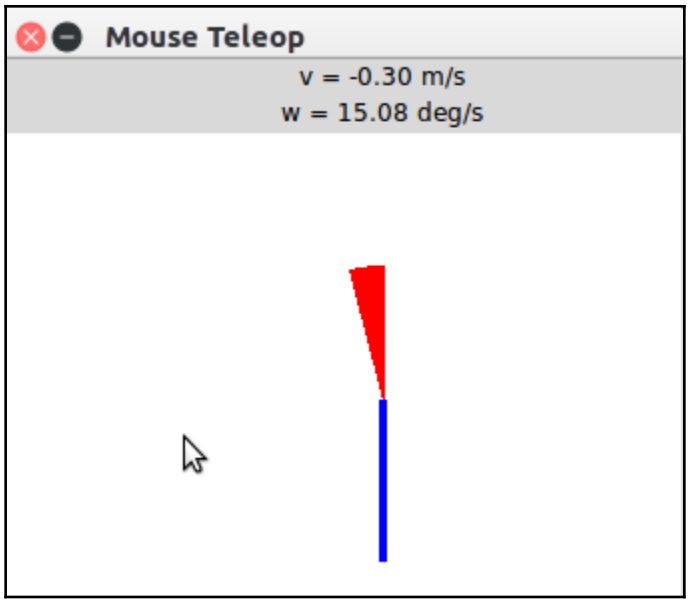

rqt_image_view__ImageView - rqt
Image View
/raspicam_node/image/compressed
10.00m
e/compressed_mouse_left
Smooth scaling
0°
rqt_reconfigure__Param - rqt
Dynamic Reconfigure
Filter key:
Collapse all
Expand all
raspicam_node
Refresh
/raspicam_node
contrast -100 100 0
sharpness -100 100 0
brightness 0 100 81
saturation 0 100 0
ISO 100 1600 400
exposure_compensation -10 10 0
video_stabilisation
vFlip
hFlip
shutter_speed 0 100000 0
zoom 1.0 4.0 1.0
exposure_mode antishake (antishake)
awb_mode awb_auto (auto)
(System message might be shown here when necessary)

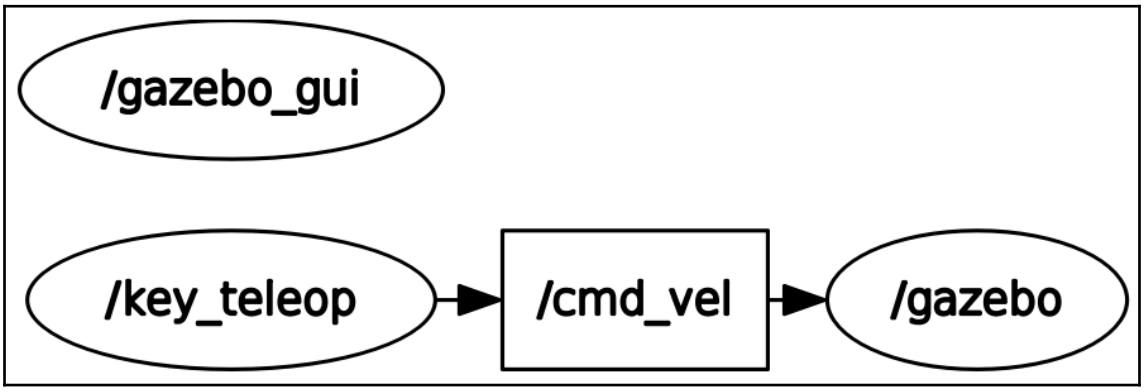
Chapter 7: Robot Control and Simulation

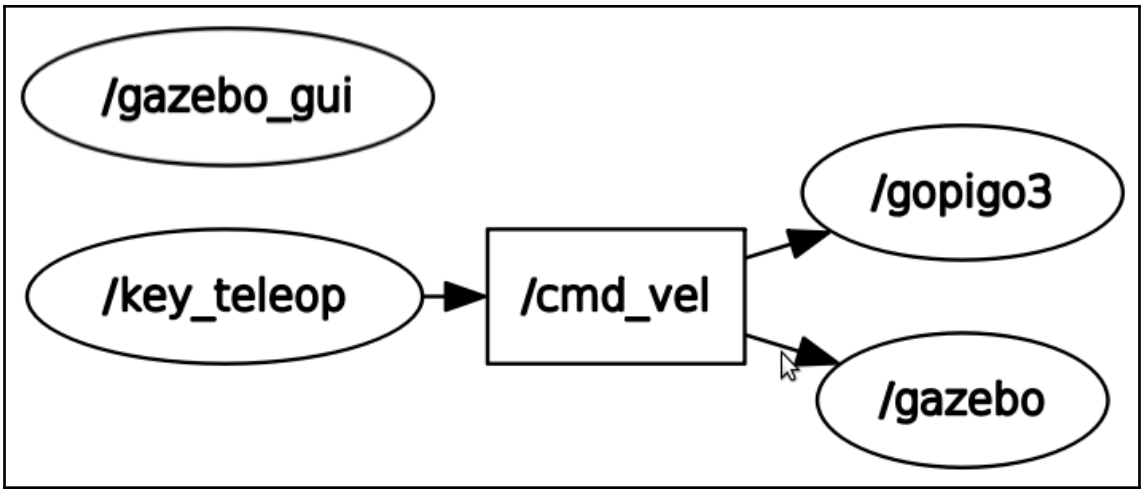




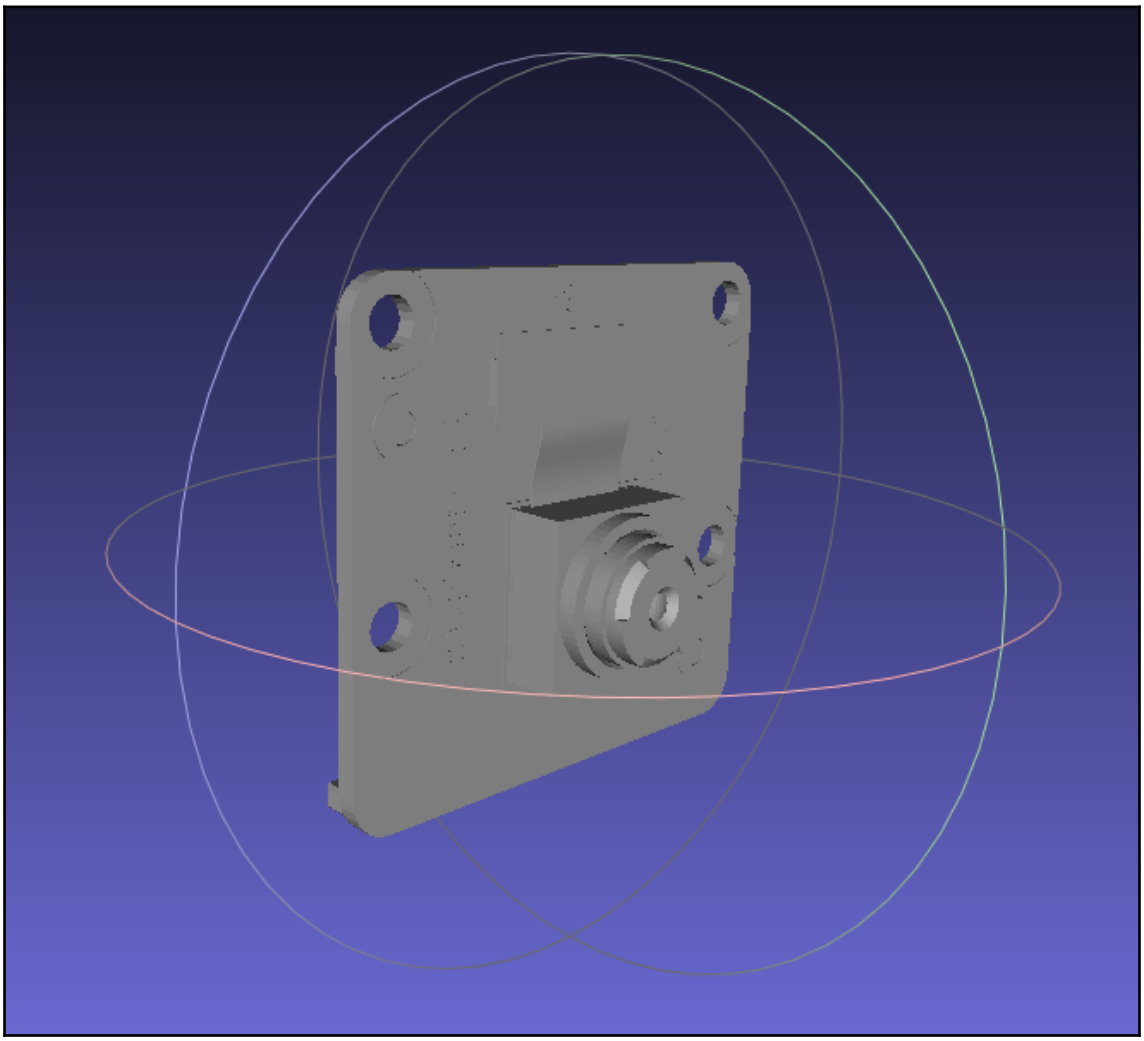


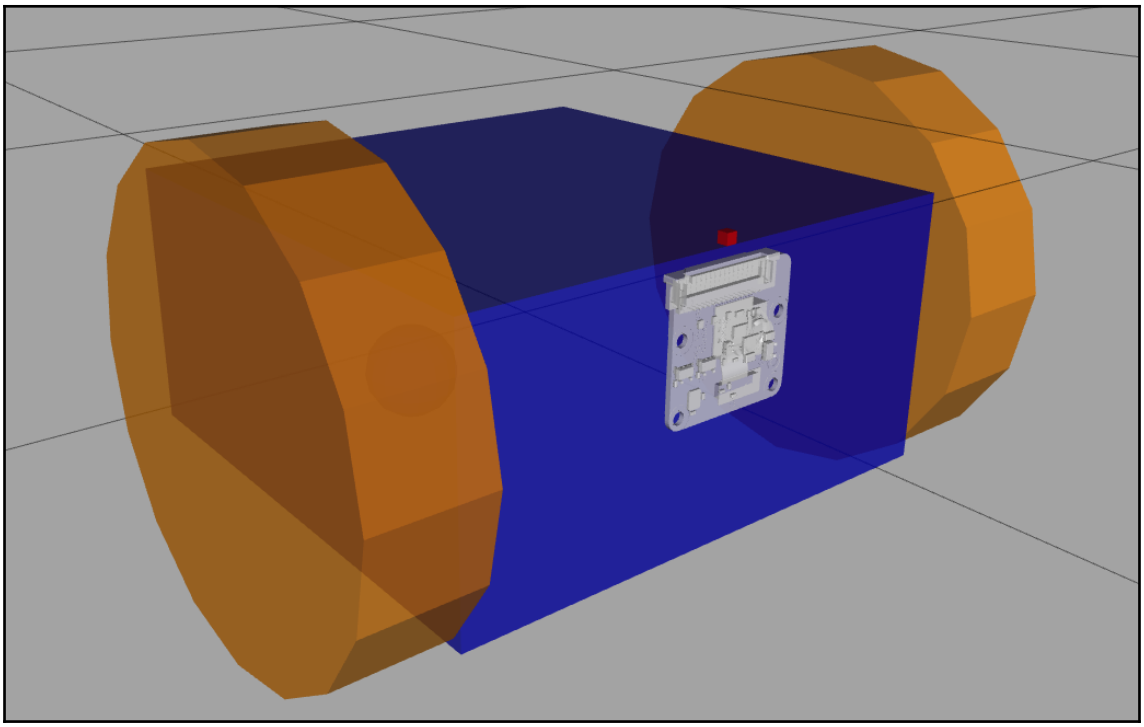

Mouse Teleop
v = -0.30 m/s
w = 15.08 deg/s

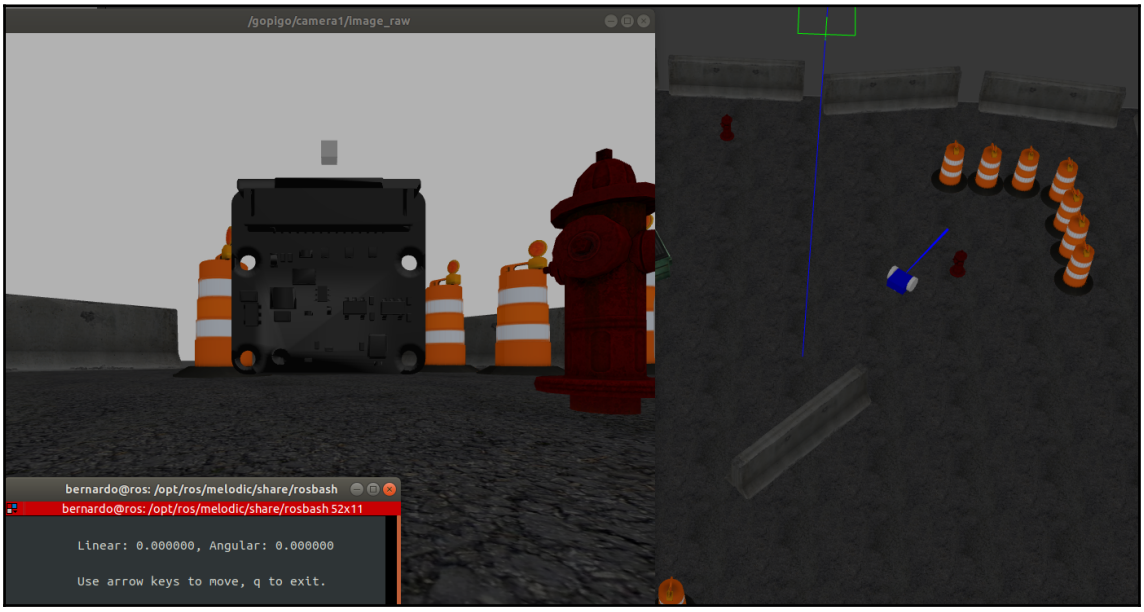

/gazebo_gui
/key_teleop
/cmd_vel
/gazebo

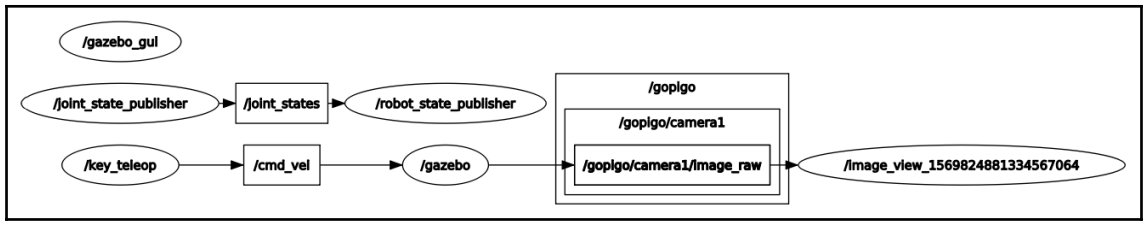

/gazebo_gui
/gopigo3
/key_teleop
/cmd_vel
/gazebo

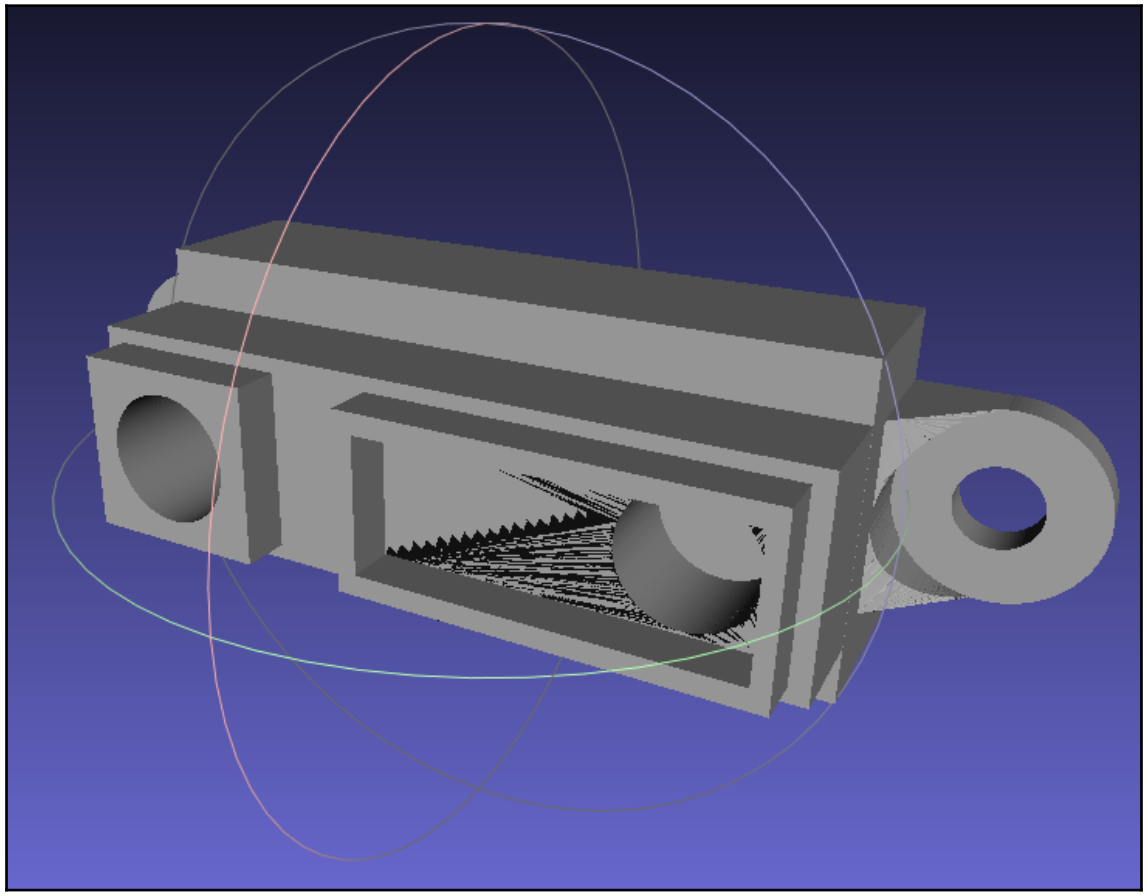
Chapter 8: Virtual SLAM and Navigation Using Gazebo

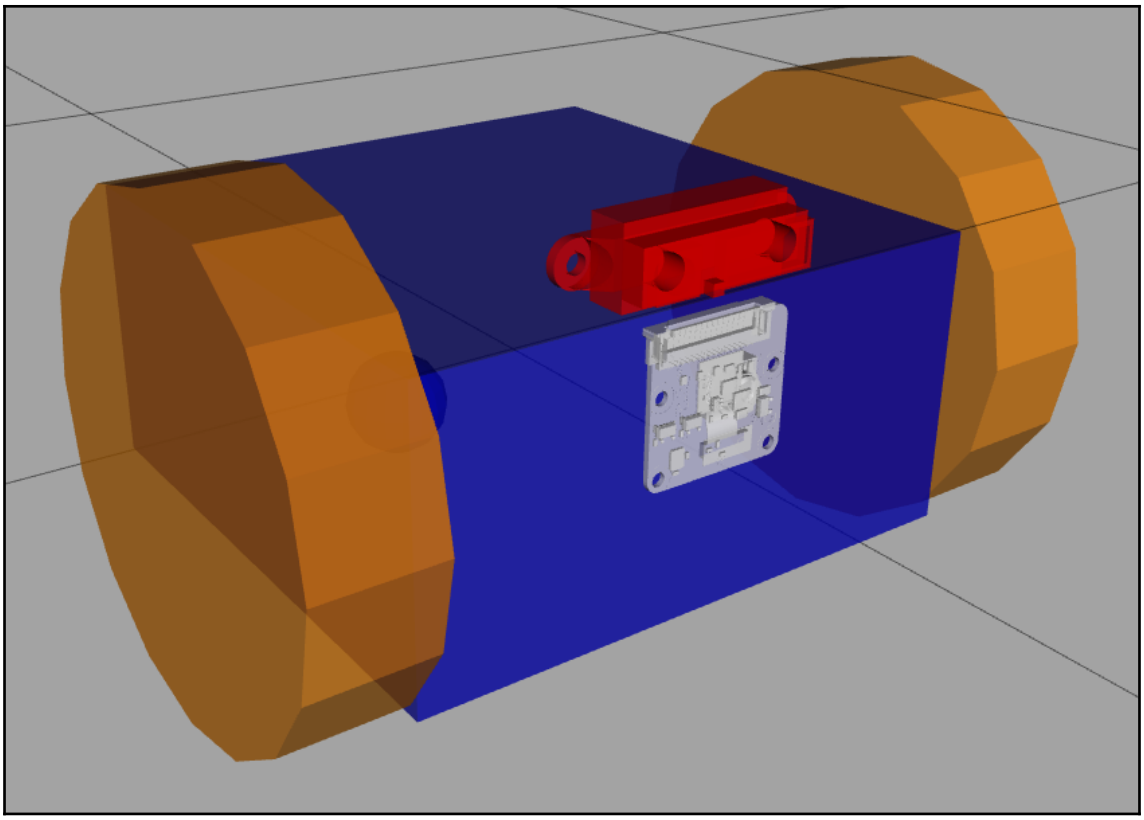


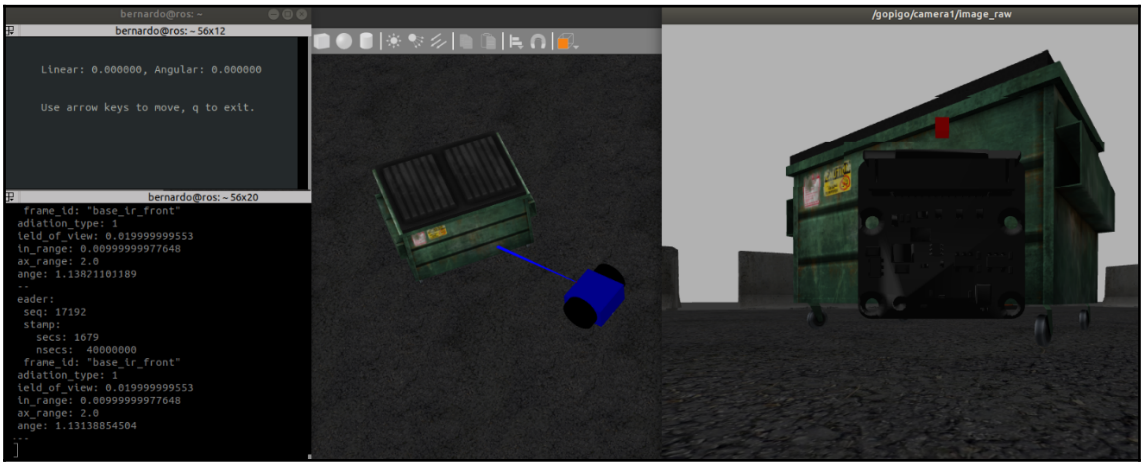



/gopigo/camera1/image_raw
bernardo@ros: /opt/ros/melodic/share/rosbash
bernardo@ros: /opt/ros/melodic/share/rosbash 52x11
Linear: 0.000000, Angular: 0.000000
Use arrow keys to move, q to exit.

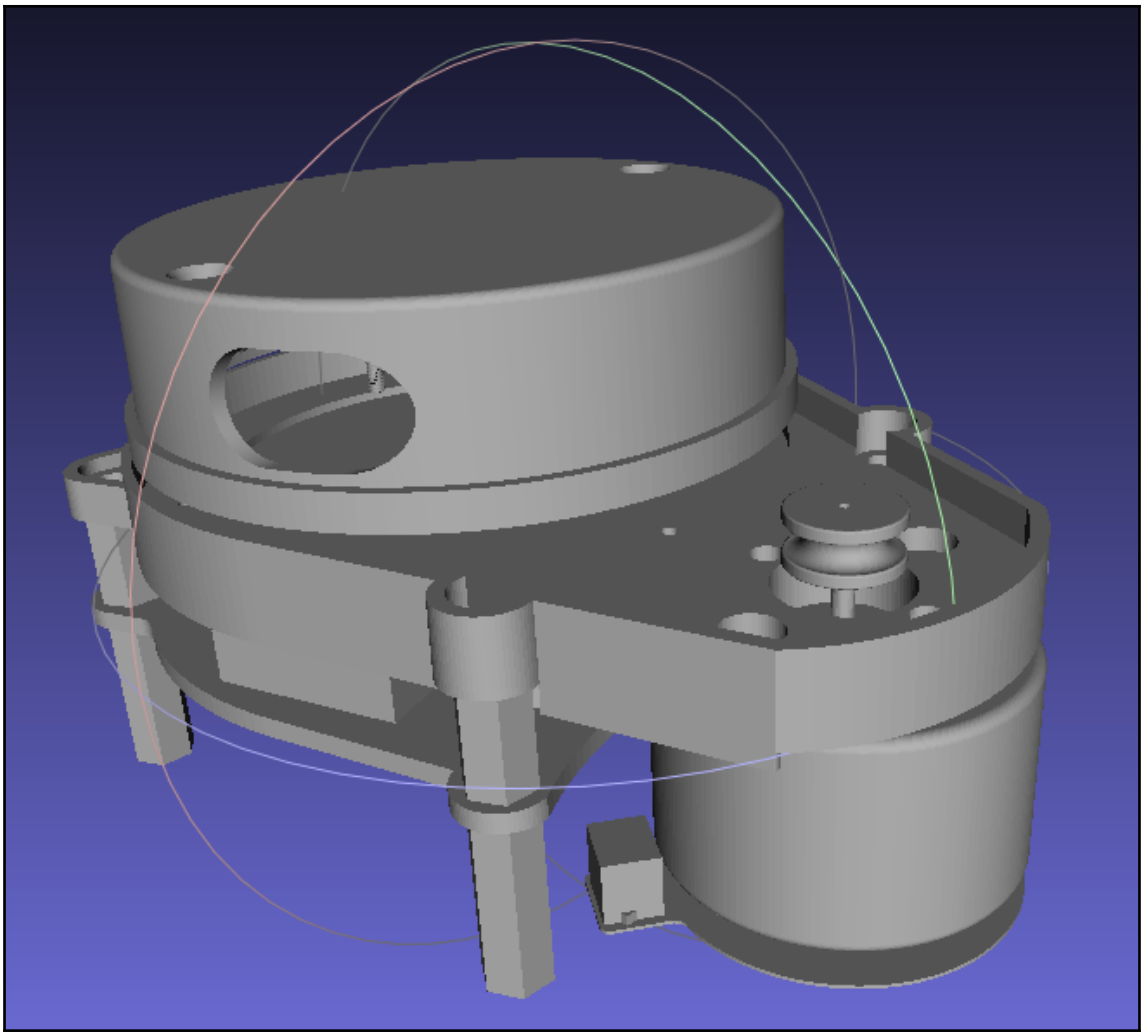

/gazebo_gui
/joint_state_publisher
/joint_states
/robot_state_publisher
/gopigo
/gopigo/camera1
/key_teleop
/cmd_vel
/gazebo
/gopigo/camera1/image_raw
/image_view_1569824881334567064

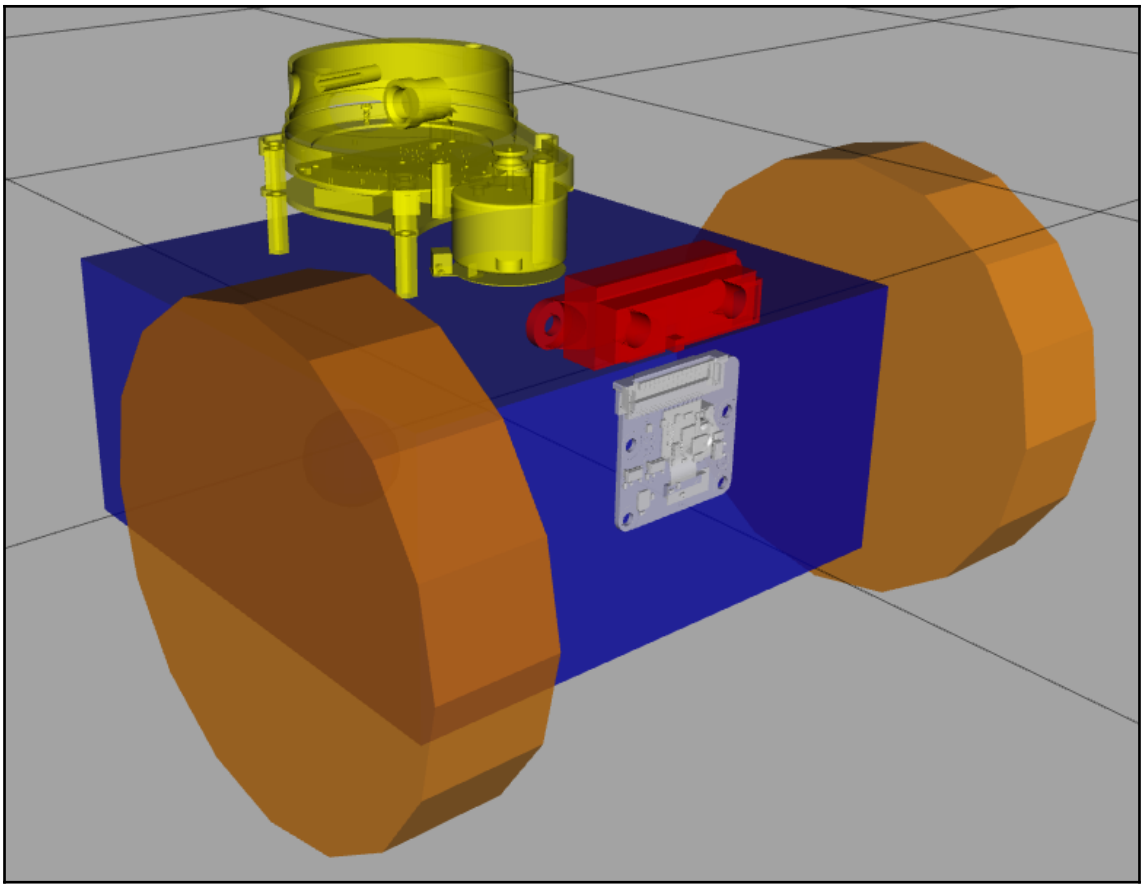


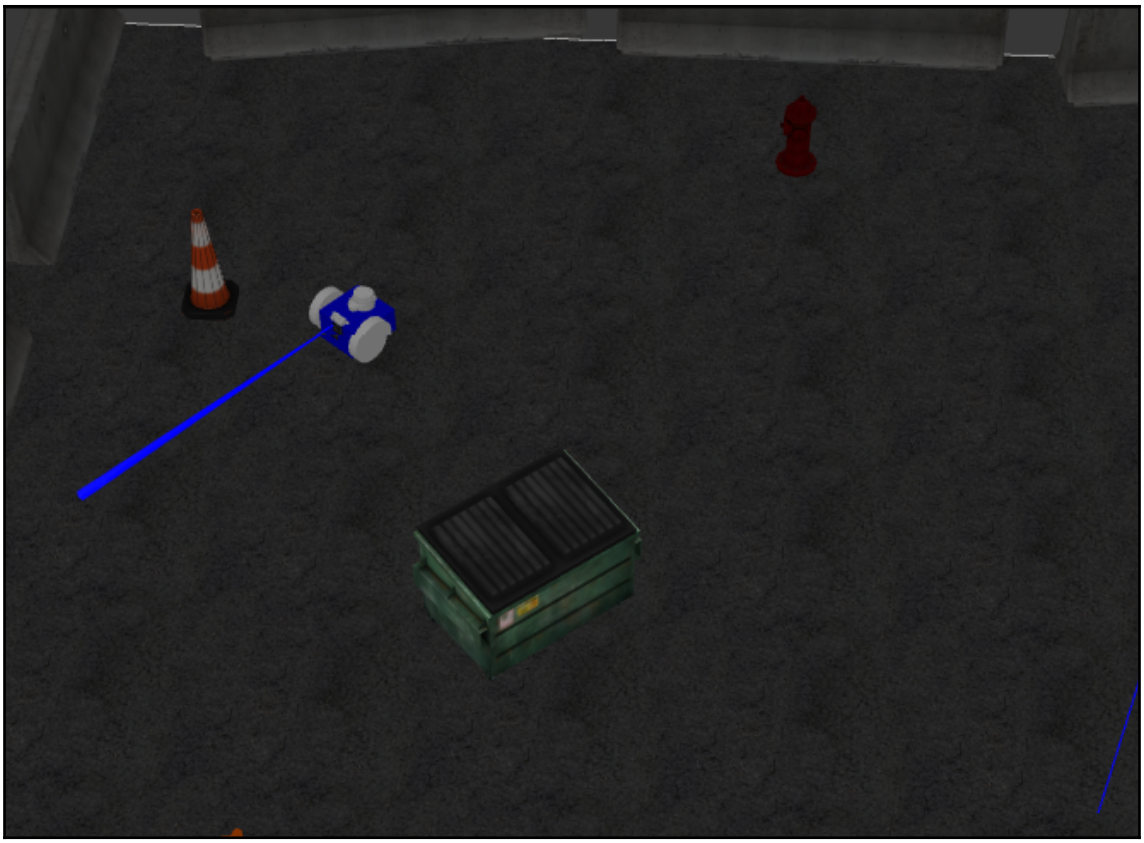


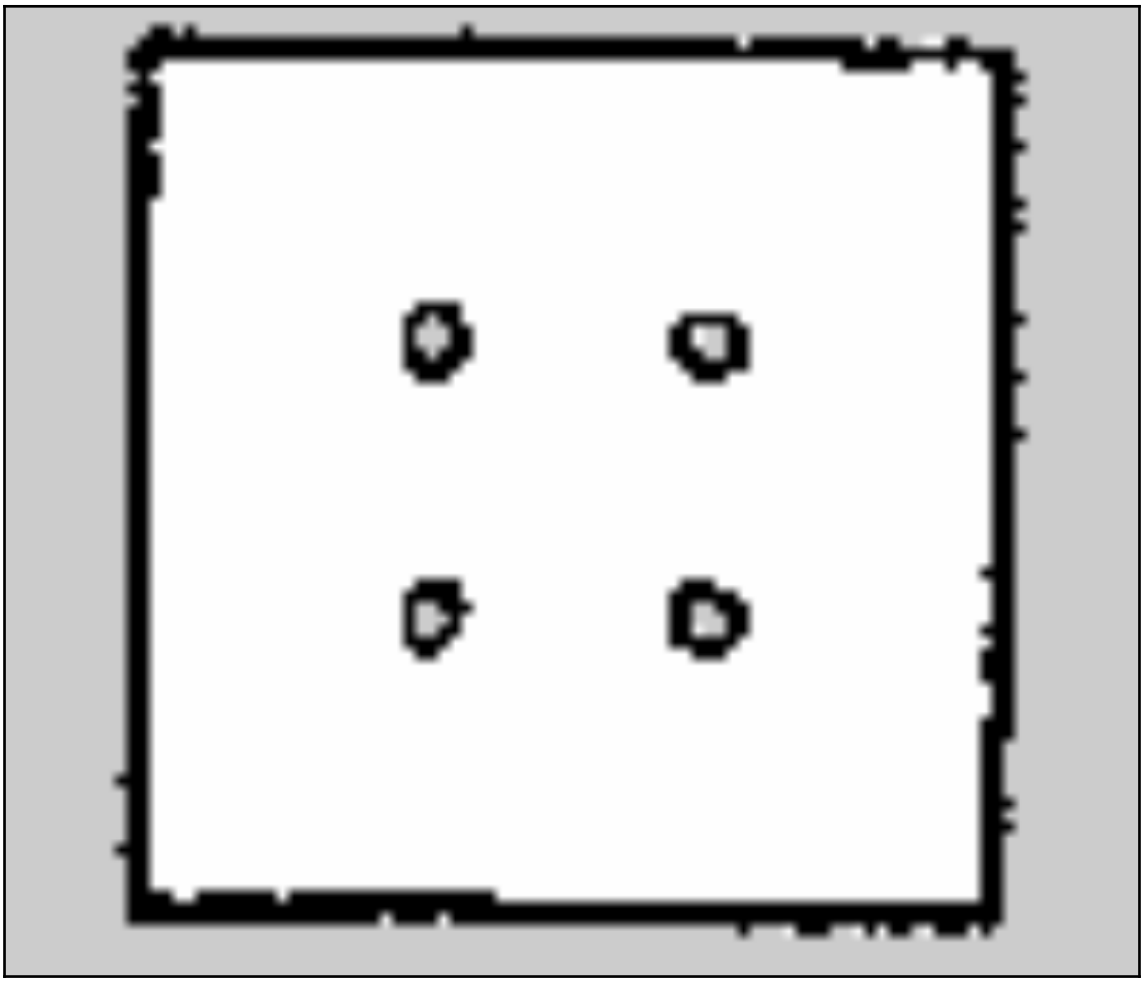

bernardo@ros: ~
bernardo@ros: ~ 56x12
Linear: 0.000000, Angular: 0.000000
Use arrow keys to move, q to exit.
bernardo@ros: ~ 56x20
frame_id: "base_ir_front"
adiation_type: 1
ield_of_view: 0.019999999553
in_range: 0.00999999977648
ax_range: 2.0
ange: 1.13821101189
---
eader:
seq: 17192
stamp:
secs: 1679
nsecs: 40000000
frame_id: "base_ir_front"
adiation_type: 1
ield_of_view: 0.019999999553
in_range: 0.00999999977648
ax_range: 2.0
ange: 1.13138854504

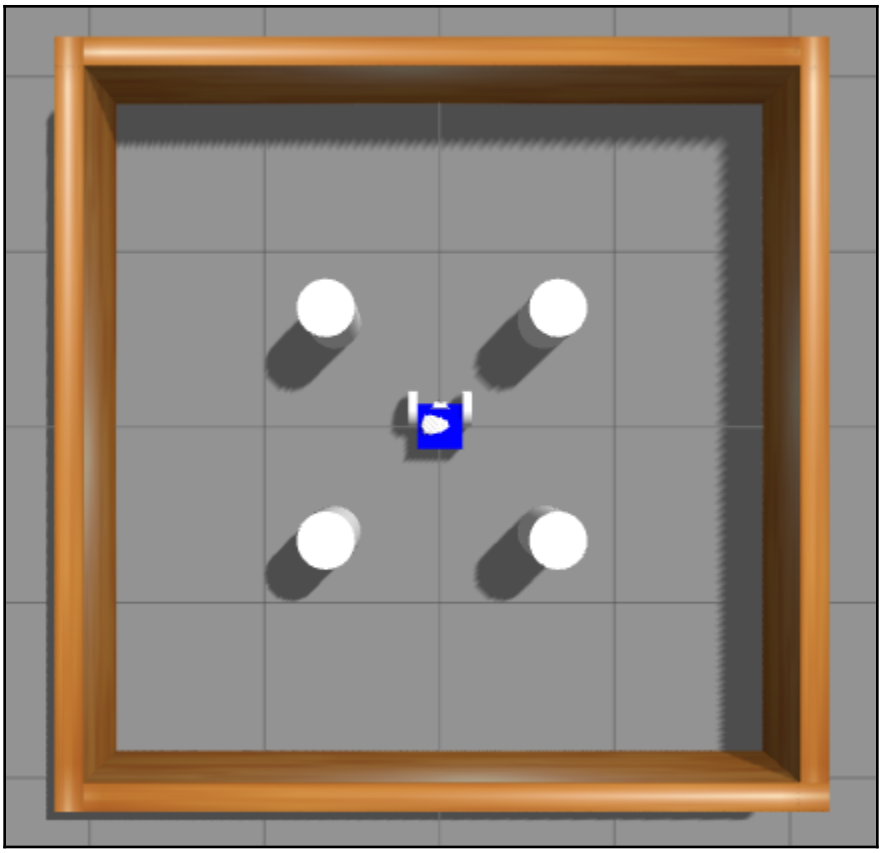
]
/gopigo/camera1/image_raw

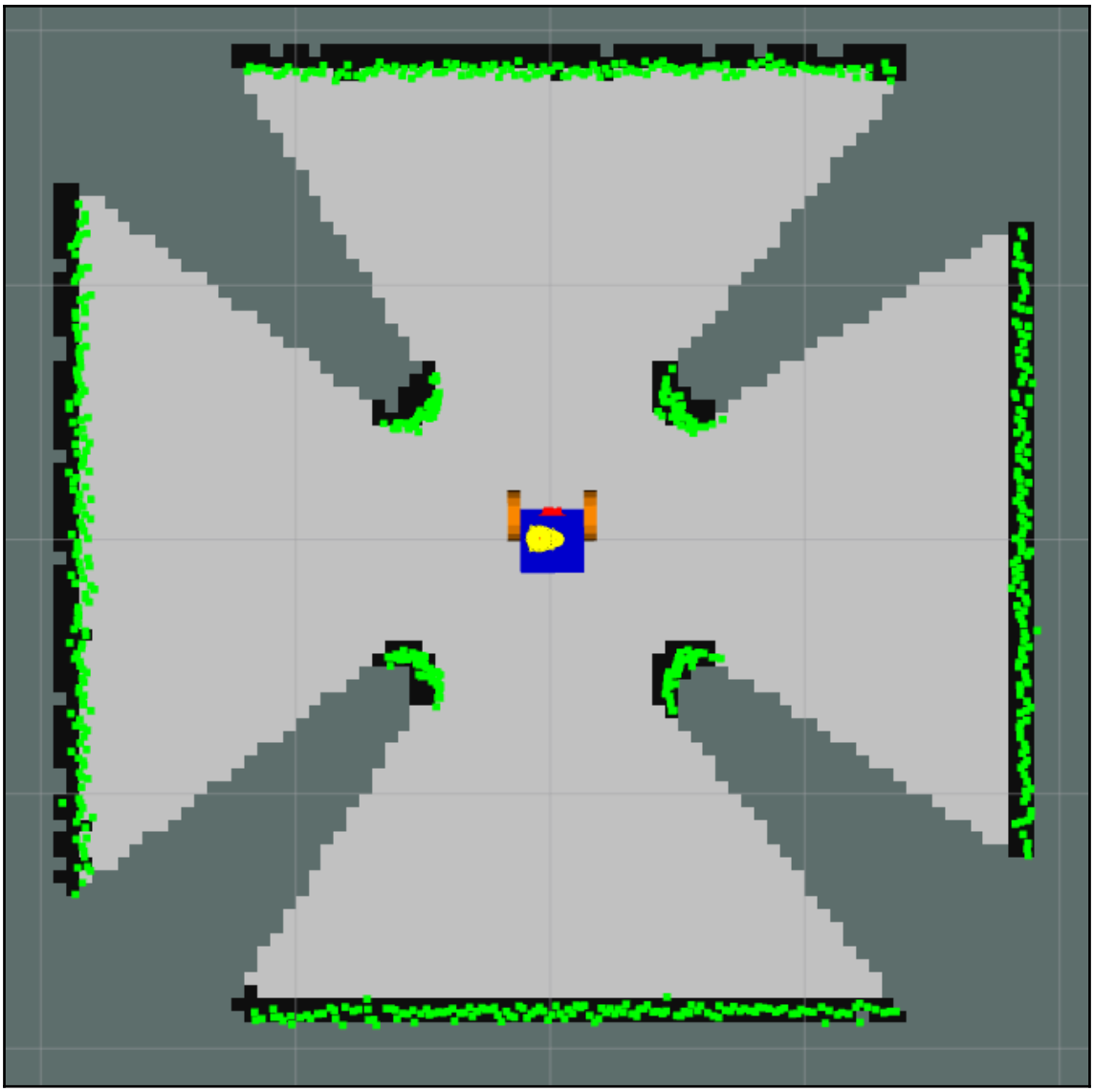


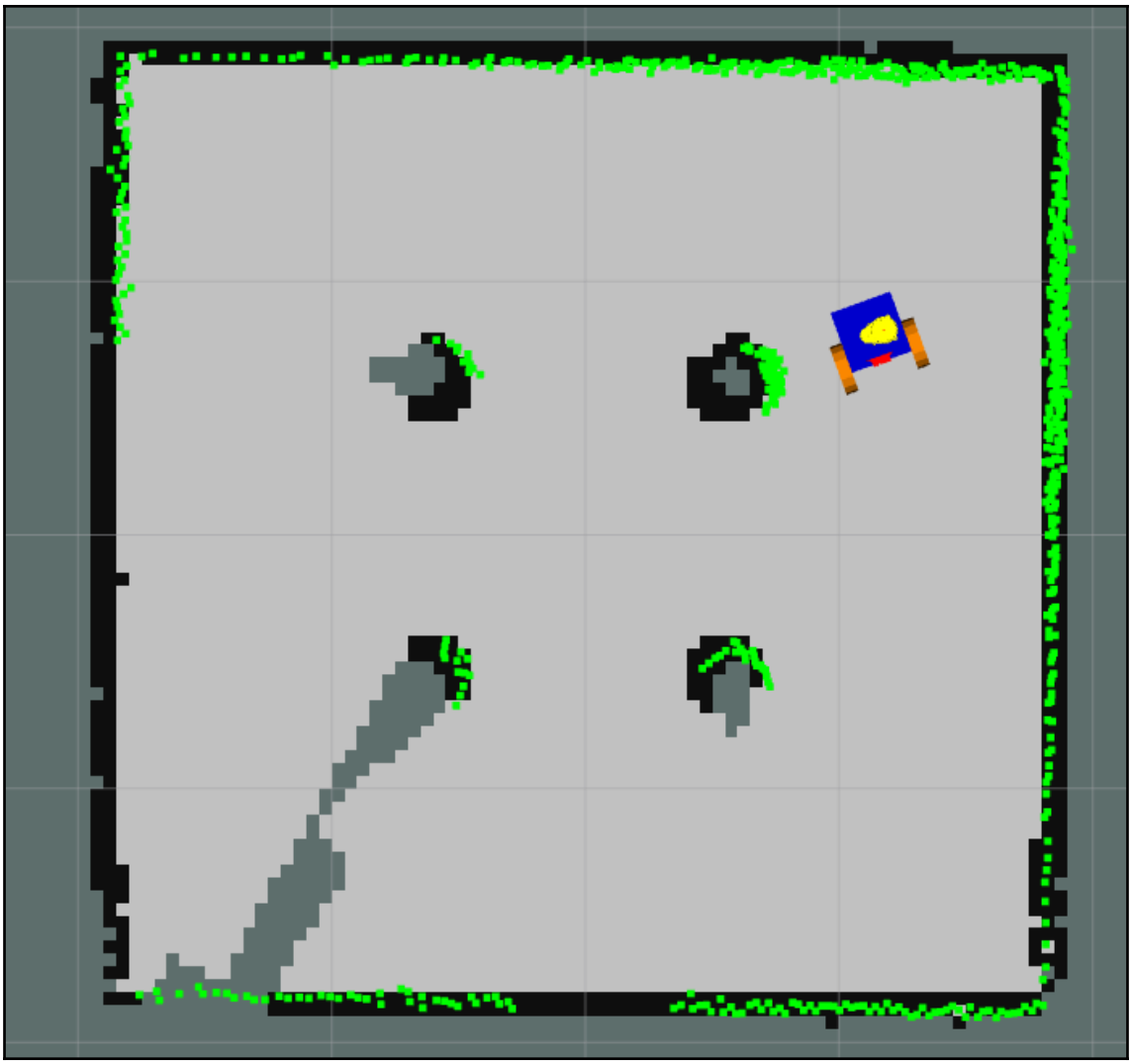


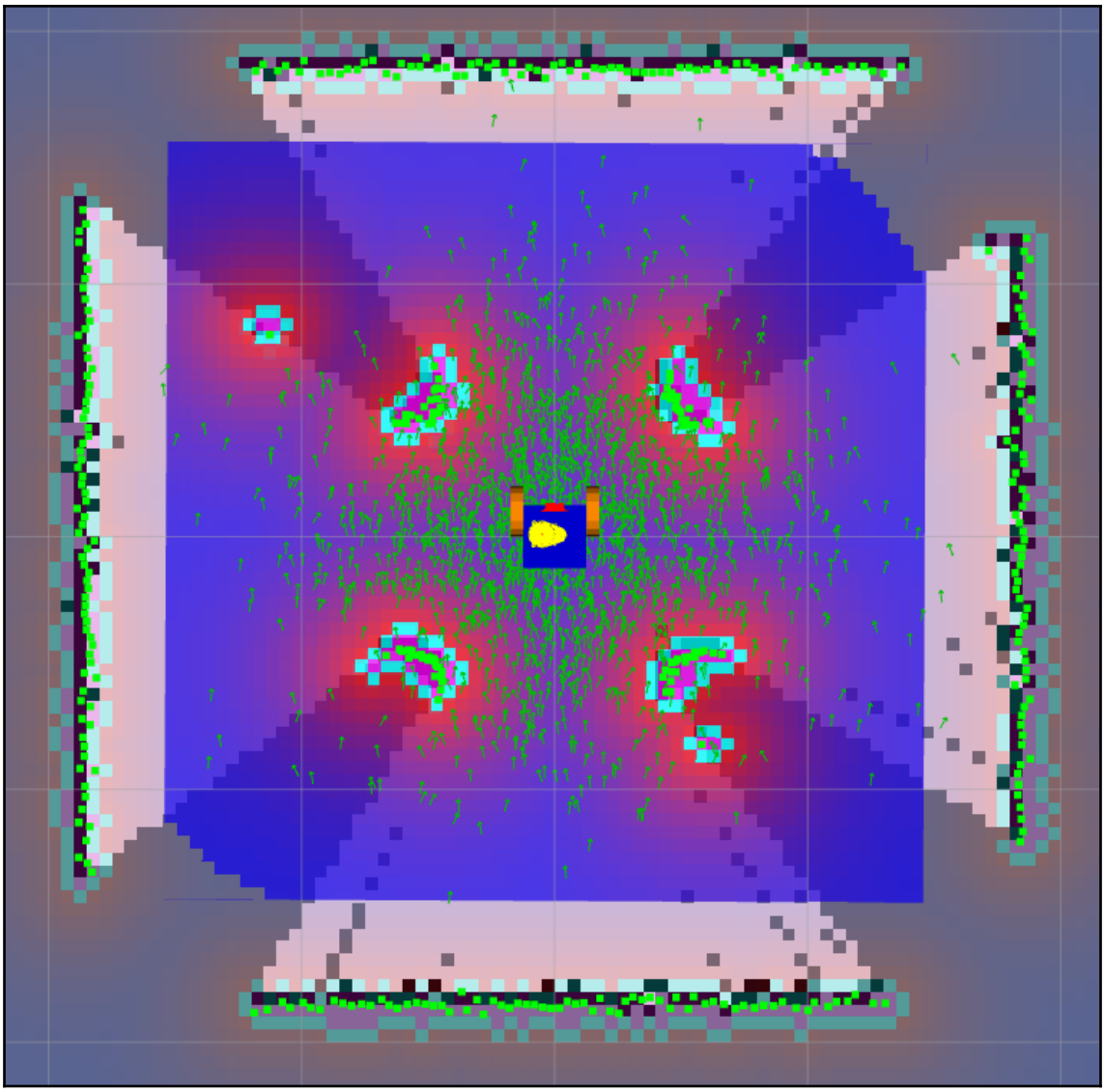


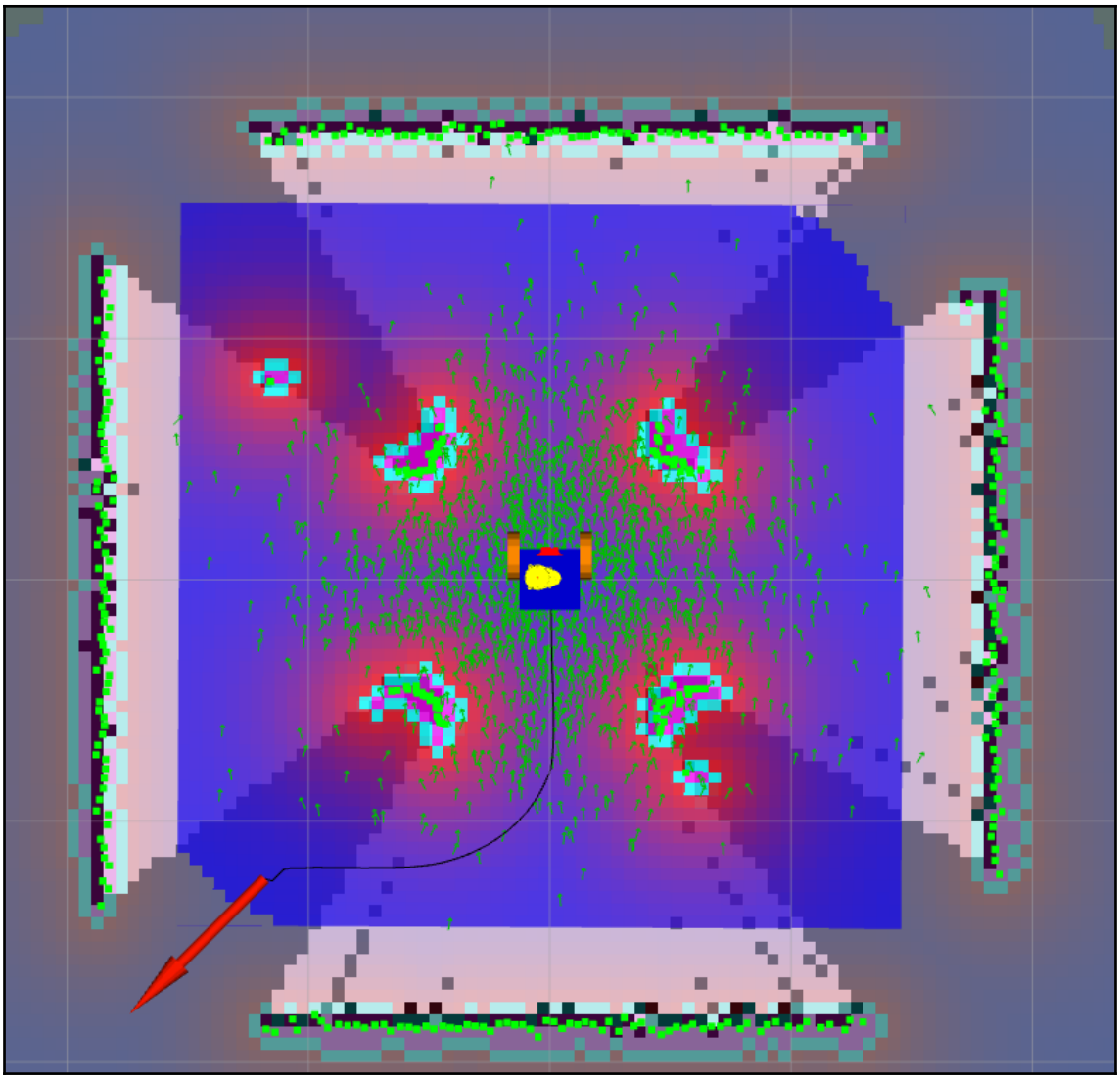


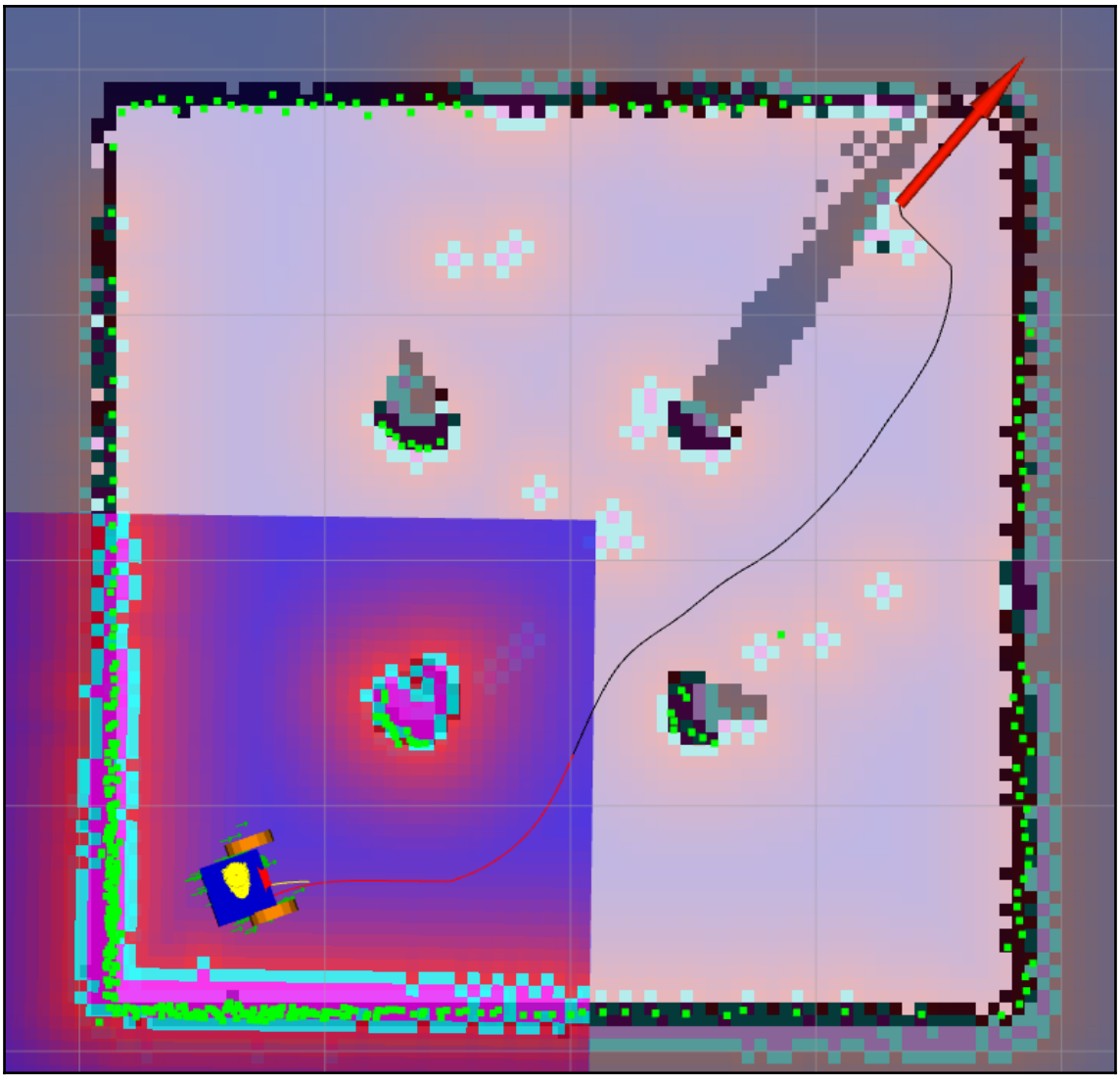


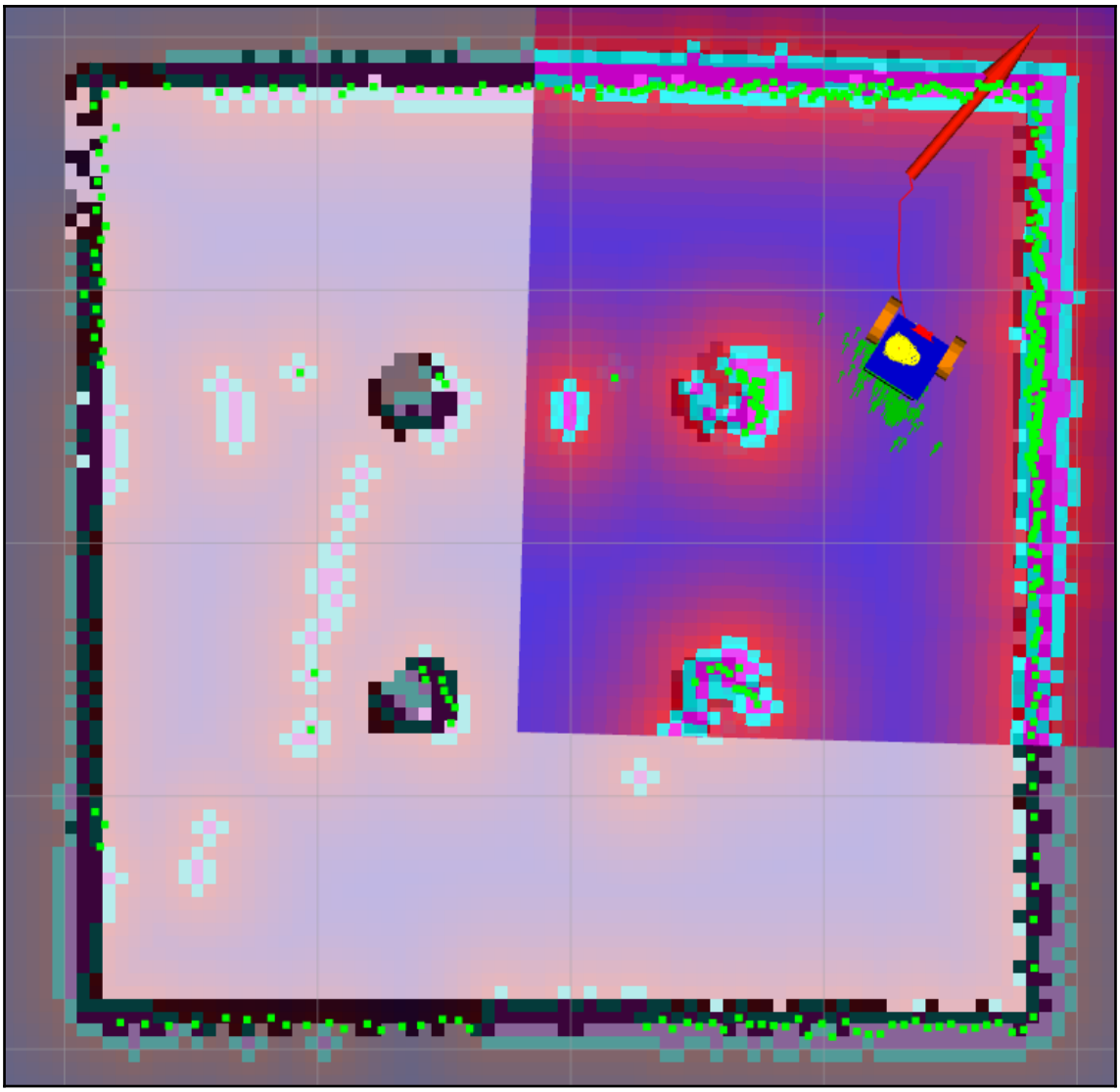




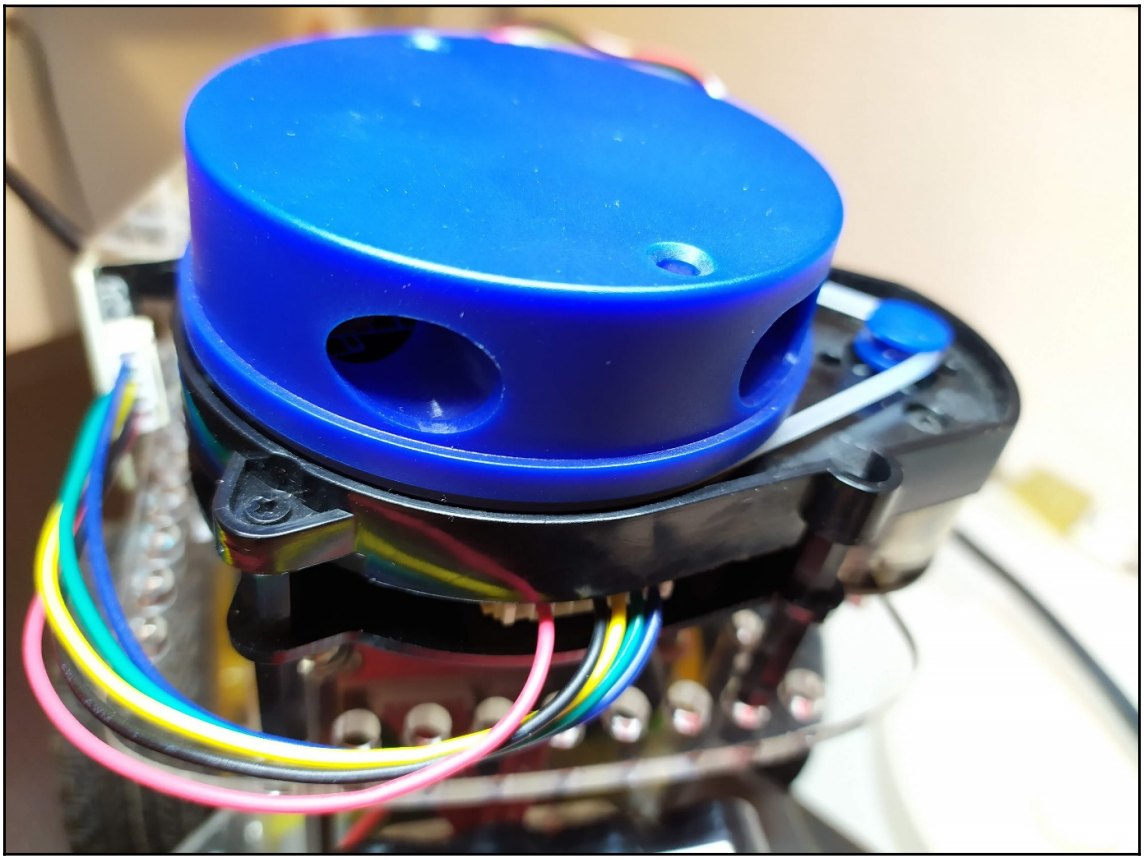


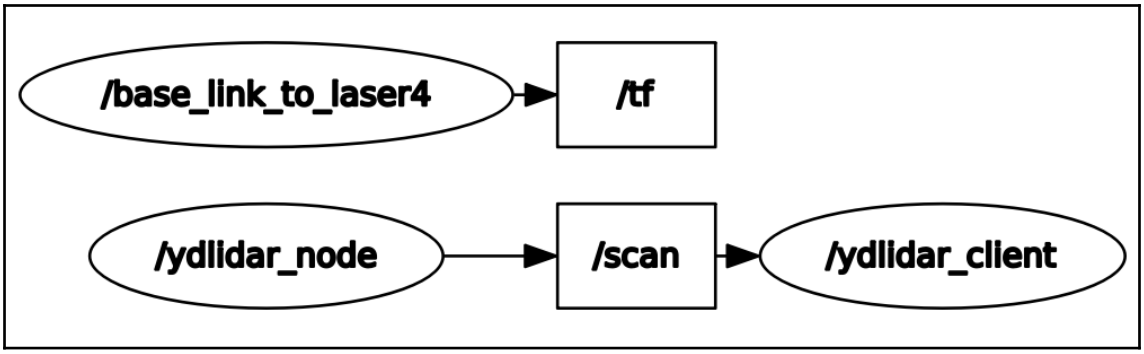


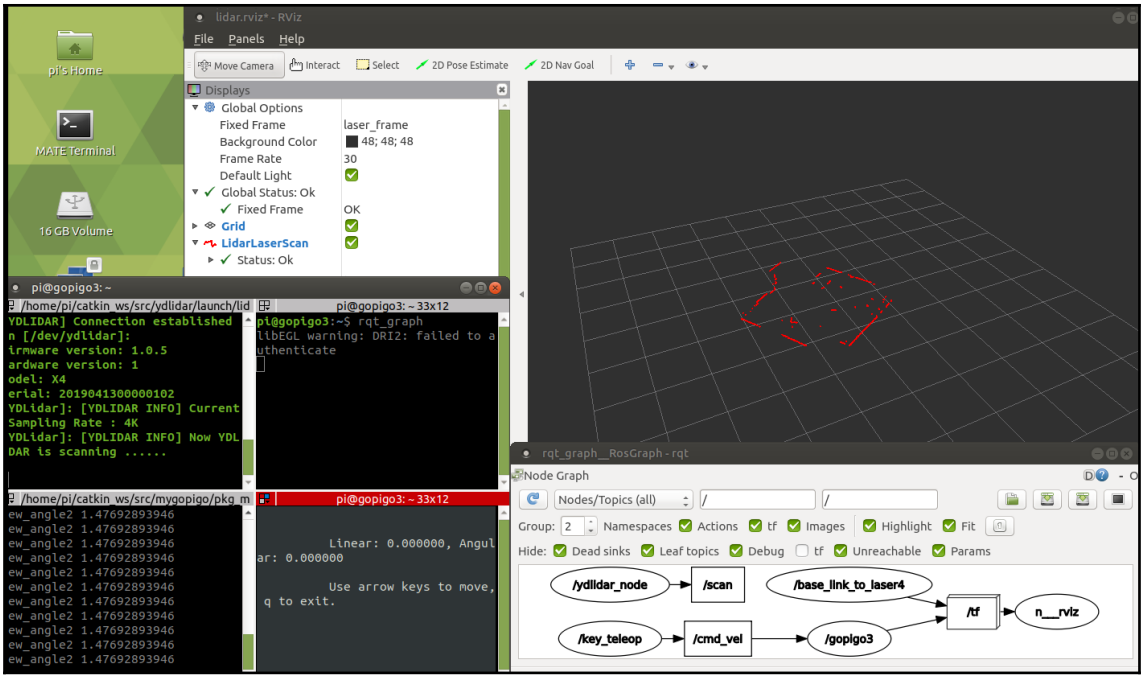


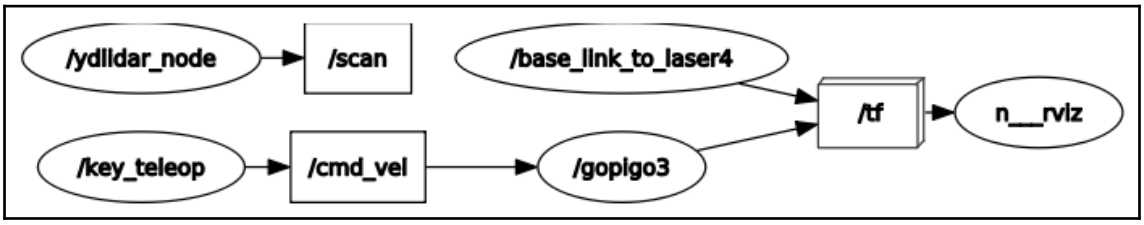


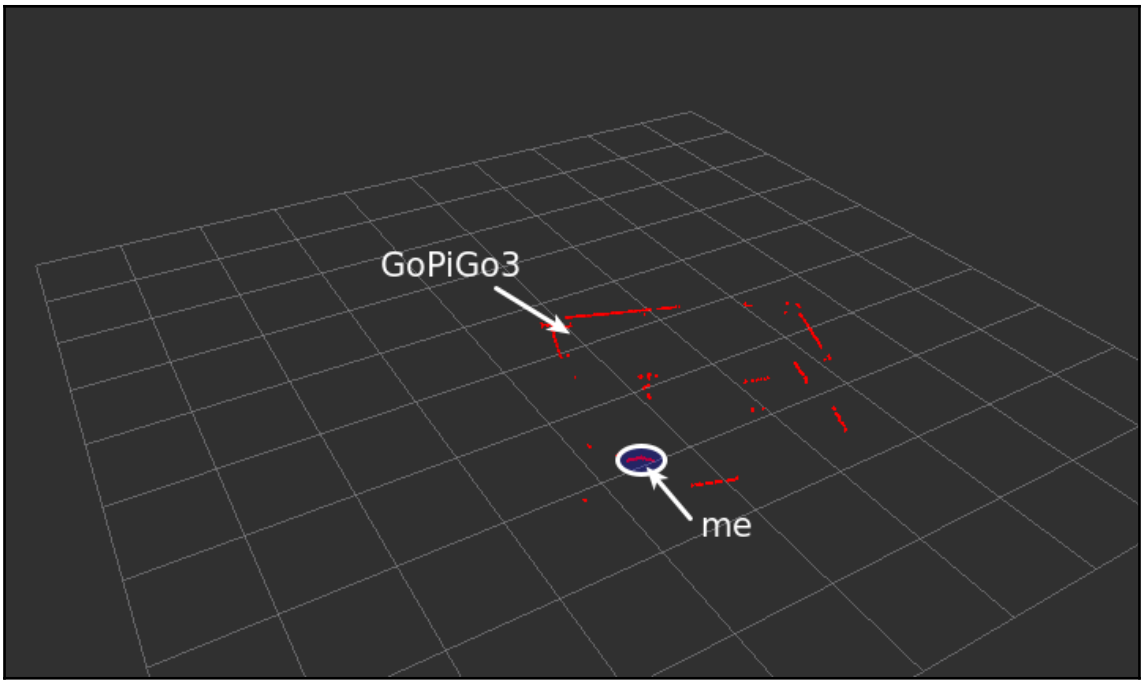
Chapter 9: SLAM for Robot Navigation

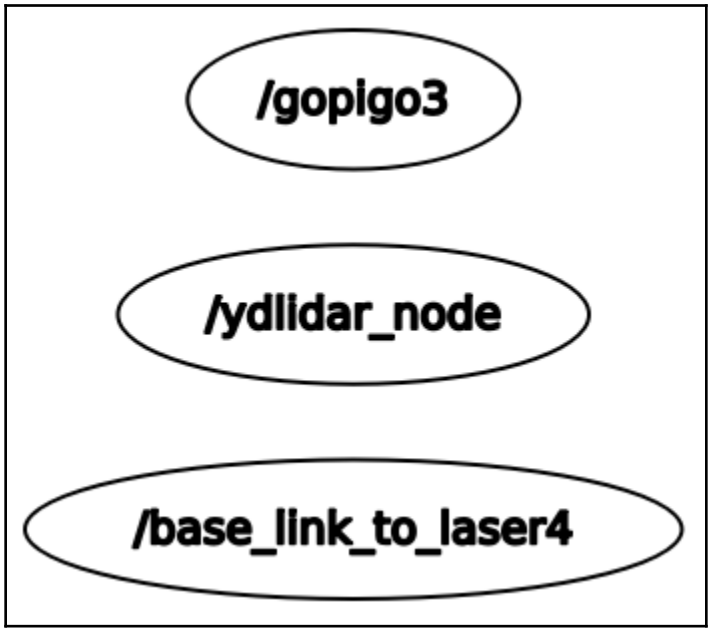


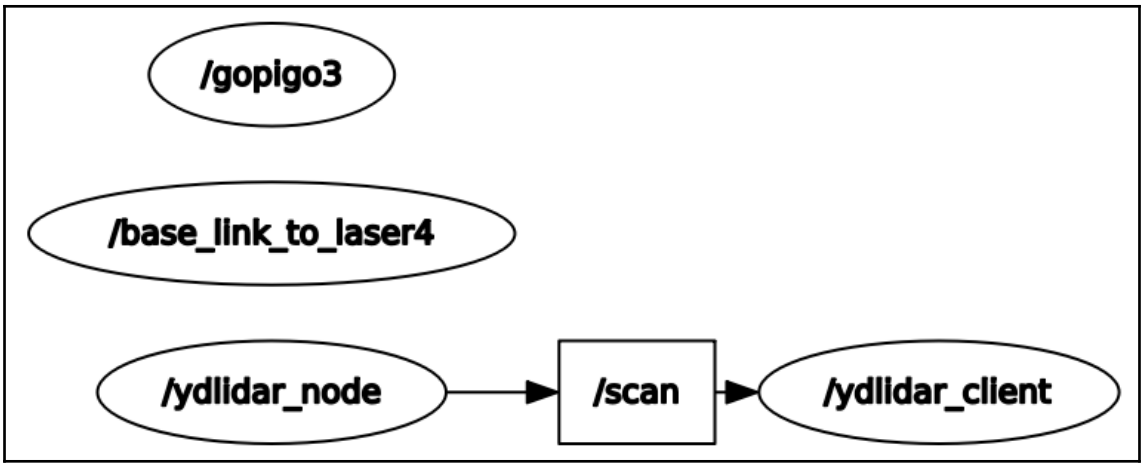


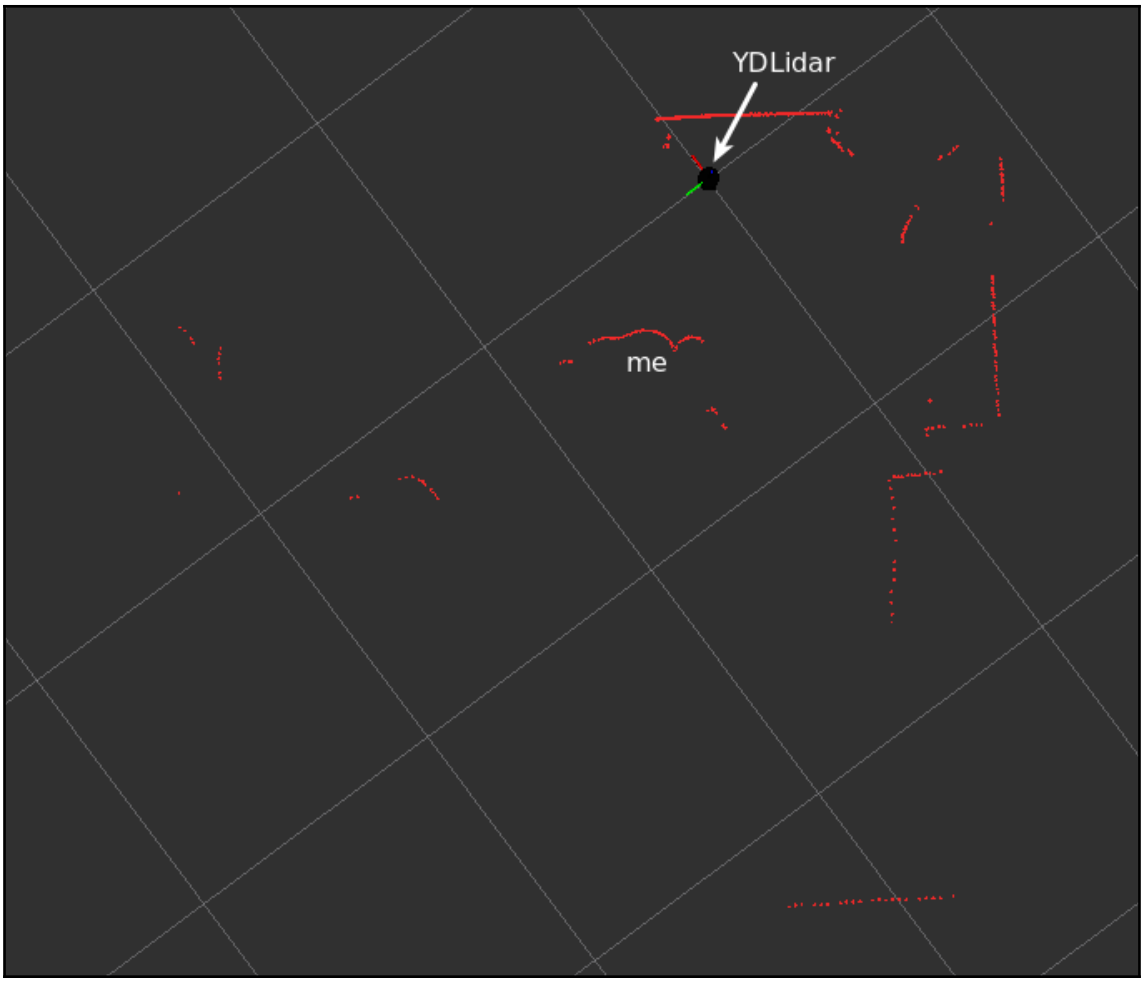

lidar.rviz* - RViz
File Panels Help
Move Camera Interact Select 2D Pose Estimate 2D Nav Goal
Displays
Global Options
Fixed Frame laser_frame
Background Color 48; 48; 48
Frame Rate 30
Default Light
Global Status: Ok
Fixed Frame OK
Grid
LidarLaserScan
Status: Ok
pi's Home
MATE Terminal
16 GB Volume
pi@gopigo3: ~
/home/pi/catkin_ws/src/ydlidar/launch/lid
YDLIDAR] Connection established
n [/dev/ydlidar]:
irmware version: 1.0.5
ardware version: 1
odel: X4
erial: 2019041300000102
YDLidar]: [YDLIDAR INFO] Current
Sampling Rate : 4K
YDLidar]: [YDLIDAR INFO] Now YDL
DAR is scanning ......
pi@gopigo3: ~ 33x12
pi@gopigo3:~$ rqt_graph
libEGL warning: DRI2: failed to a
uthenticate
/home/pi/catkin_ws/src/mygopigo/pkg_m
ew_angle2 1.47692893946
pi@gopigo3: ~ 33x12
Linear: 0.000000, Angul
ar: 0.000000
Use arrow keys to move,
q to exit.
rqt_graph__RosGraph - rqt
Node Graph
Nodes/Topics (all)
Group: 2 Namespaces Actions tf Images Highlight Fit
Hide: Dead sinks Leaf topics Debug tf Unreachable Params
/ydlidar_node
/scan
/base_link_to_laser4
/tf
n__rviz
/key_teleop
/cmd_vel
/gopigo3

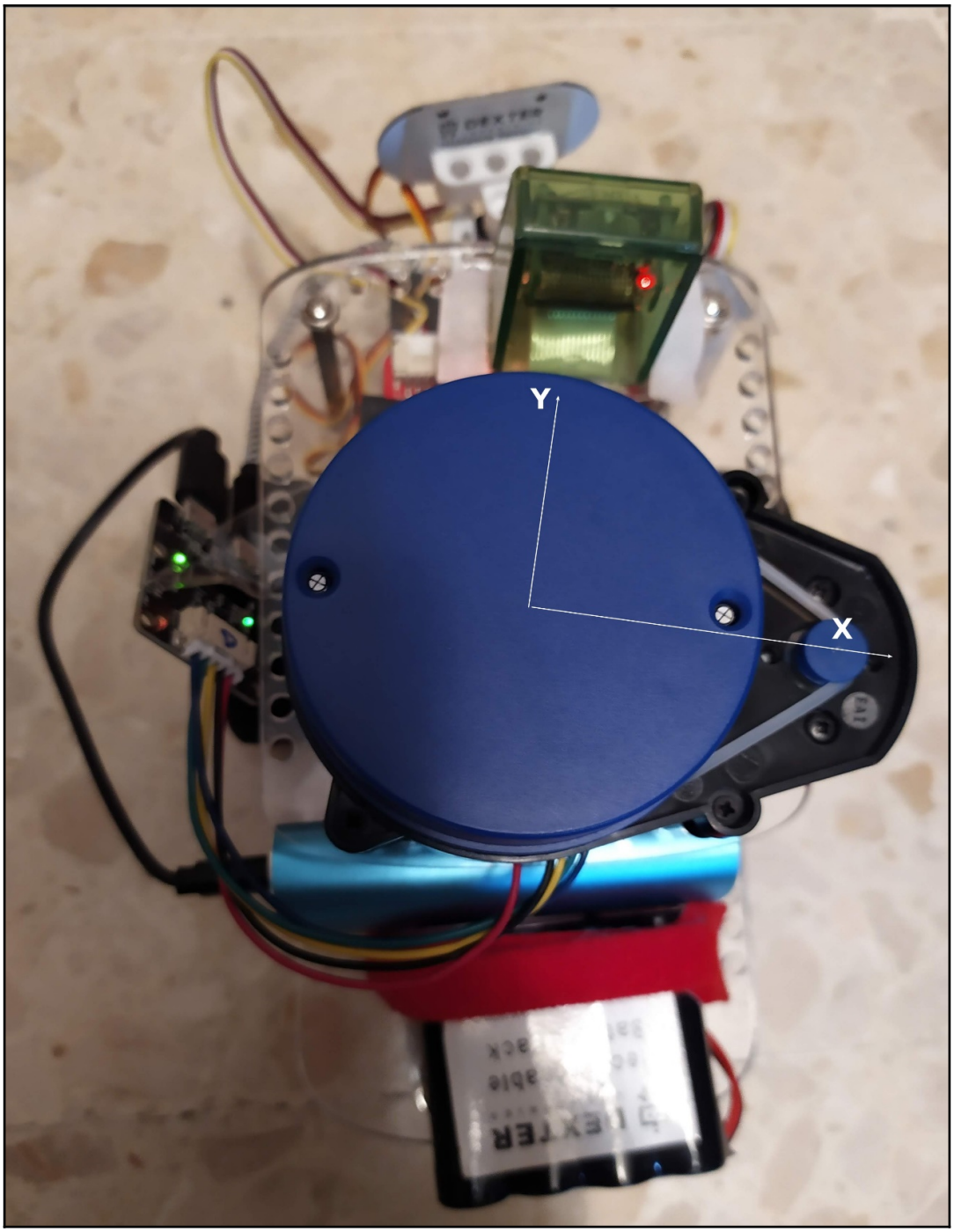

/ydlidar_node
/scan
/base_link_to_laser4
/tf
n__rviz
/key_teleop
/cmd_vel
/gopigo3

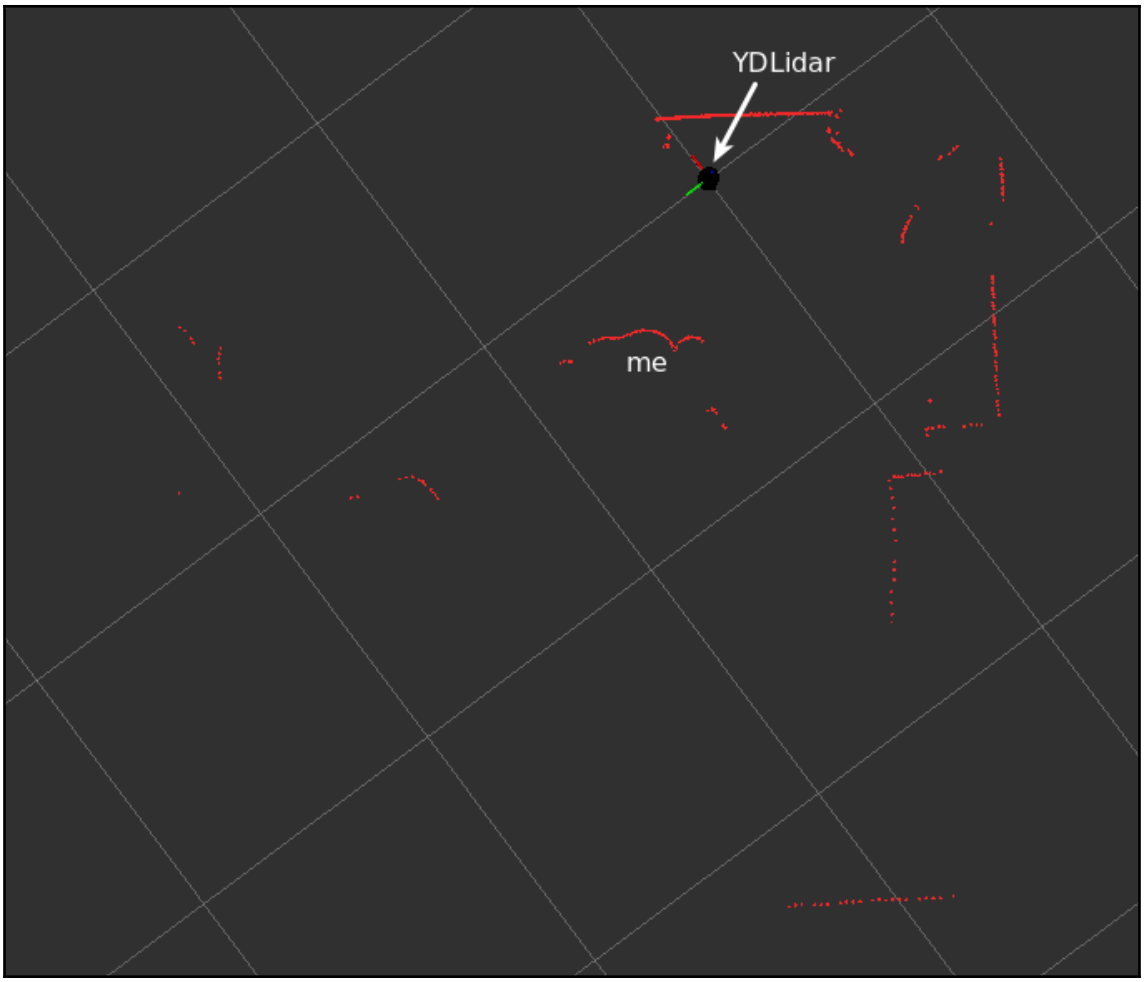

GoPiGo3
me

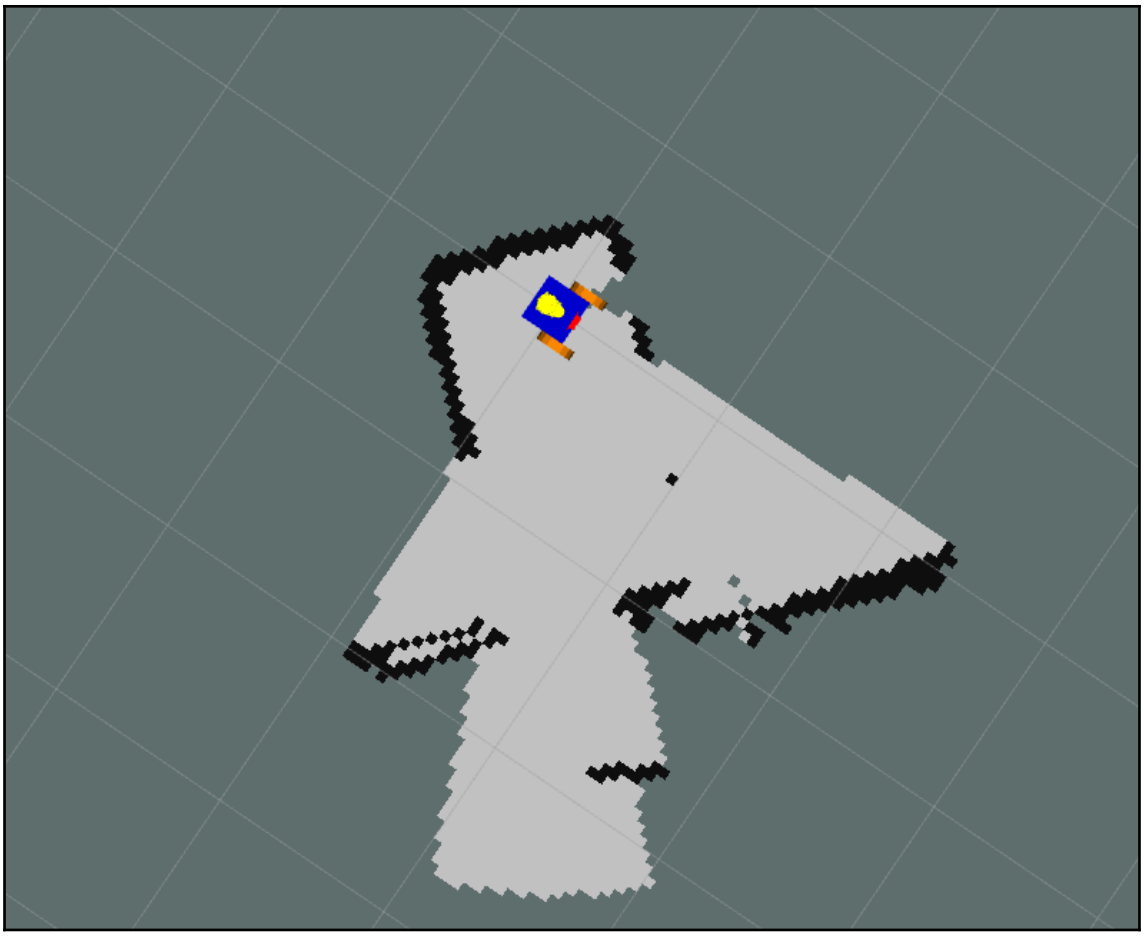

/gopigo3
/ydlidar_node
/base_link_to_laser4

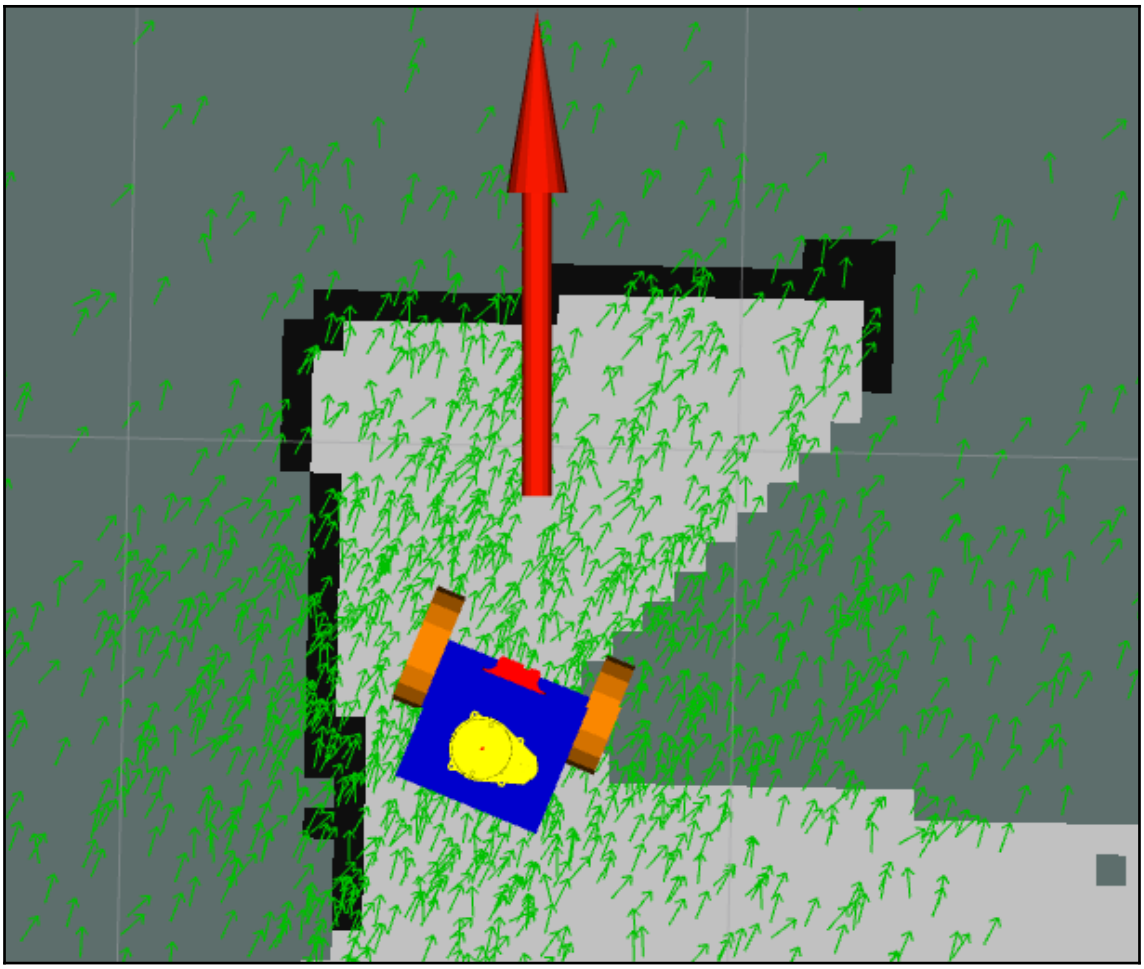

/gopigo3
/base_link_to_laser4
/ydlidar_node
/scan
/ydlidar_client


YDLidar
me

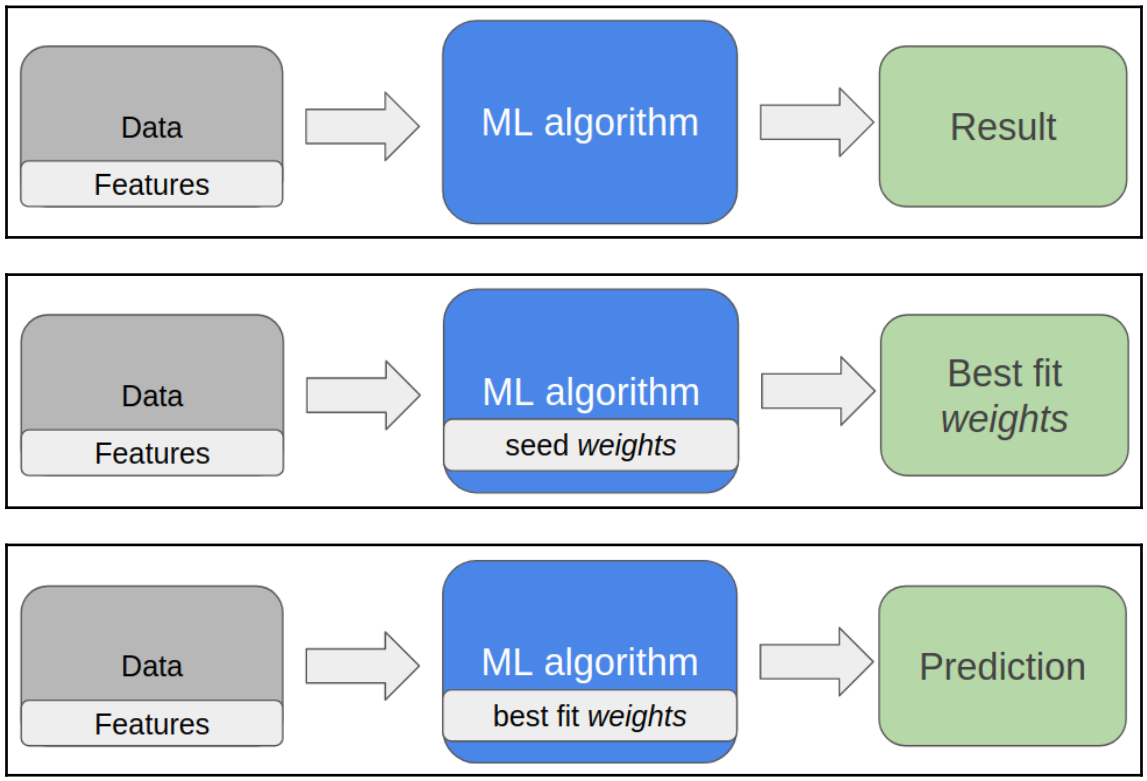

Y
X

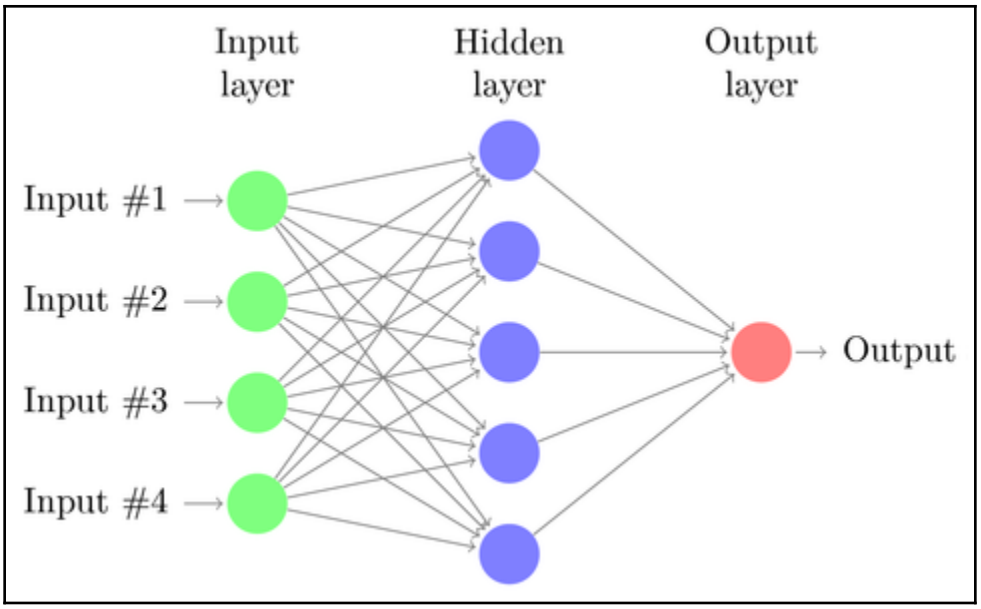

YDLidar
me

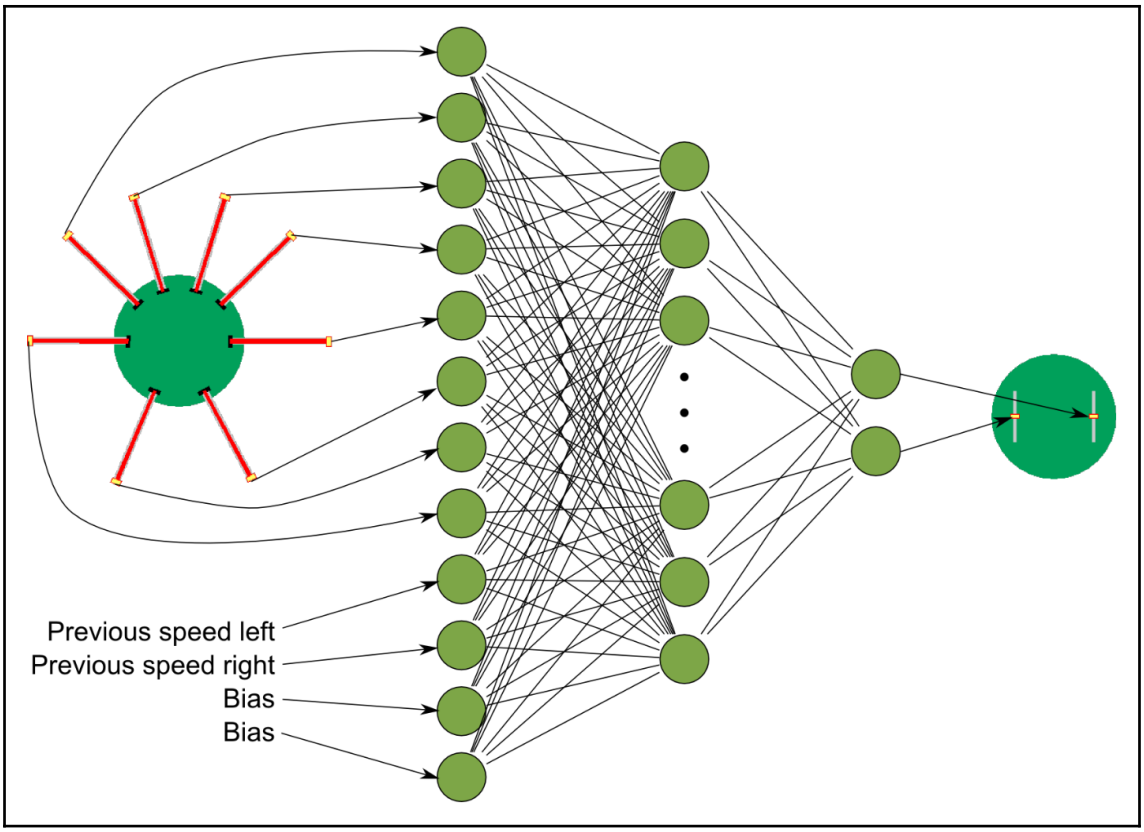


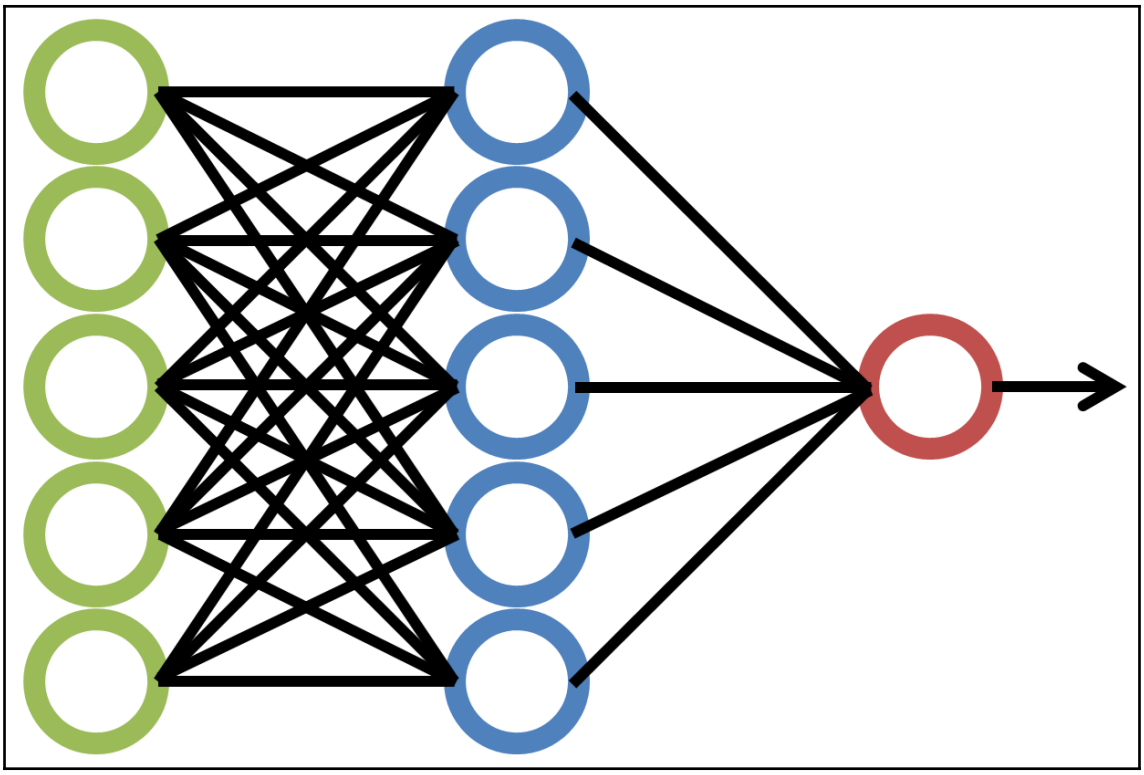


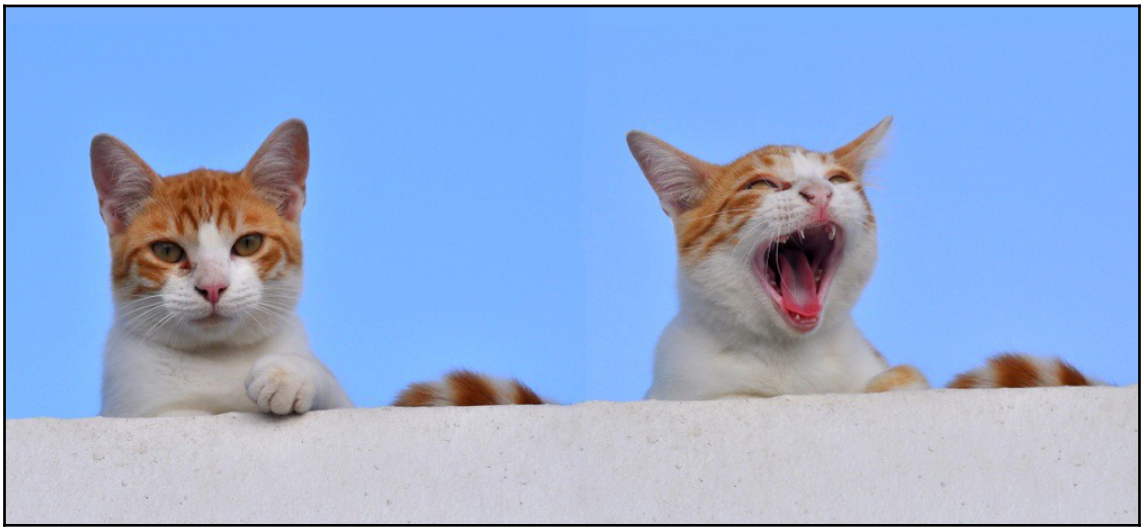
Chapter 10: Applying Machine Learning in Robotics

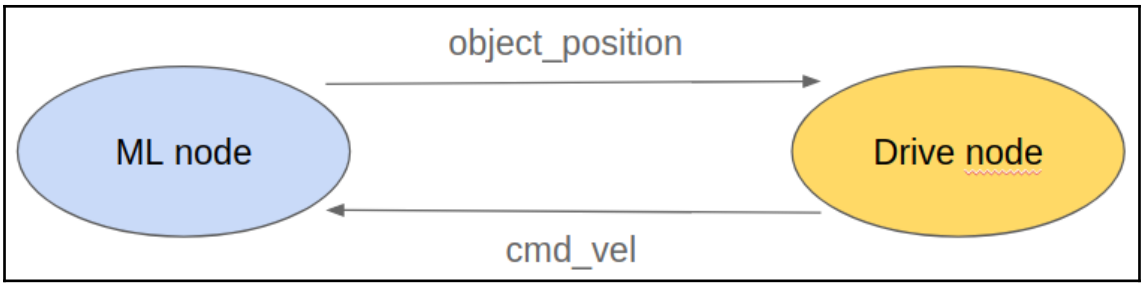


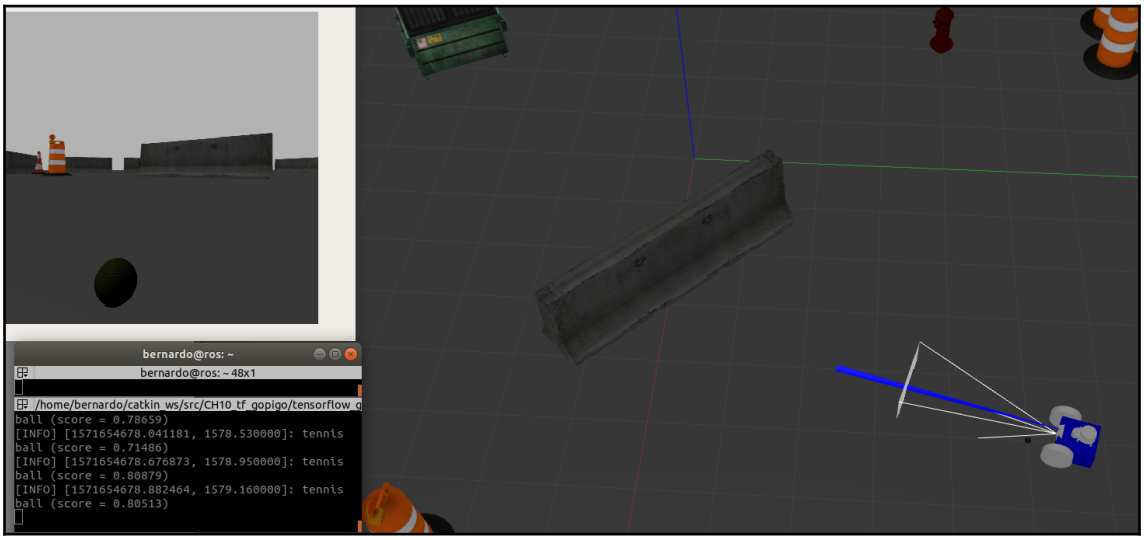

Input layer
Hidden layer
Output layer
Input #1
Input #2
Input #3
Input #4
Output

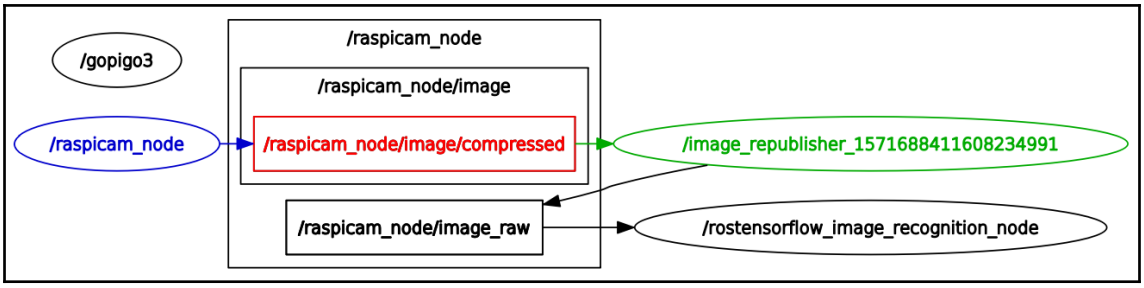

Previous speed left
Previous speed right
Bias
Bias



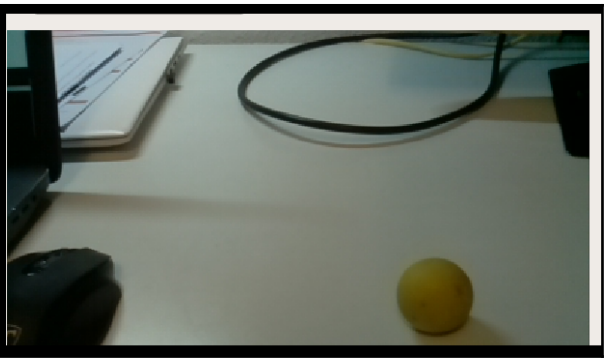



object_position
ML node
Drive node
cmd_vel


bernardo@ros: ~
bernardo@ros: ~ 48x1
/home/bernardo/catkin_ws/src/CH10_tf_gopigo/tensorflow_g
ball (score = 0.78659)
[INFO] [1571654678.041181, 1578.530000]: tennis
ball (score = 0.71486)
[INFO] [1571654678.676873, 1578.950000]: tennis
ball (score = 0.80879)
[INFO] [1571654678.882464, 1579.160000]: tennis
ball (score = 0.80513)


/gopigo3
/raspicam_node
/raspicam_node
/raspicam_node/image
/raspicam_node/image/compressed
/image_republisher_1571688411608234991
/raspicam_node/image_raw
/rostensorflow_image_recognition_node

```
INFO] [1571689149.488735]: ping-pong ball (score = 0.97778)
INFO] [1571689149.689258]: ping-pong ball (score = 0.97247)
INFO] [1571689149.882329]: ping-pong ball (score = 0.97294)
INFO] [1571689150.087556]: ping-pong ball (score = 0.97071)
INFO] [1571689150.303695]: ping-pong ball (score = 0.98911)
INFO] [1571689150.505037]: ping-pong ball (score = 0.97336)
INFO] [1571689150.706528]: ping-pong ball (score = 0.96148)
INFO] [1571689150.912074]: ping-pong ball (score = 0.90815)
INFO] [1571689151.123799]: ping-pong ball (score = 0.91183)
INFO] [1571689151.321923]: ping-pong ball (score = 0.95970)
INFO] [1571689151.532252]: ping-pong ball (score = 0.89629)
INFO] [1571689151.726855]: ping-pong ball (score = 0.93603)
INFO] [1571689151.927561]: ping-pong ball (score = 0.91060)
INFO] [1571689152.136753]: ping-pong ball (score = 0.94214)
INFO] [1571689152.338259]: ping-pong ball (score = 0.94241)
INFO] [1571689152.537690]: ping-pong ball (score = 0.95392)
INFO] [1571689152.732645]: ping-pong ball (score = 0.95624)
INFO] [1571689152.934889]: ping-pong ball (score = 0.89774)
```

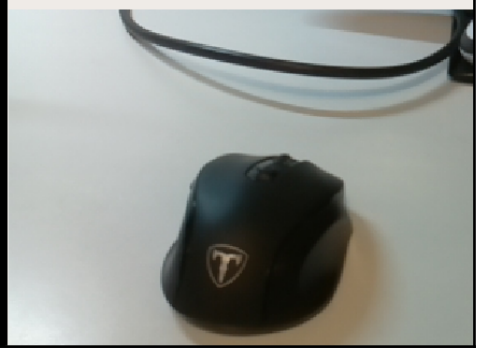


```
/home/bernardo/catkin_ws/src/CH10_tf_gopigo/tensorflow_gopigo/launch/start_ima
[INFO] [1571689051.738835]: mouse, computer mouse (score = 0.98608)
[INFO] [1571689051.949426]: mouse, computer mouse (score = 0.97787)
[INFO] [1571689052.164913]: mouse, computer mouse (score = 0.98420)
[INFO] [1571689052.365560]: mouse, computer mouse (score = 0.98989)
[INFO] [1571689052.569650]: mouse, computer mouse (score = 0.98446)
[INFO] [1571689052.769788]: mouse, computer mouse (score = 0.99303)
[INFO] [1571689052.967114]: mouse, computer mouse (score = 0.96587)
[INFO] [1571689053.174494]: mouse, computer mouse (score = 0.97875)
[INFO] [1571689053.374430]: mouse, computer mouse (score = 0.95413)
[INFO] [1571689053.579760]: mouse, computer mouse (score = 0.96012)
[INFO] [1571689053.798699]: mouse, computer mouse (score = 0.98175)
[INFO] [1571689054.001643]: mouse, computer mouse (score = 0.96827)
[INFO] [1571689054.214068]: mouse, computer mouse (score = 0.97883)
[INFO] [1571689054.417679]: mouse, computer mouse (score = 0.98194)
[INFO] [1571689054.644198]: mouse, computer mouse (score = 0.94865)
[INFO] [1571689054.853103]: mouse, computer mouse (score = 0.91265)
[INFO] [1571689055.083619]: mouse, computer mouse (score = 0.97772)
[INFO] [1571689055.290233]: mouse, computer mouse (score = 0.96349)
[INFO] [1571689055.495021]: mouse, computer mouse (score = 0.96558)
[INFO] [1571689055.699317]: mouse, computer mouse (score = 0.96813)
```

Image View

/raspicam_node/image_raw

_node/image_raw_mouse_left Smooth scaling



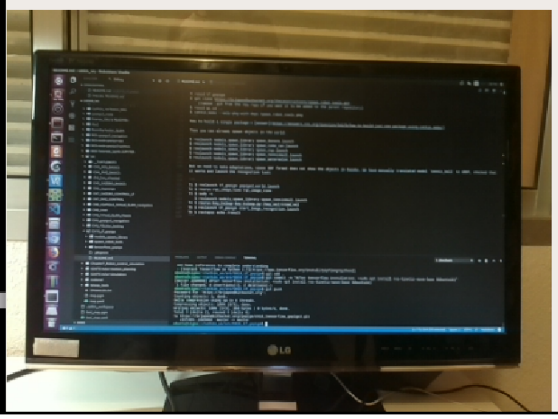
```
/home/bernardo/catkin_ws/src/CH10_tf_gopigo/tensorflow_gopigo/launch/start_ima
[INFO] [1571689014.367048]: desktop computer (score = 0.44572)
[INFO] [1571689014.379072]: monitor (score = 0.29404)
[INFO] [1571689014.582196]: monitor (score = 0.43965)
[INFO] [1571689014.591130]: desktop computer (score = 0.28883)
[INFO] [1571689014.800651]: monitor (score = 0.53406)
[INFO] [1571689014.810858]: desktop computer (score = 0.20969)
[INFO] [1571689014.818540]: screen, CRT screen (score = 0.10970)
[INFO] [1571689015.019019]: monitor (score = 0.55342)
[INFO] [1571689015.030763]: desktop computer (score = 0.18312)
[INFO] [1571689015.043185]: screen, CRT screen (score = 0.10870)
[INFO] [1571689015.264456]: desktop computer (score = 0.37002)
[INFO] [1571689015.276449]: monitor (score = 0.34566)
[INFO] [1571689015.471779]: desktop computer (score = 0.38103)
[INFO] [1571689015.479882]: monitor (score = 0.36858)
[INFO] [1571689015.674645]: monitor (score = 0.54904)
[INFO] [1571689015.683236]: desktop computer (score = 0.22279)
[INFO] [1571689015.696716]: screen, CRT screen (score = 0.12075)
[INFO] [1571689015.906711]: monitor (score = 0.60641)
[INFO] [1571689015.914253]: desktop computer (score = 0.16470)
[INFO] [1571689015.922272]: screen, CRT screen (score = 0.11742)
```

```
/rqt_gui_cpp_node_5024/compressed/parameter_descriptions
/rqt_gui_cpp_node_5024/compressed/parameter_updates
/servo/position/1
/servo/position/2
/servo/pulse_width/1
/servo/pulse_width/2
```

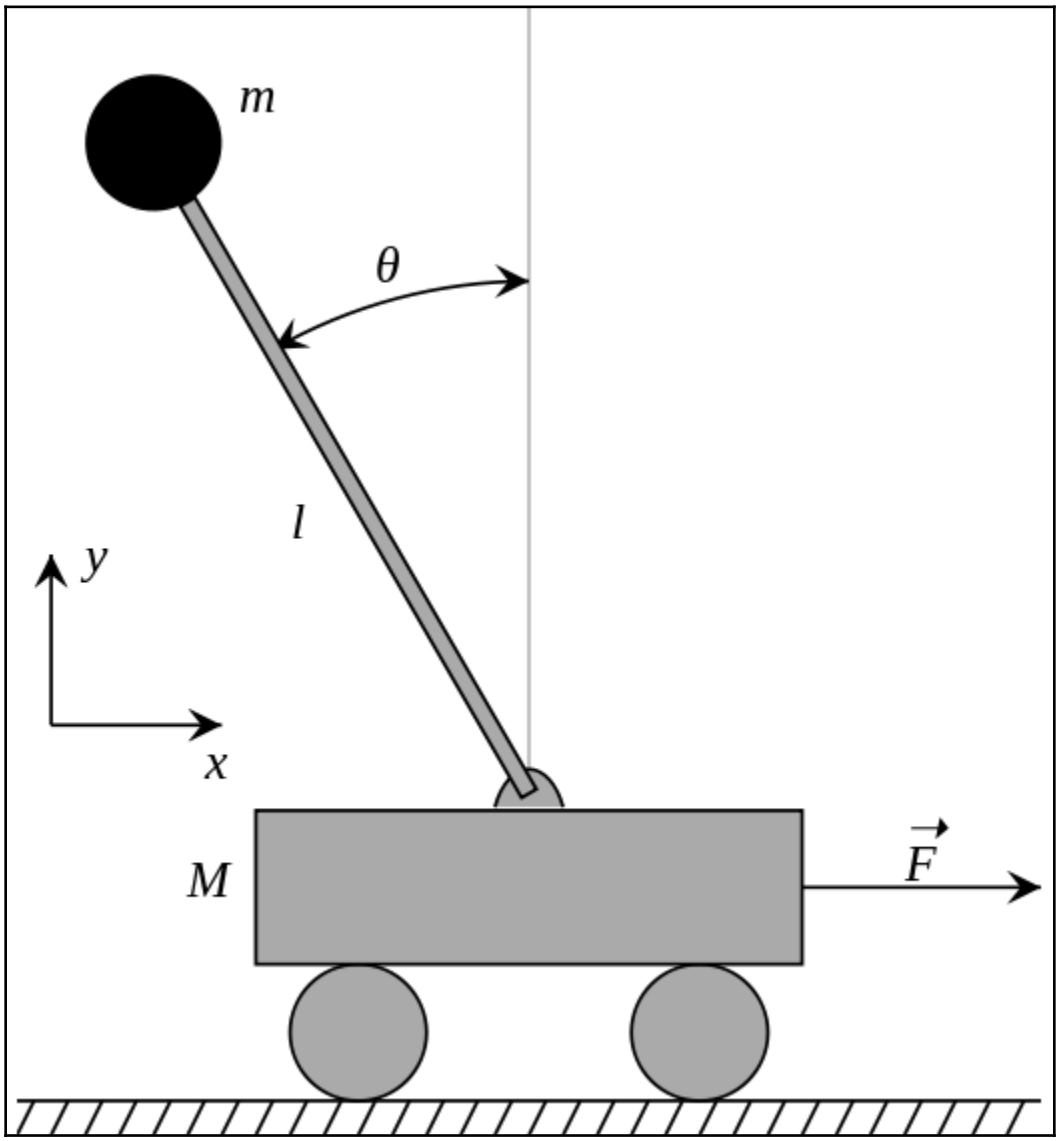
Image View

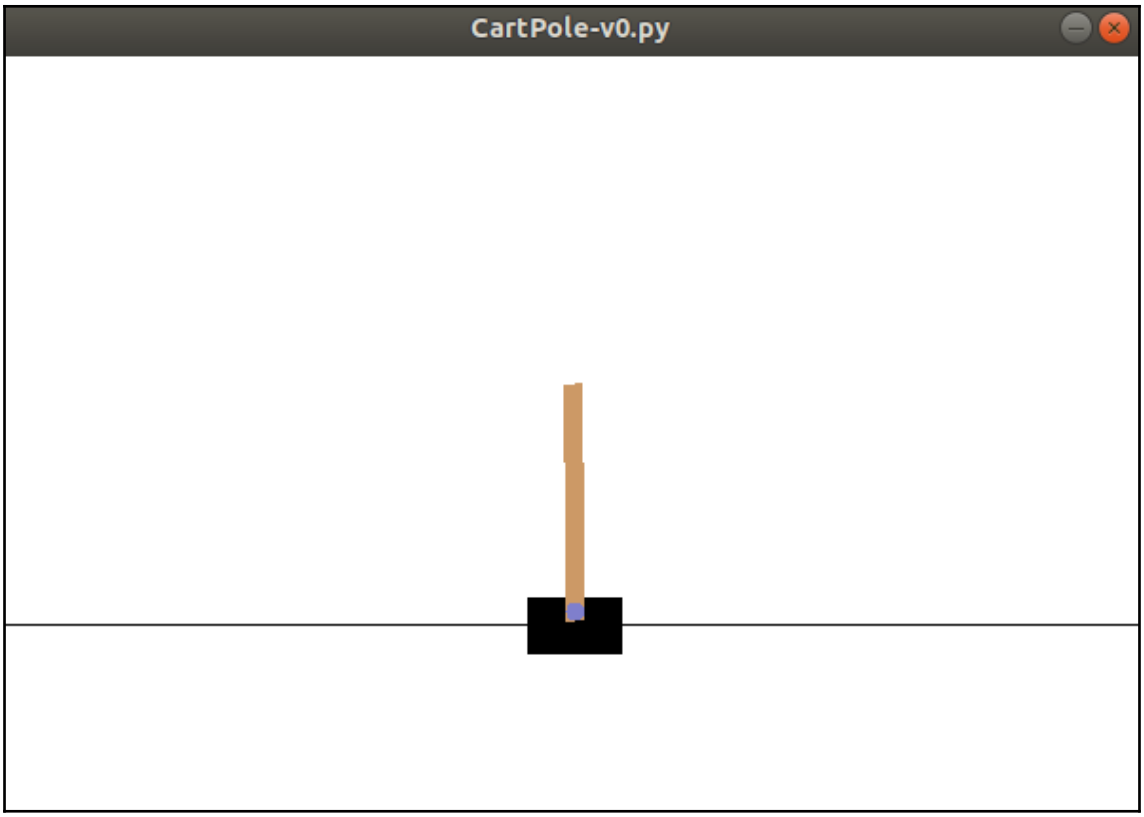
/raspicam_node/image_raw 0 10.00m

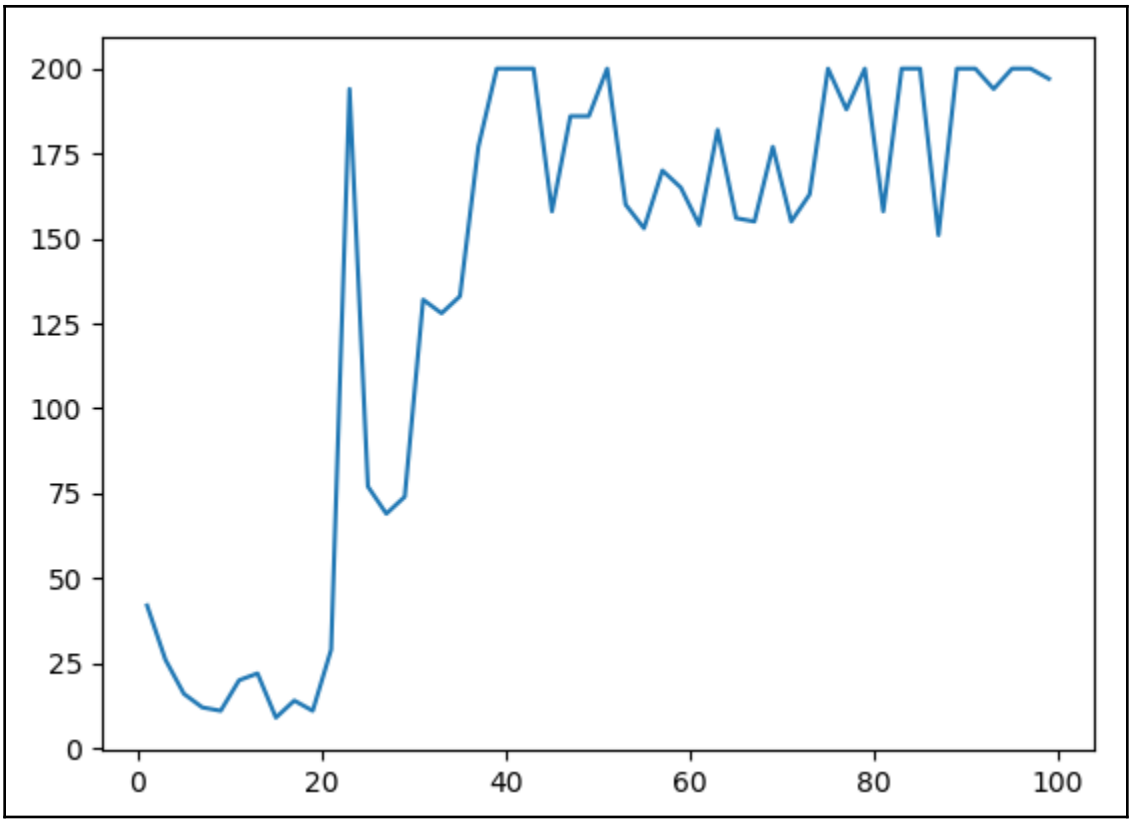
_node/image_raw_mouse_left Smooth scaling 0°

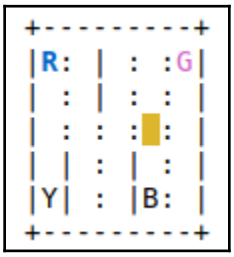


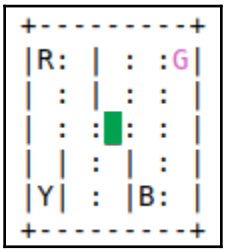
Chapter 11: Machine Learning with OpenAI Gym

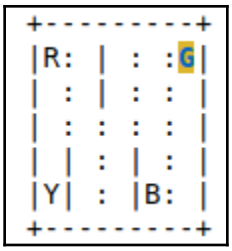


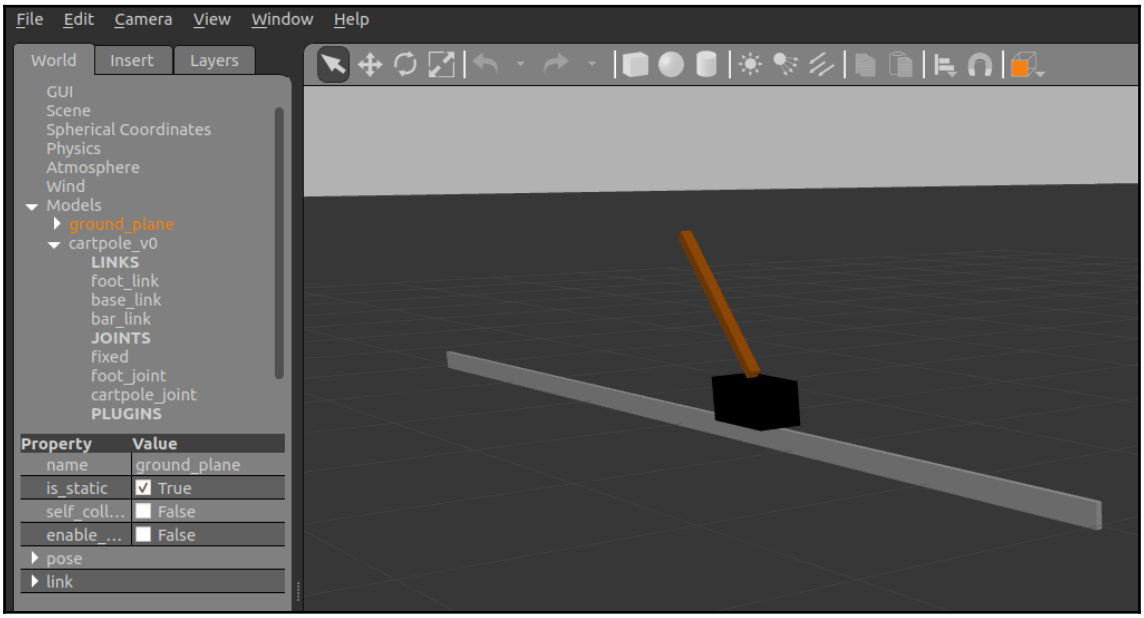

CartPole-v0.py

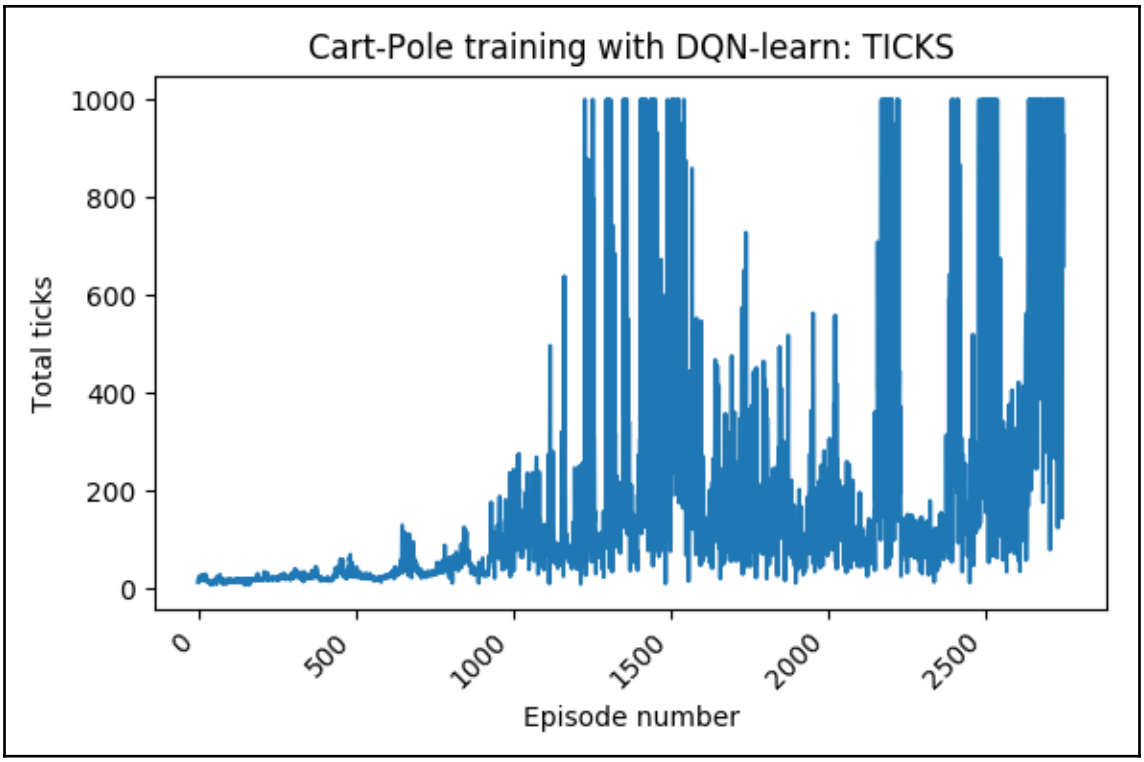

200
175
150
125
100
75
50
25
0
0
20
40
60
80
100

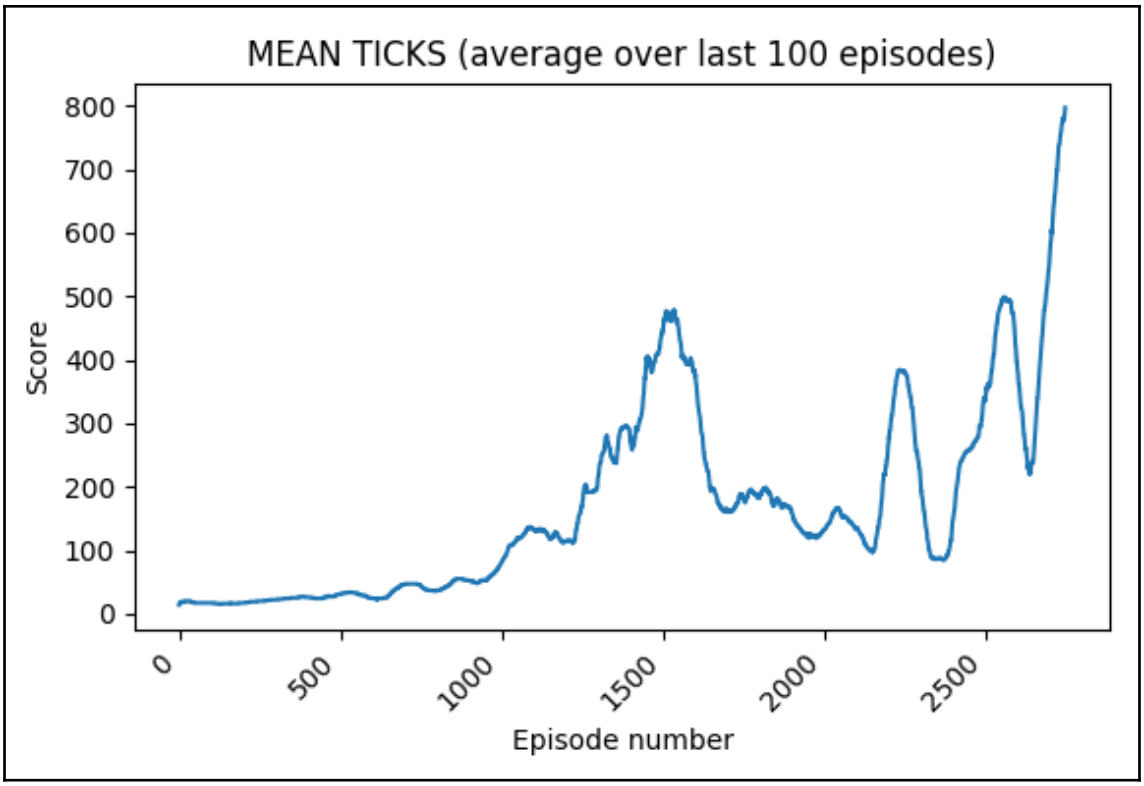

+---------+
|R: | : :G|
| : | : : |
| : : : : |
| | : | : |
|Y| : |B: |
+---------+

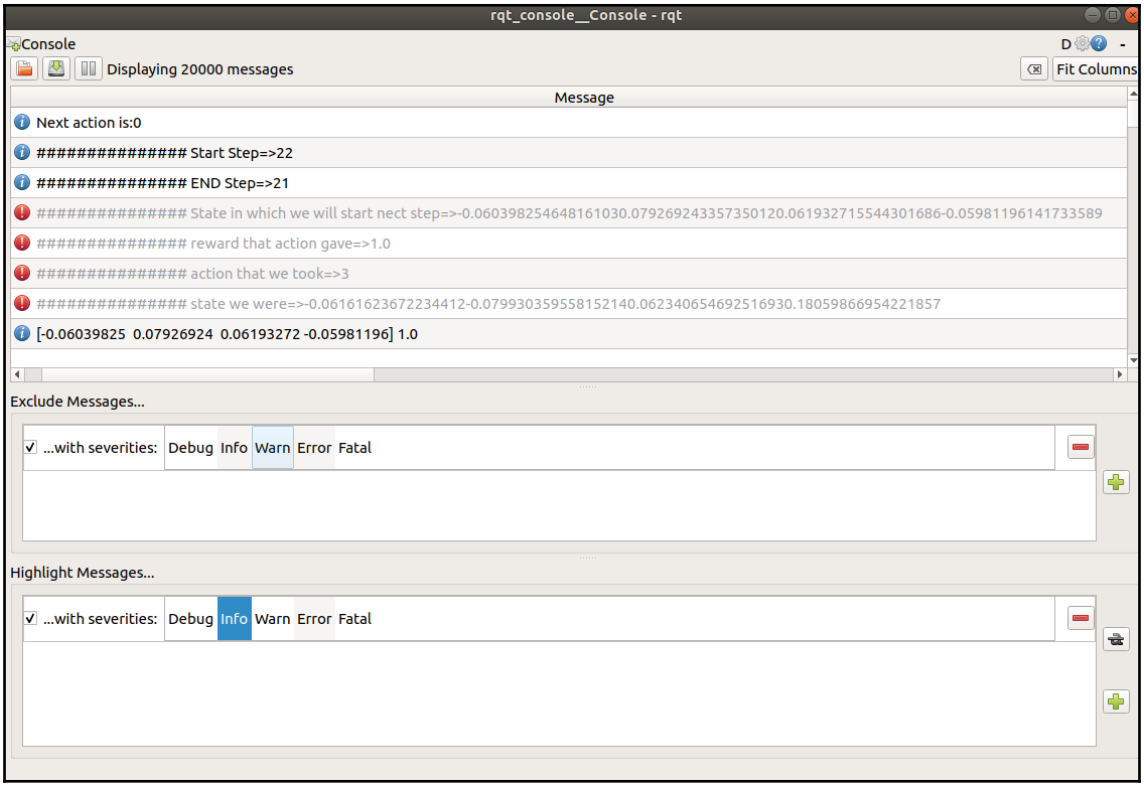

+---------+
|R: | : :G|
| : | : : |
| : : : : |
| | : | : |
|Y| : |B: |
+---------+

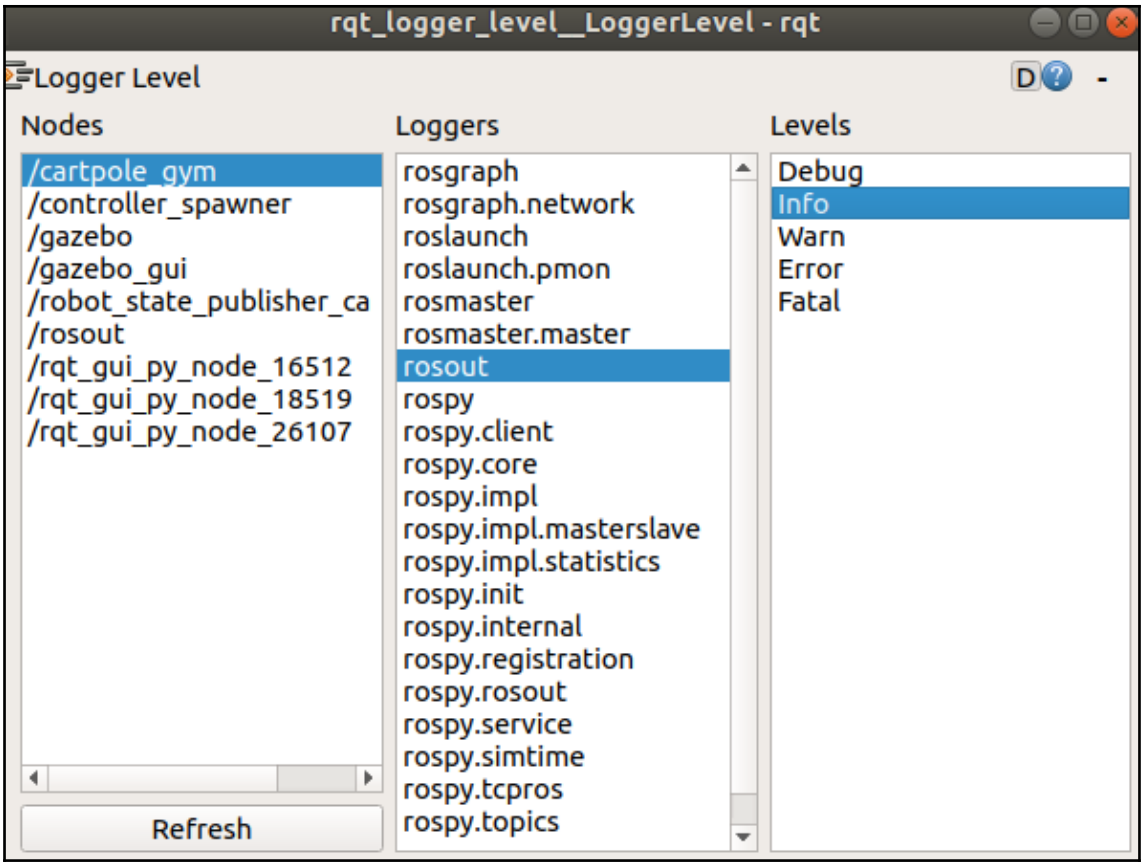

+---------+
|R: | : :G|
| : | : : |
| : : : : |
| | : | : |
|Y| : |B: |
+---------+


File Edit Camera View Window Help
World Insert Layers
GUI
Scene
Spherical Coordinates
Physics
Atmosphere
Wind
Models
ground_plane
cartpole_v0
LINKS
foot_link
base_link
bar_link
JOINTS
fixed
foot_joint
cartpole_joint
PLUGINS
Property Value
name ground_plane
is_static True
self_coll... False
enable_... False
pose
link

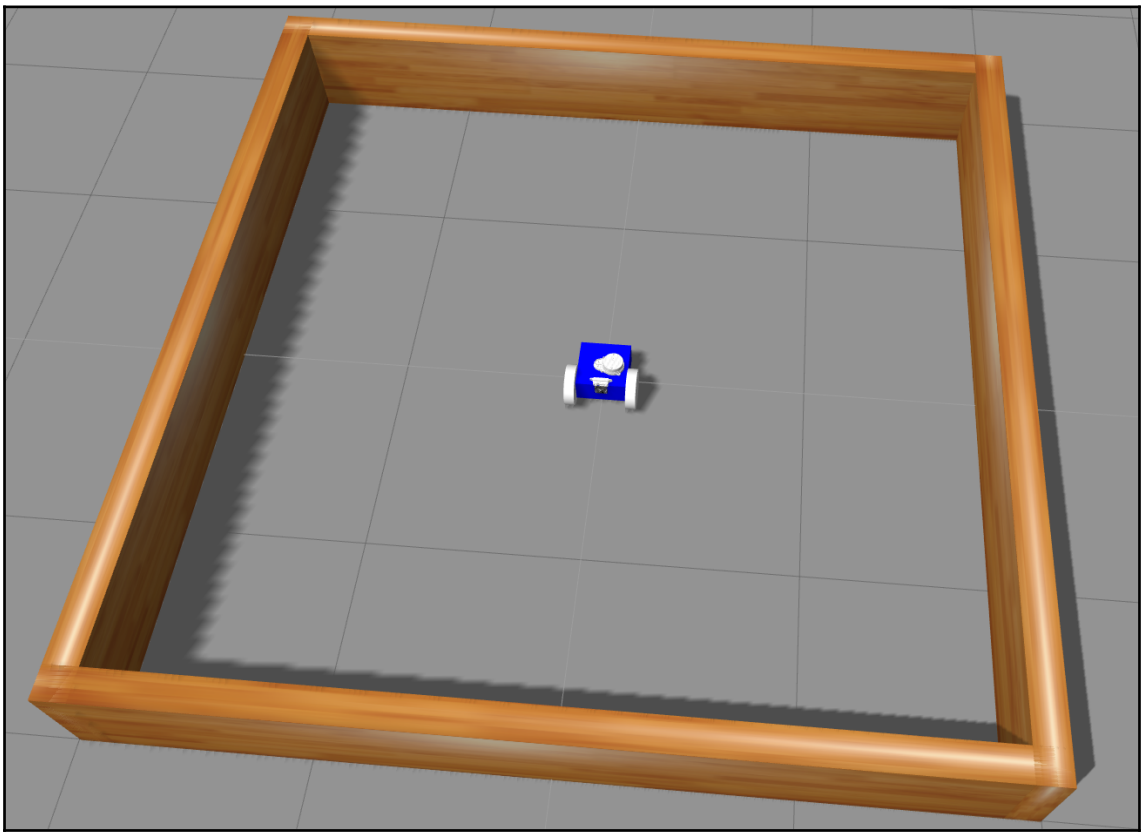

Cart-Pole training with DQN-learn: TICKS
Total ticks
1000
800
600
400
200
0
0
500
1000
1500
2000
2500
Episode number

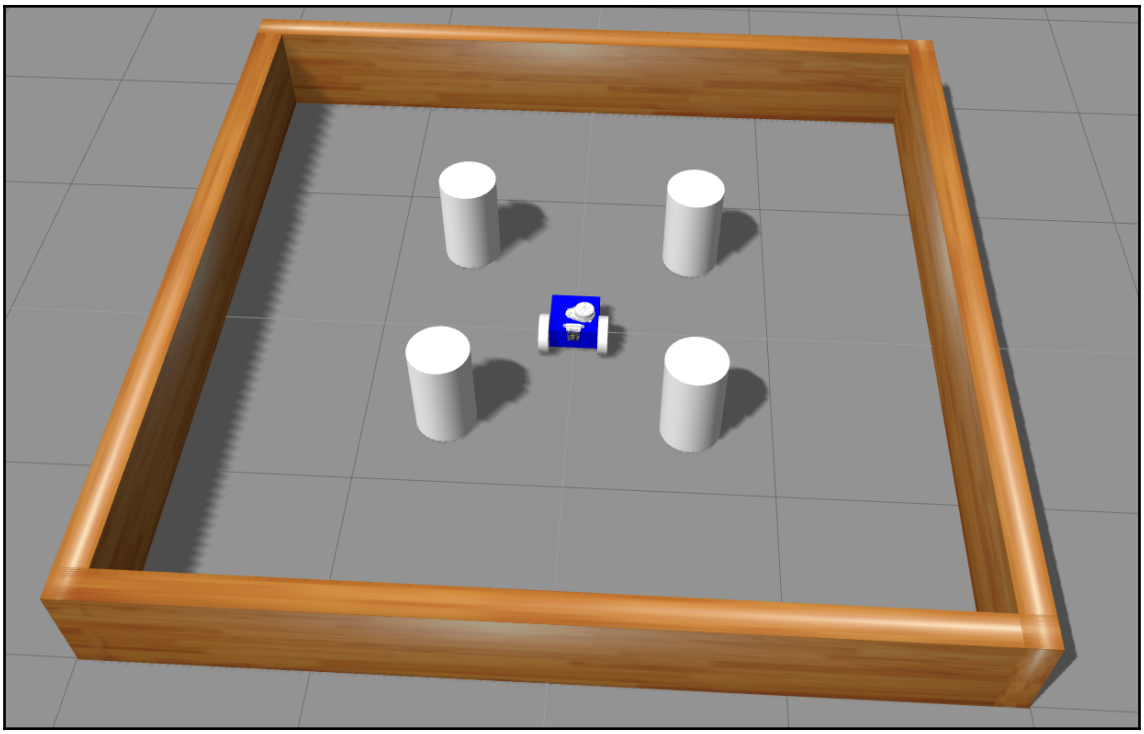

MEAN TICKS (average over last 100 episodes)
Score
800
700
600
500
400
300
200
100
0
0
500
1000
1500
2000
2500
Episode number

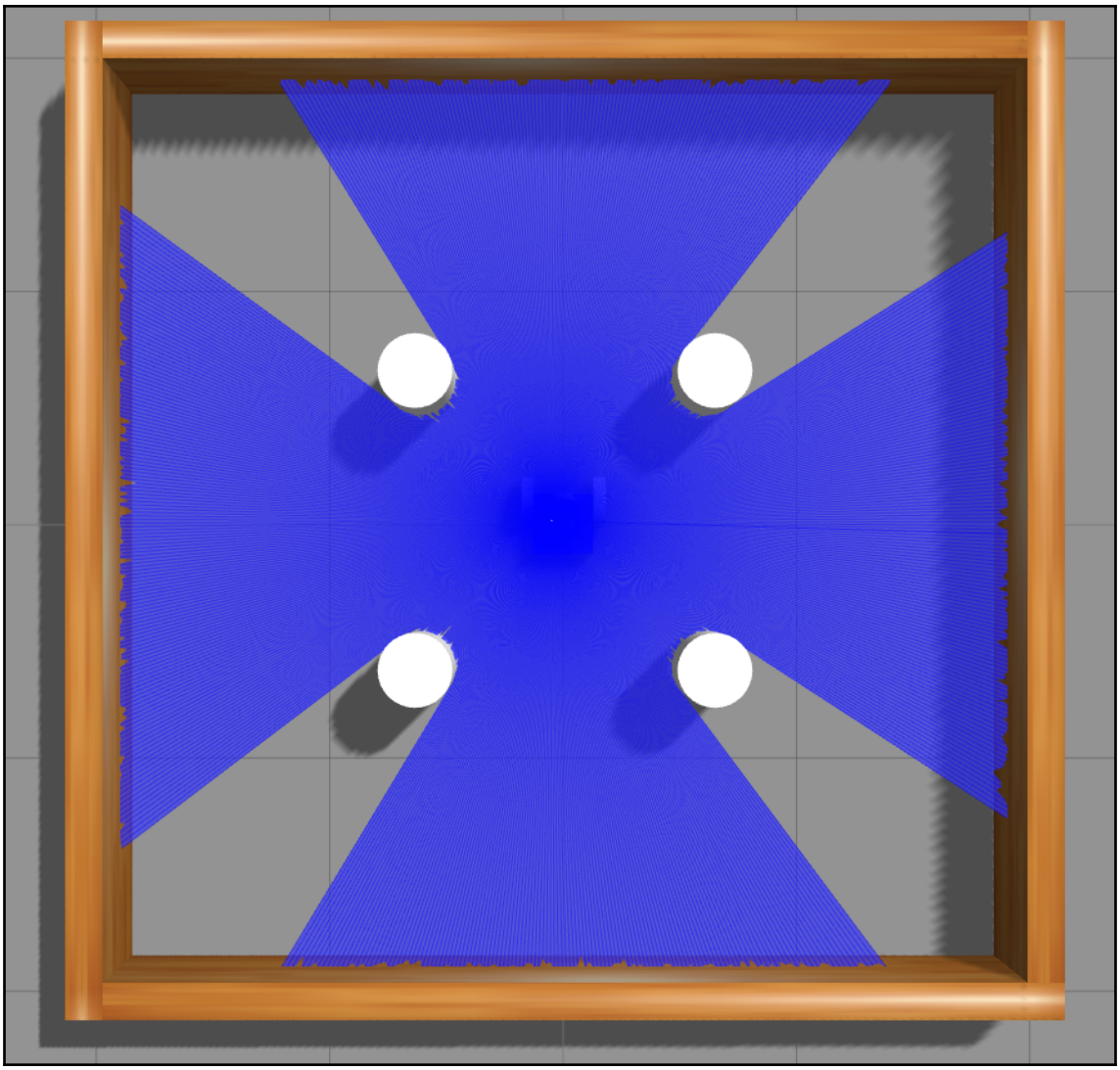

rqt_console__Console - rqt
Console
Displaying 20000 messages
Fit Columns
Message
Next action is:0
################ Start Step=>22
################ END Step=>21
################ State in which we will start nect step=>-0.060398254648161030.079269243357350120.061932715544301686-0.05981196141733589
################ reward that action gave=>1.0
################ action that we took=>3
################ state we were=>-0.06161623672234412-0.079930359558152140.062340654692516930.18059866954221857
[-0.06039825 0.07926924 0.06193272 -0.05981196] 1.0
Exclude Messages...
...with severities:
Debug
Info
Warn
Error
Fatal
Highlight Messages...
...with severities:
Debug
Info
Warn
Error
Fatal

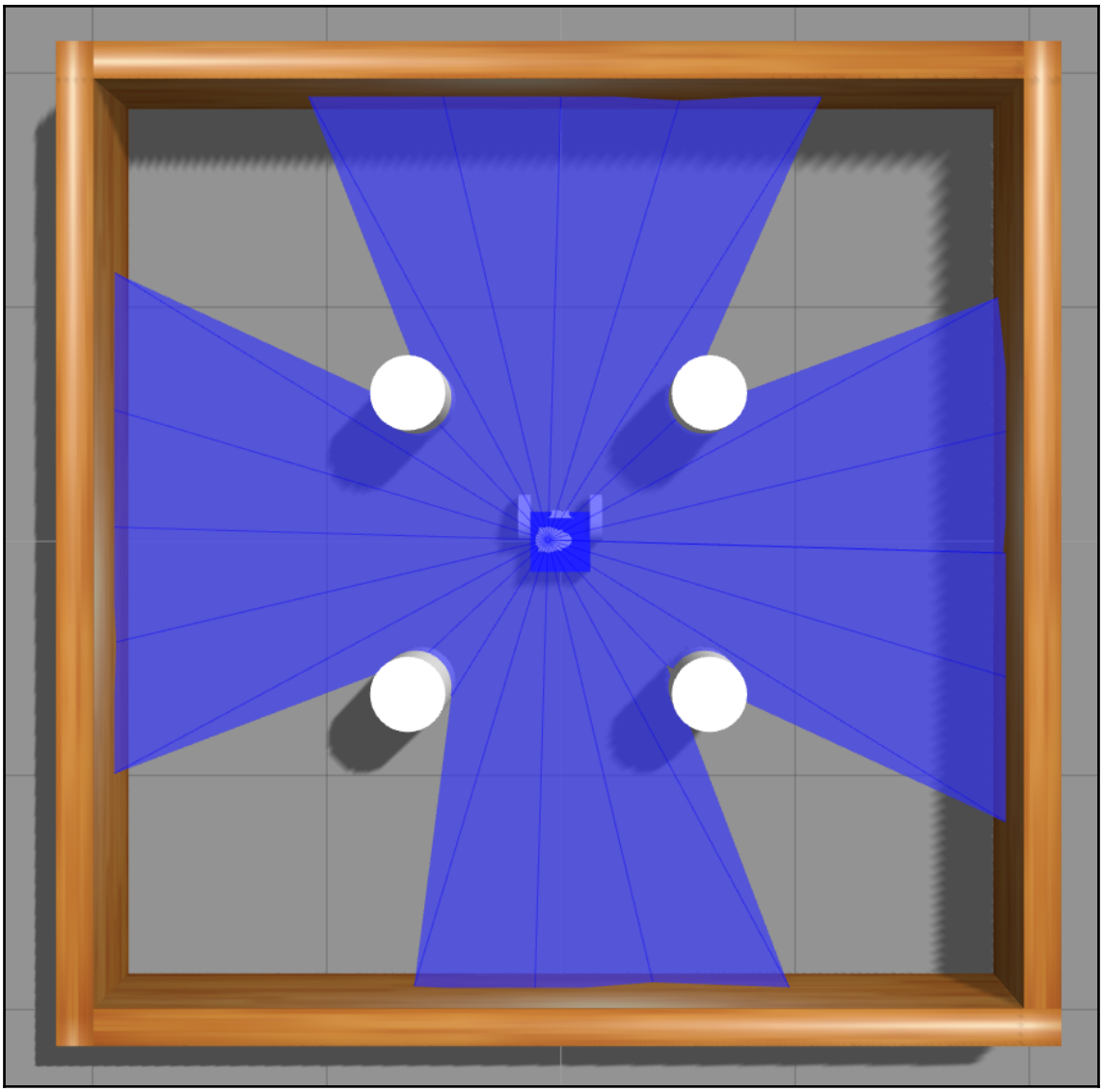

rqt_logger_level__LoggerLevel - rqt
Logger Level
Nodes
Loggers
Levels
/cartpole_gym
/controller_spawner
/gazebo
/gazebo_gui
/robot_state_publisher_ca
/rosout
/rqt_gui_py_node_16512
/rqt_gui_py_node_18519
/rqt_gui_py_node_26107
rosgraph
rosgraph.network
roslaunch
roslaunch.pmon
rosmaster
rosmaster.master
rosout
rospy
rospy.client
rospy.core
rospy.impl
rospy.impl.masterslave
rospy.impl.statistics
rospy.init
rospy.internal
rospy.registration
rospy.rosout
rospy.service
rospy.simtime
rospy.tcpros
rospy.topics
Debug
Info
Warn
Error
Fatal
Refresh

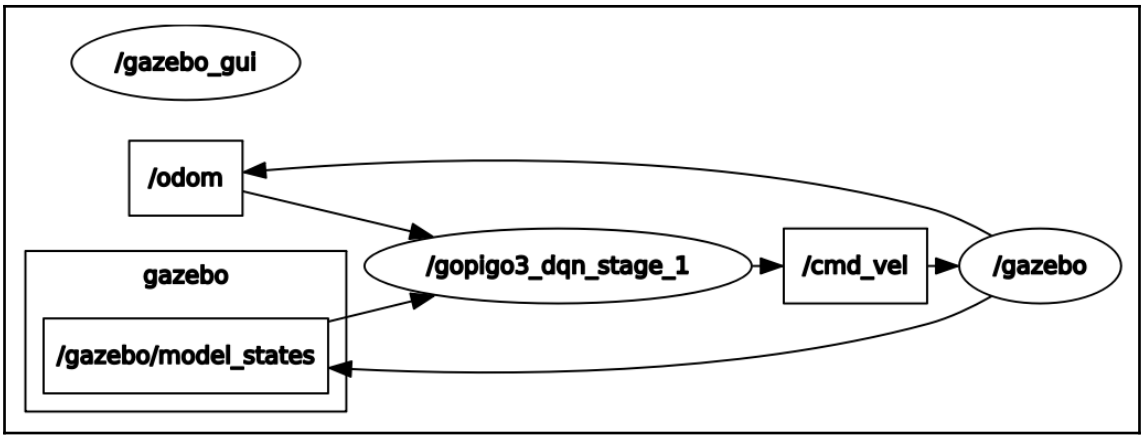
Chapter 12: Achieve a Goal through Reinforcement Learning

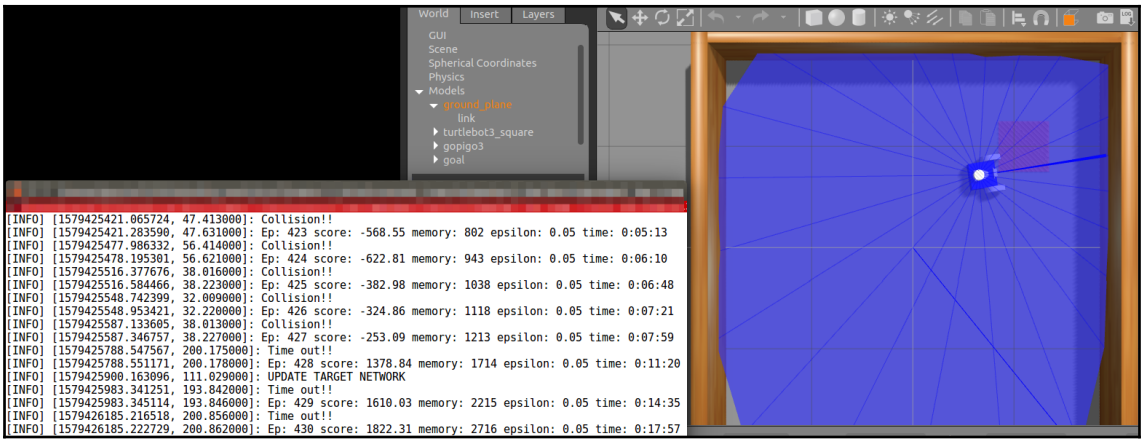


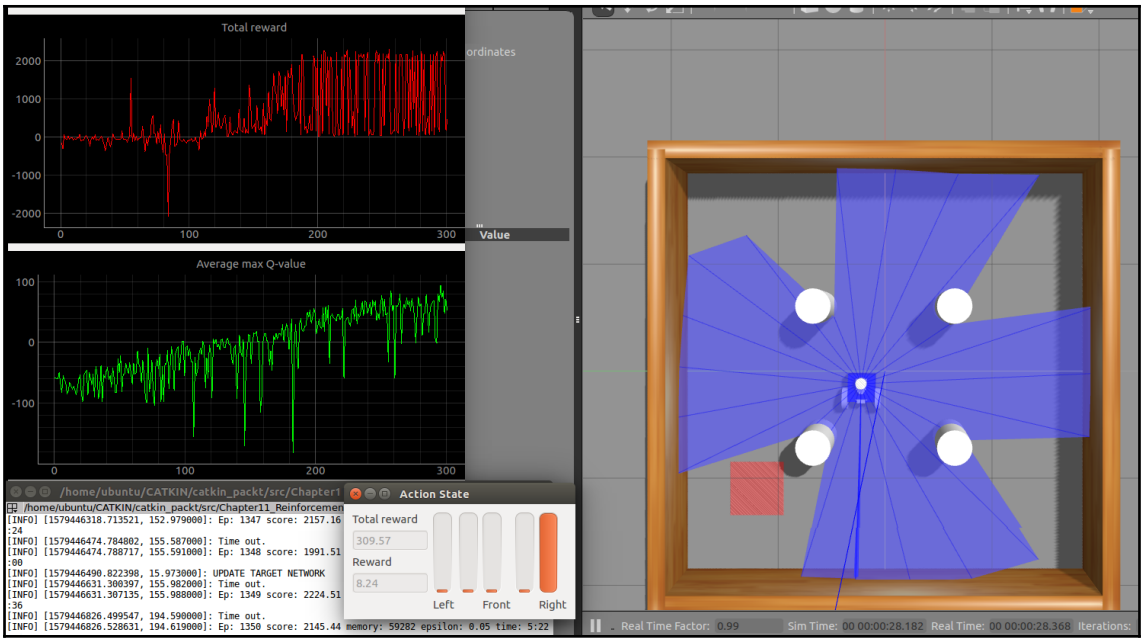


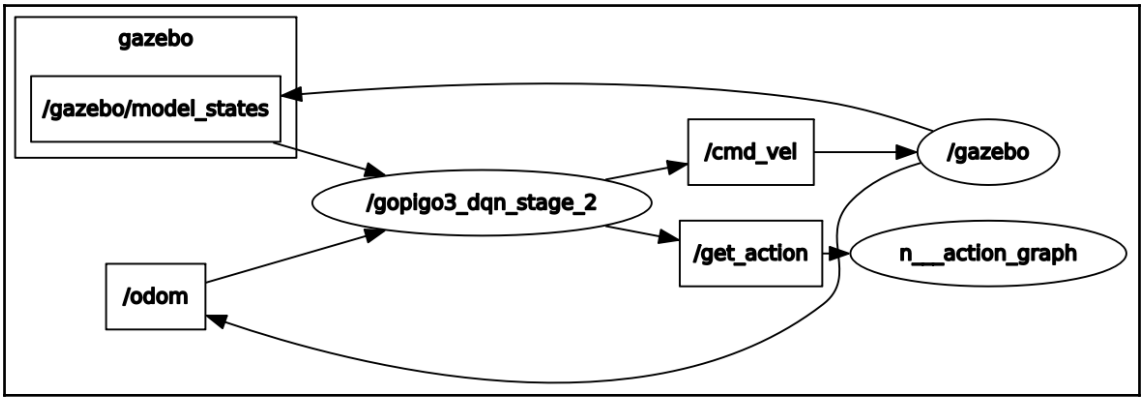


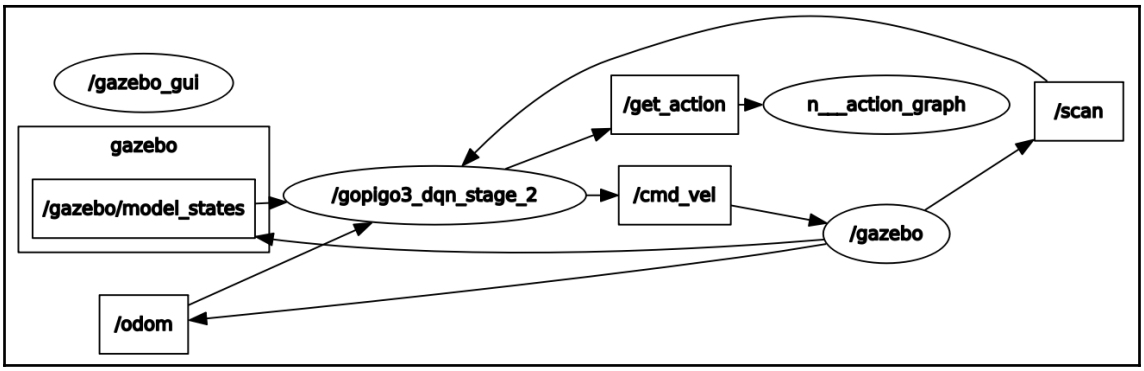


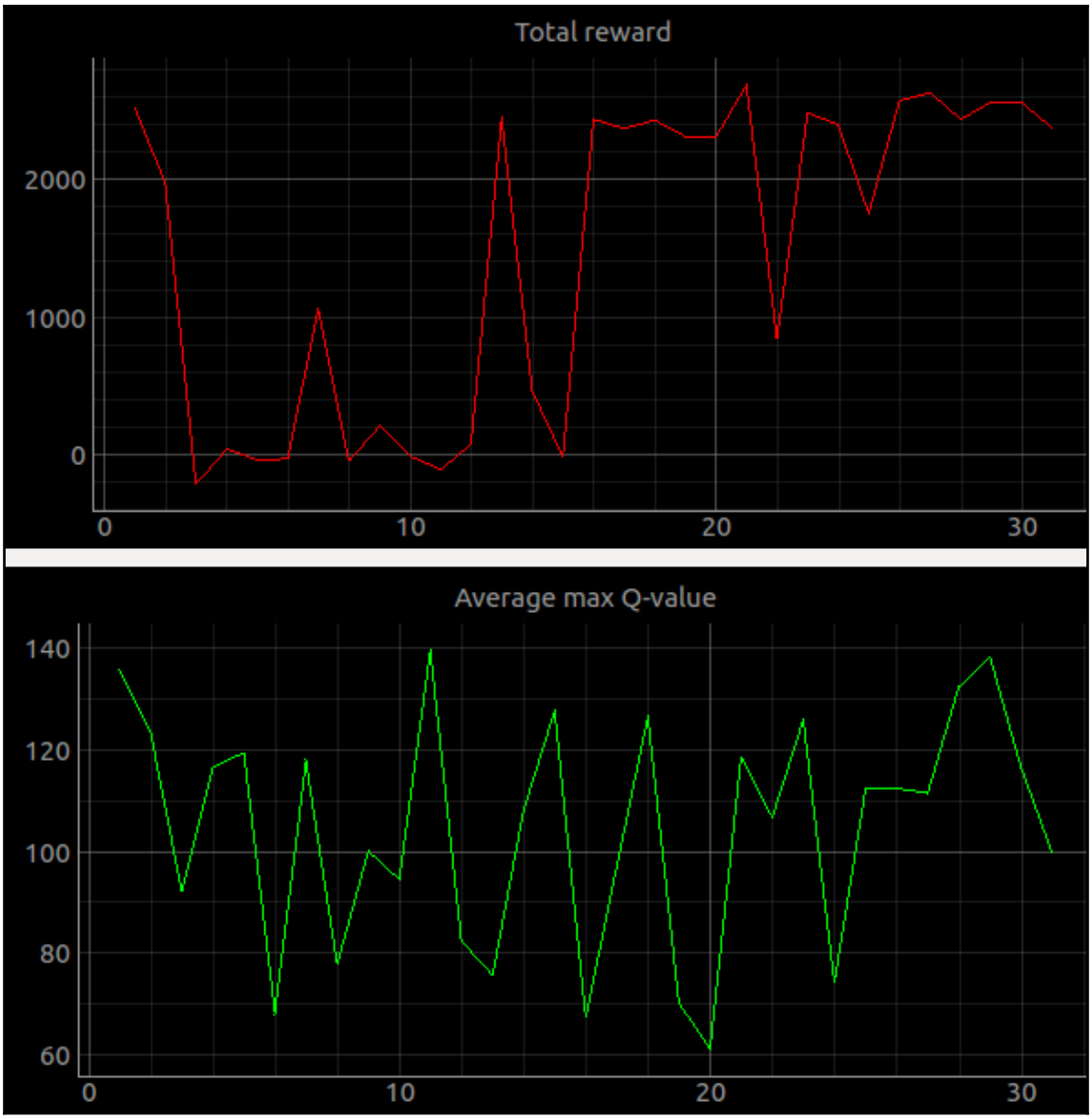

/gazebo_gui
/odom
gazebo
/gazebo/model_states
/gopigo3_dqn_stage_1
/cmd_vel
/gazebo


World
Insert
Layers
GUI
Scene
Spherical Coordinates
Physics
Models
ground_plane
link
turtlebot3_square
gopigo3
goal
[INFO] [1579425421.065724, 47.413000]: Collision!!
[INFO] [1579425421.283590, 47.631000]: Ep: 423 score: -568.55 memory: 802 epsilon: 0.05 time: 0:05:13
[INFO] [1579425477.986332, 56.414000]: Collision!!
[INFO] [1579425478.195301, 56.621000]: Ep: 424 score: -622.81 memory: 943 epsilon: 0.05 time: 0:06:10
[INFO] [1579425516.377676, 38.016000]: Collision!!
[INFO] [1579425516.584466, 38.223000]: Ep: 425 score: -382.98 memory: 1038 epsilon: 0.05 time: 0:06:48
[INFO] [1579425548.742399, 32.009000]: Collision!!
[INFO] [1579425548.953421, 32.220000]: Ep: 426 score: -324.86 memory: 1118 epsilon: 0.05 time: 0:07:21
[INFO] [1579425587.133605, 38.013000]: Collision!!
[INFO] [1579425587.346757, 38.227000]: Ep: 427 score: -253.09 memory: 1213 epsilon: 0.05 time: 0:07:59
[INFO] [1579425788.547567, 200.175000]: Time out!!
[INFO] [1579425788.551171, 200.178000]: Ep: 428 score: 1378.84 memory: 1714 epsilon: 0.05 time: 0:11:20
[INFO] [1579425900.163096, 111.029000]: UPDATE TARGET NETWORK
[INFO] [1579425983.341251, 193.842000]: Time out!!
[INFO] [1579425983.345114, 193.846000]: Ep: 429 score: 1610.03 memory: 2215 epsilon: 0.05 time: 0:14:35
[INFO] [1579426185.216518, 200.856000]: Time out!!
[INFO] [1579426185.222729, 200.862000]: Ep: 430 score: 1822.31 memory: 2716 epsilon: 0.05 time: 0:17:57


Total reward
2000
1000
0
-1000
-2000
0
100
200
300
Value
Average max Q-value
100
0
-100
0
100
200
300
/home/ubuntu/CATKIN/catkin_packt/src/Chapter1
/home/ubuntu/CATKIN/catkin_packt/src/Chapter11_Reinforcemen
[INFO] [1579446318.713521, 152.979000]: Ep: 1347 score: 2157.16
:24
[INFO] [1579446474.784802, 155.587000]: Time out.
[INFO] [1579446474.788717, 155.591000]: Ep: 1348 score: 1991.51
:00
[INFO] [1579446490.822398, 15.973000]: UPDATE TARGET NETWORK
[INFO] [1579446631.300397, 155.982000]: Time out.
[INFO] [1579446631.307135, 155.988000]: Ep: 1349 score: 2224.51
:36
[INFO] [1579446826.499547, 194.590000]: Time out.
[INFO] [1579446826.528631, 194.619000]: Ep: 1350 score: 2145.44 memory: 59282 epsilon: 0.05 time: 5:22
Action State
Total reward
309.57
Reward
8.24
Left
Front
Right
Real Time Factor: 0.99
Sim Time: 00 00:00:28.182
Real Time: 00 00:00:28.368
Iterations:


gazebo
/gazebo/model_states
/cmd_vel
/gazebo
/gopigo3_dqn_stage_2
/get_action
n__action_graph
/odom


/gazebo_gui
gazebo
/gazebo/model_states
/gopigo3_dqn_stage_2
/get_action
n___action_graph
/scan
/cmd_vel
/gazebo
/odom


Total reward
2000
1000
0
0
10
20
30
Average max Q-value
140
120
100
80
60
0
10
20
30