Introduction to ROS

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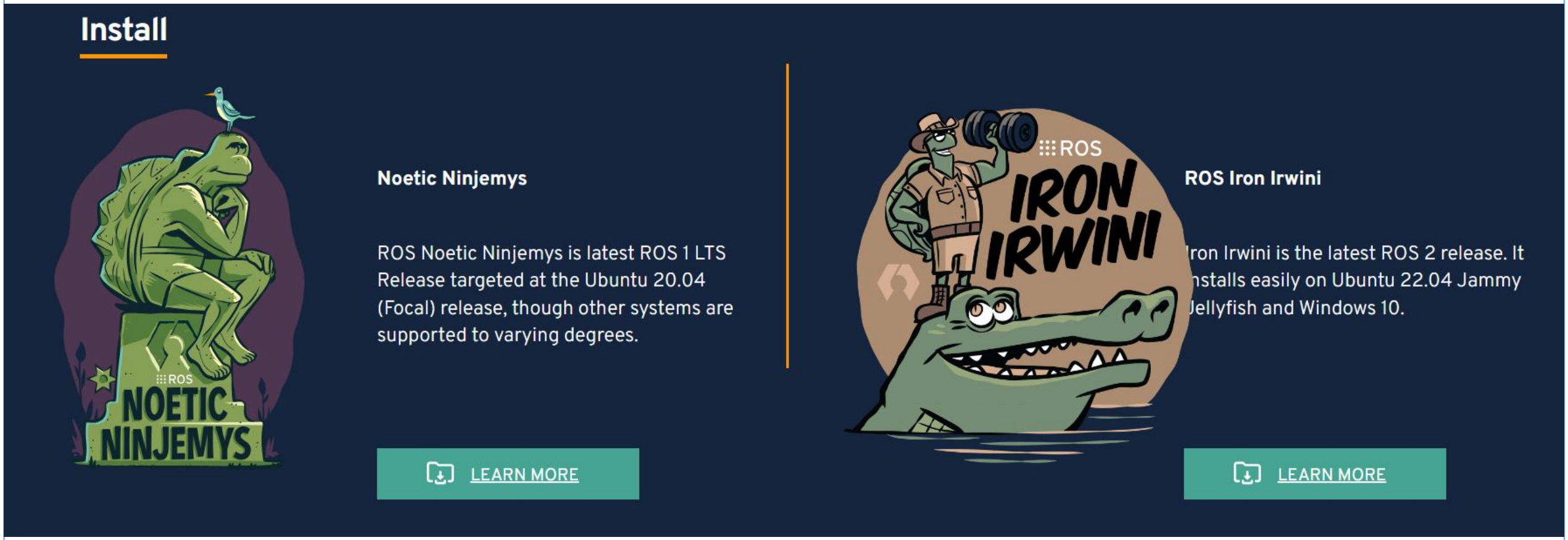
What is ROS?

The Robot Operating System (ROS) is a set of software libraries and tools that help you build robot applications. From drivers to state-of-the-art algorithms, and with powerful developer tools, ROS has what you need for your next robotics project. And it's all open source [1].

[1].https://www.ros.org/. Accessed on 23-10-2023.

Versions of ROS



[1]

[1].https://www.ros.org/. Accessed on 23-10-2023.

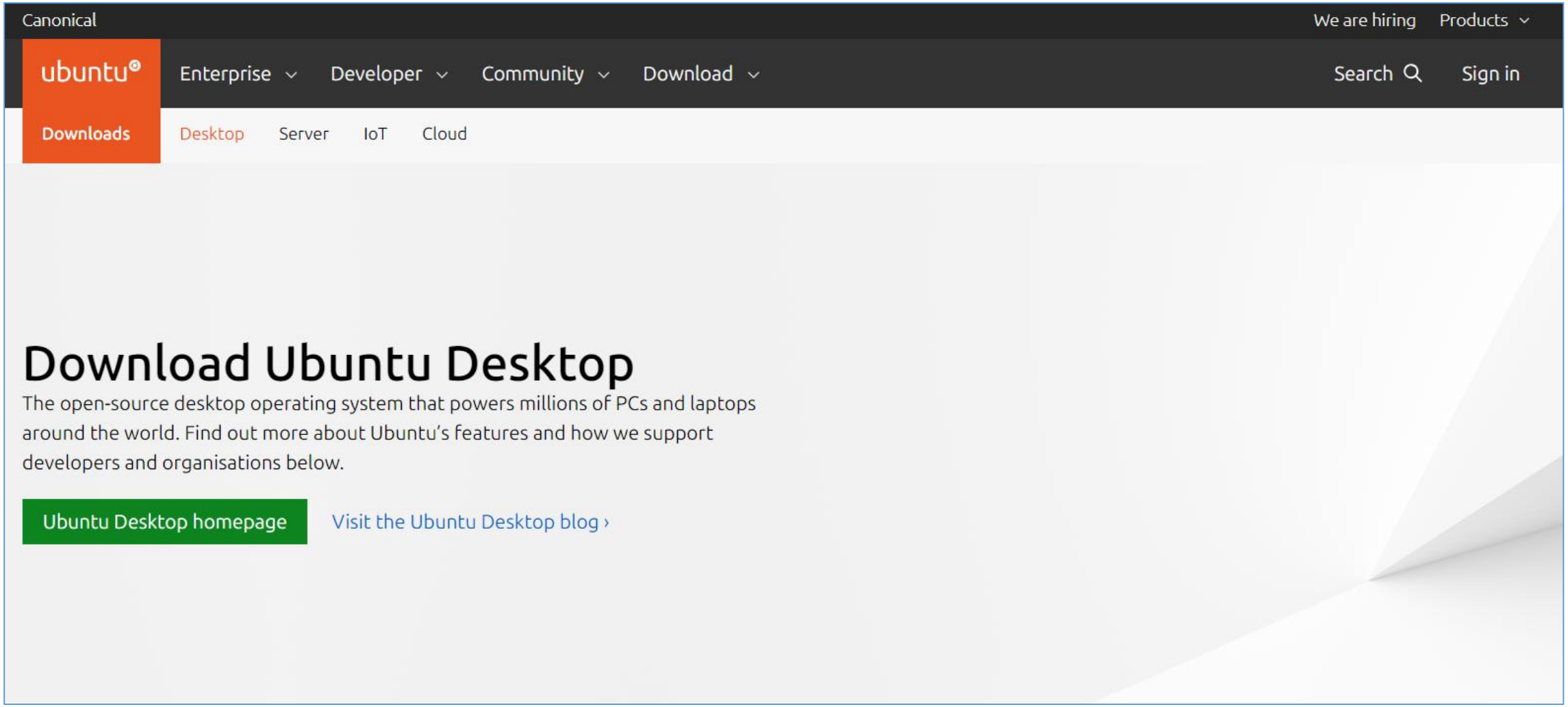
What is Linux ?

Linux® is an open source operating system (OS). An operating system is the software that directly manages a system's hardware and resources, like CPU, memory, and storage. The OS sits between applications and hardware and makes the connections between all of your software and the physical resources that do the work [2].

[2]. https://www.redhat.com/en/topics/linux/what-is-linux. Accessed on 22-10-2023.

About Ubuntu

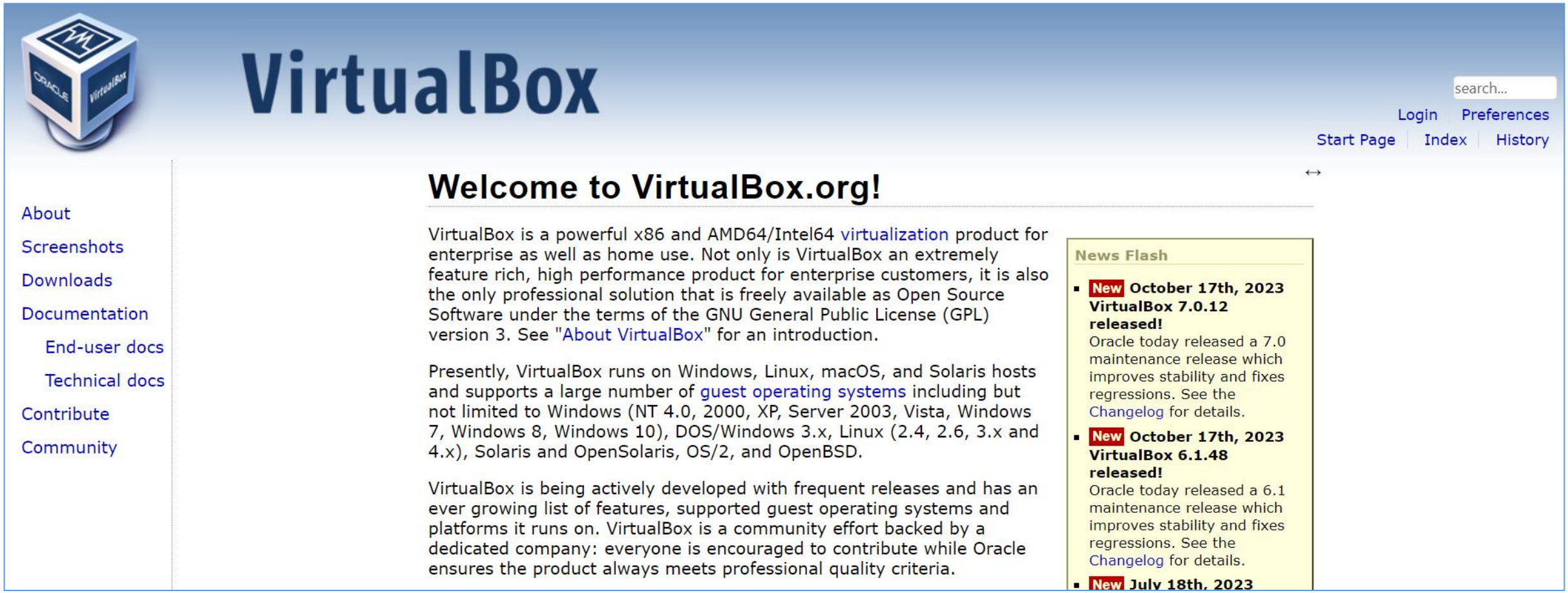
https://ubuntu.com/download/desktop



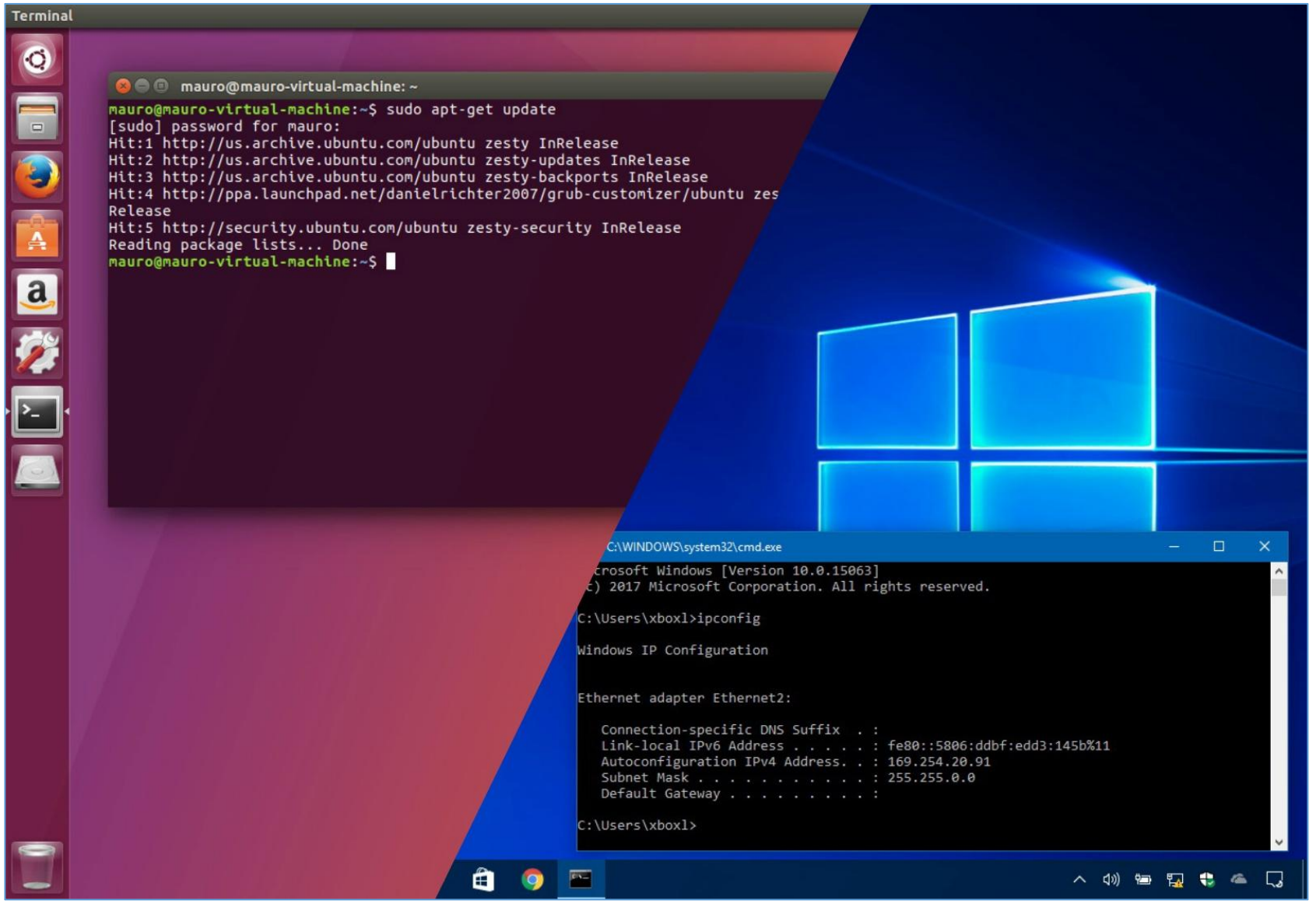
Where to Install Ubuntu?

Virtual box

https://www.virtualbox.org/

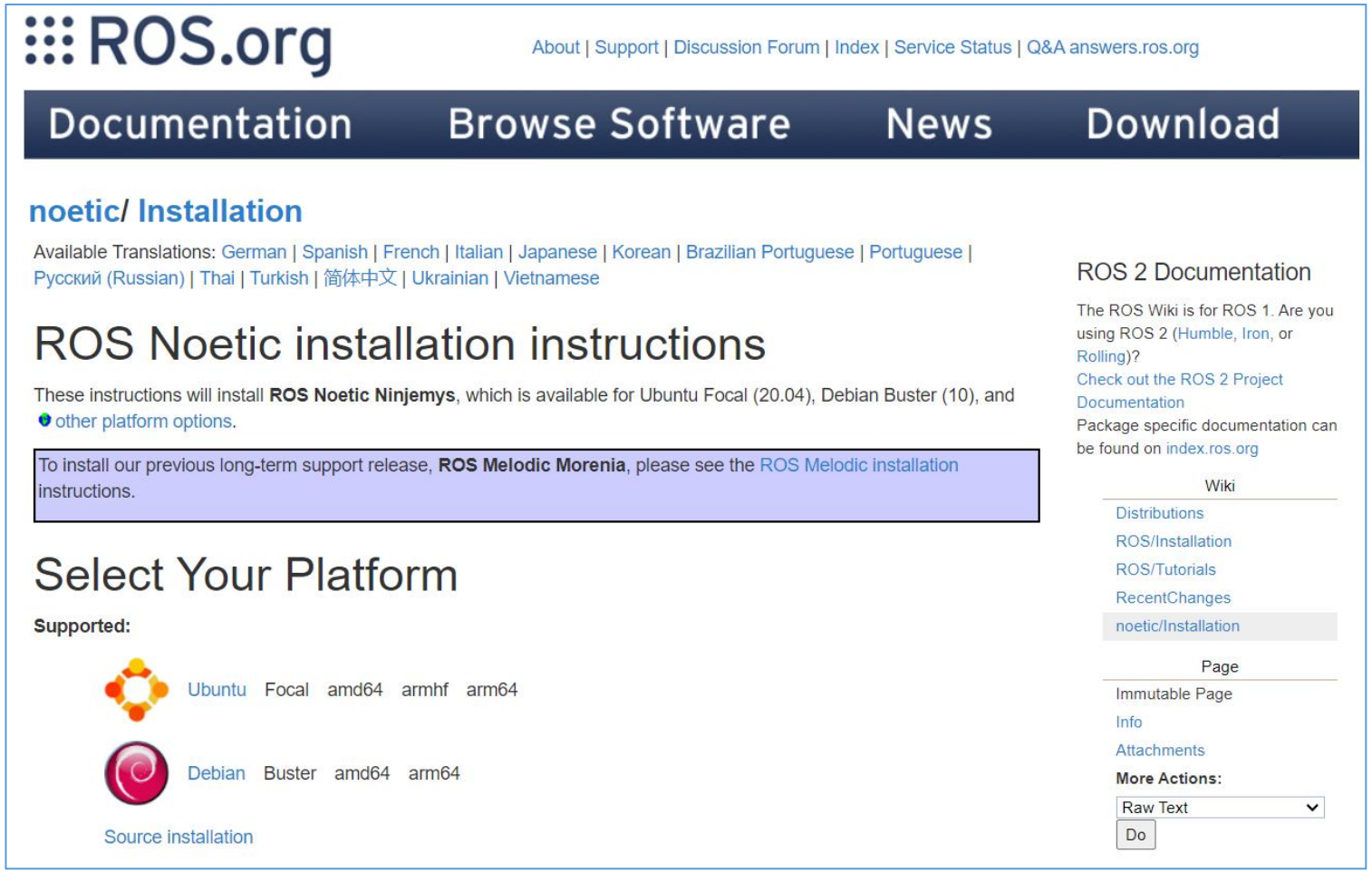


Dual Boot


Terminal
mauro@mauro-virtual-machine: ~
mauro@mauro-virtual-machine:~$ sudo apt-get update
[sudo] password for mauro:
Hit:1 http://us.archive.ubuntu.com/ubuntu zesty InRelease
Hit:2 http://us.archive.ubuntu.com/ubuntu zesty-updates InRelease
Hit:3 http://us.archive.ubuntu.com/ubuntu zesty-backports InRelease
Hit:4 http://ppa.launchpad.net/danielrichter2007/grub-customizer/ubuntu zes
Release
Hit:5 http://security.ubuntu.com/ubuntu zesty-security InRelease
Reading package lists... Done
mauro@mauro-virtual-machine:~$
C:\WINDOWS\system32\cmd.exe
crosoft Windows [Version 10.0.15063]
) 2017 Microsoft Corporation. All rights reserved.
C:\Users\xboxl>ipconfig
Windows IP Configuration
Ethernet adapter Ethernet2:
Connection-specific DNS Suffix . :
Link-local IPv6 Address . . . . . : fe80::5806:ddbf:edd3:145b%11
Autoconfiguration IPv4 Address. . : 169.254.20.91
Subnet Mask . . . . . : 255.255.0.0
Default Gateway . . . . . :
C:\Users\xboxl>

How to Install ROS?

https://wiki.ros.org/noetic/Installation



How to Install ROS?

https://wiki.ros.org/noetic/Installation/Ubuntu

1. Installation

1.1 Configure your Ubuntu repositories

Configure your Ubuntu repositories to allow "restricted," "universe," and "multiverse." You can follow the Ubuntu guide for instructions on doing this.

1.2 Setup your sources.list

Setup your computer to accept software from packages.ros.org.

```
sudo sh -c 'echo "deb http://packages.ros.org/ros/ubuntu $(lsb_release -sc) main" > /etc/apt/sources.list.d/ros-latest.list'
```

Mirrors Source Debs are also available

1.3 Set up your keys

```
sudo apt install curl # if you haven't already installed curl
curl -s https://raw.githubusercontent.com/ros/rosdistro/master/ros.asc | sudo apt-key add -
```

1.4 Installation

First, make sure your Debian package index is up-to-date:

```
sudo apt update
```

How to Install ROS?

1.4 Installation

First, make sure your Debian package index is up-to-date:

```
sudo apt update
```

Now pick how much of ROS you would like to install.

Desktop-Full Install: (Recommended) : Everything in **Desktop** plus 2D/3D simulators and 2D/3D perception packages

```
sudo apt install ros-noetic-desktop-full
```

or click here

Desktop Install: Everything in **ROS-Base** plus tools like rqt and rviz

```
sudo apt install ros-noetic-desktop
```

or click here

ROS-Base: (Bare Bones) ROS packaging, build, and communication libraries. No GUI tools.

```
sudo apt install ros-noetic-ros-base
```

or click here

There are even more packages available in ROS. You can always install a specific package directly.

```
sudo apt install ros-noetic-PACKAGE
```

e.g.

```
sudo apt install ros-noetic-slam-gmapping
```

To find available packages, see ROS Index or use:

```
apt search ros-noetic
```

How to Install ROS?

1.5 Environment setup

You must source this script in every **bash** terminal you use ROS in.

```
source /opt/ros/noetic/setup.bash
```

It can be convenient to automatically source this script every time a new shell is launched. These commands will do that for you.

Bash

If you have more than one ROS distribution installed, `~/.bashrc` must only source the `setup.bash` for the version you are currently using.

```
echo "source /opt/ros/noetic/setup.bash" >> ~/.bashrc
source ~/.bashrc
```

zsh

```
echo "source /opt/ros/noetic/setup.zsh" >> ~/.zshrc
source ~/.zshrc
```

Basic Concepts of ROS

Basic Concepts of ROS

Basic Concepts

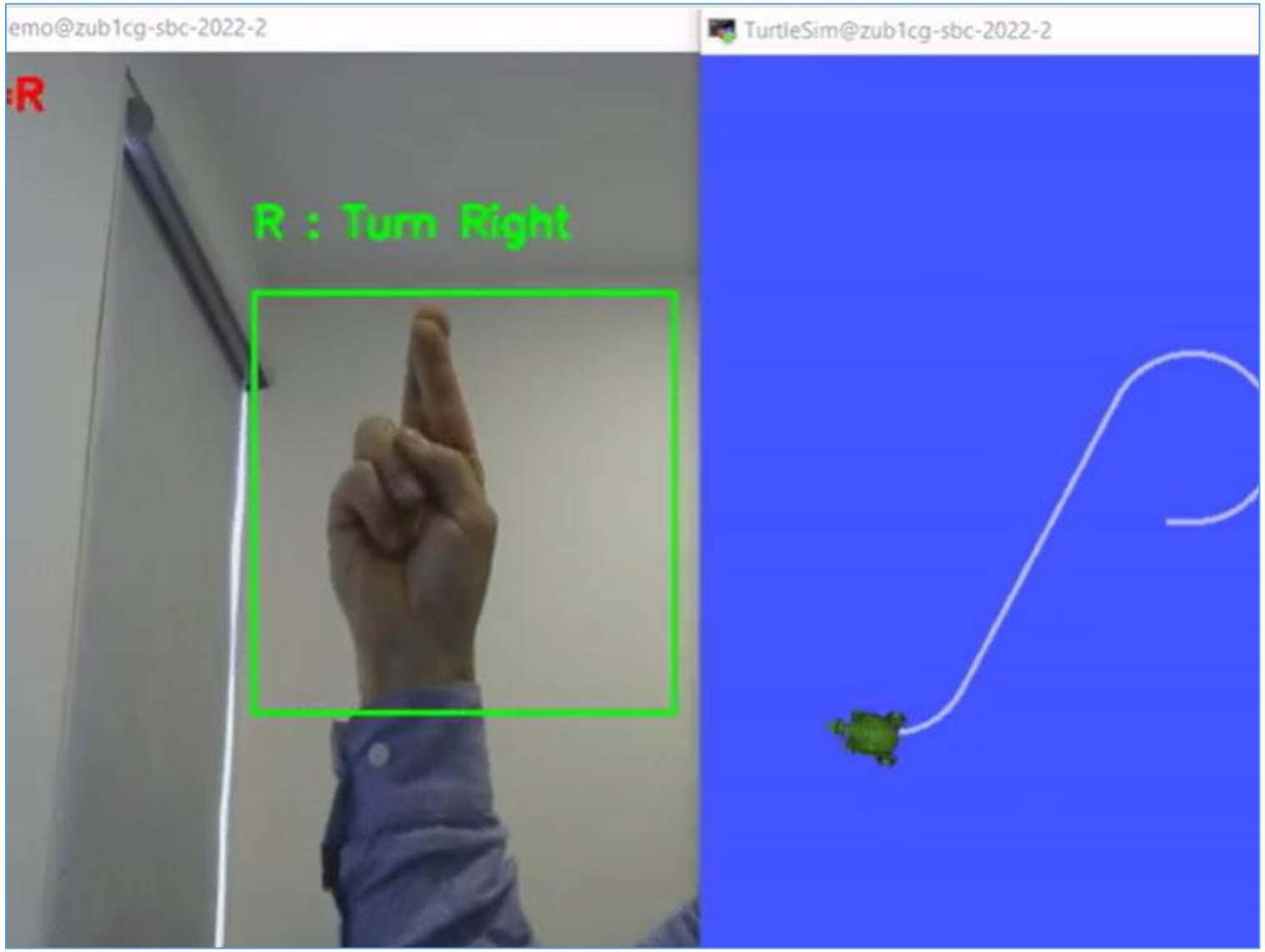
- Nodes: An executable that communicates with other nodes through ROS.
- Topics: Named communication channels over which nodes exchange messages. Nodes can *publish* or *subscribe* to a topic. Publishing is the act of sending messages over a topic and subscribing is the act of listening for messages in a topic.
- Messages: Simple data structure used by topic publishers and subscribers.
- roscore: roscore provide a number of pre-requisits to run any ROS-based system. Of debugging importance rosout logging node (equivalent of stdout/stderr) which is included in roscore.

[3]

[3]. https://classes.cs.uchicago.edu/archive/2021/winter/20600-1/ros_resources.html

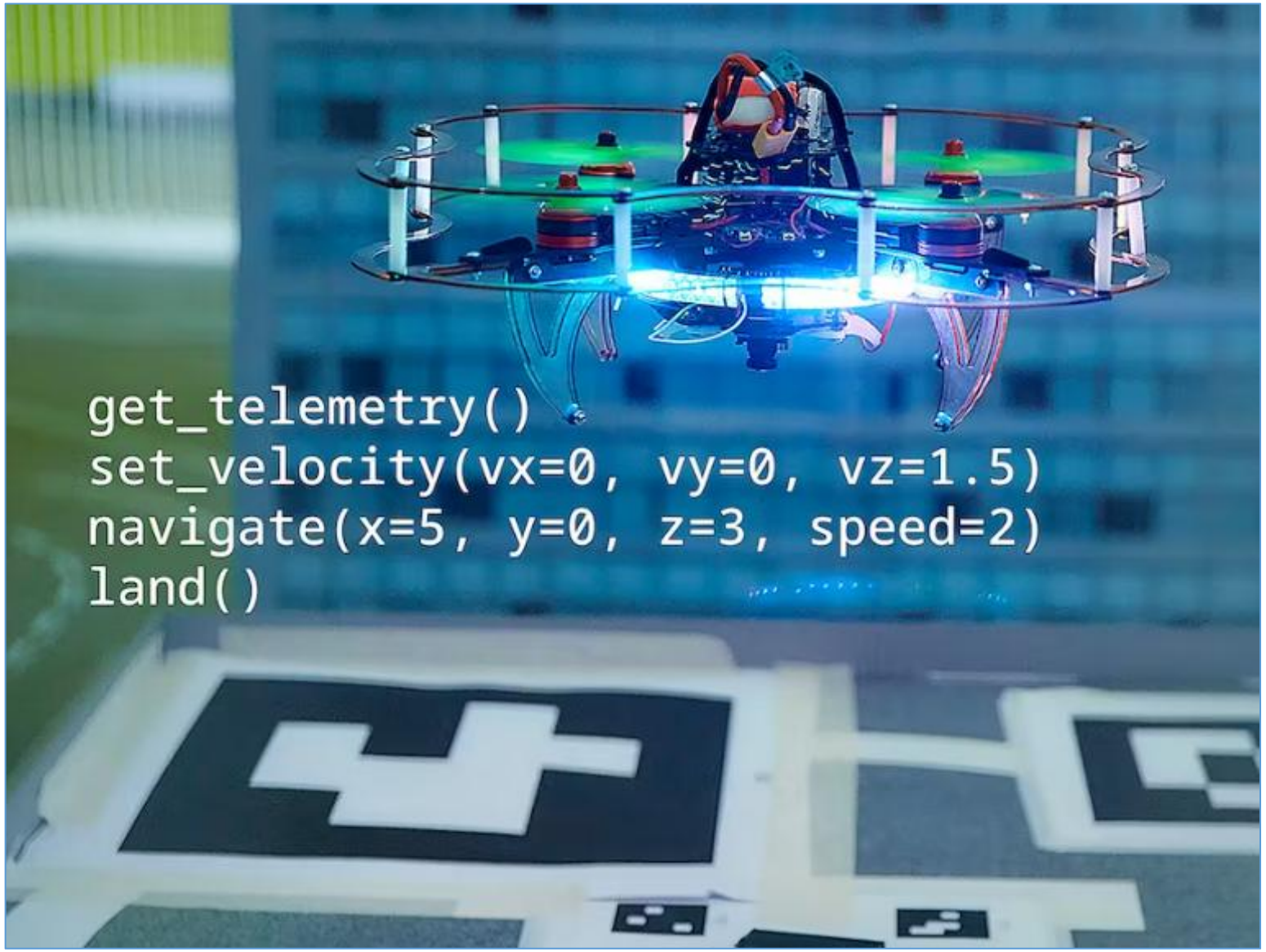
Projects with ROS

Controlling a Robot with Hand Signs

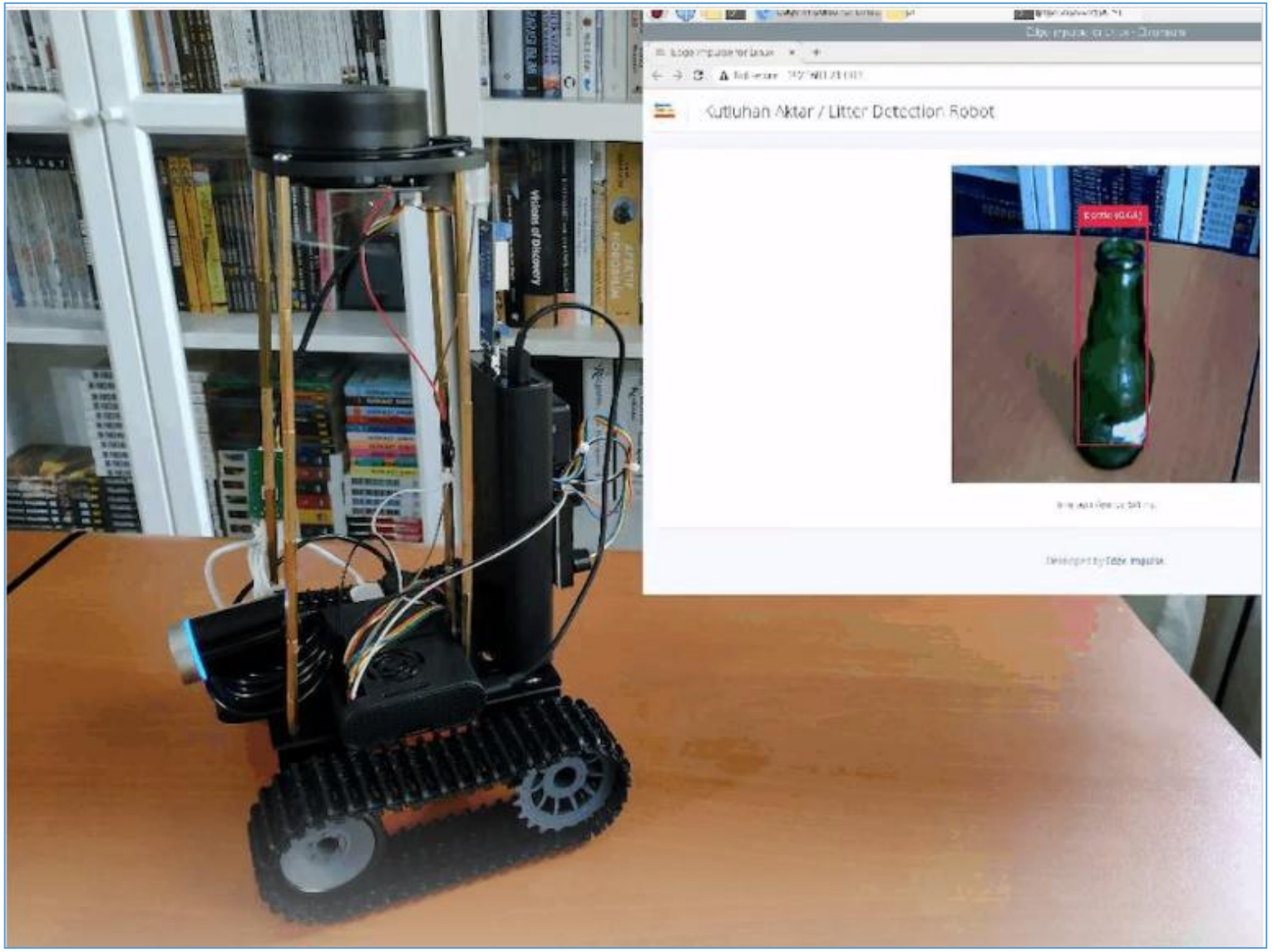


Human-Following Robot

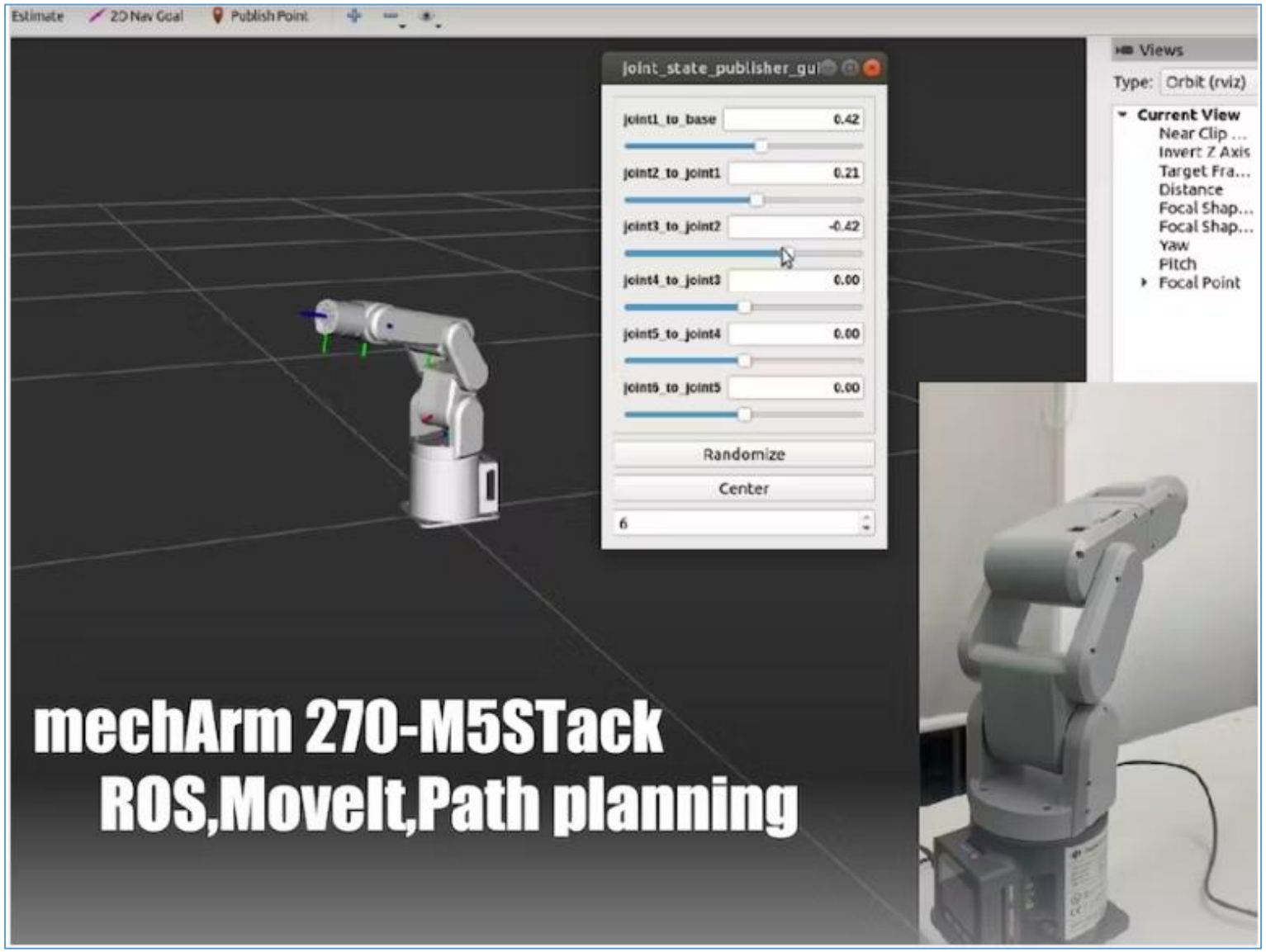
Programming drones with Raspberry Pi on board easily



Autonomous (LIDAR) Litter Detection Robot

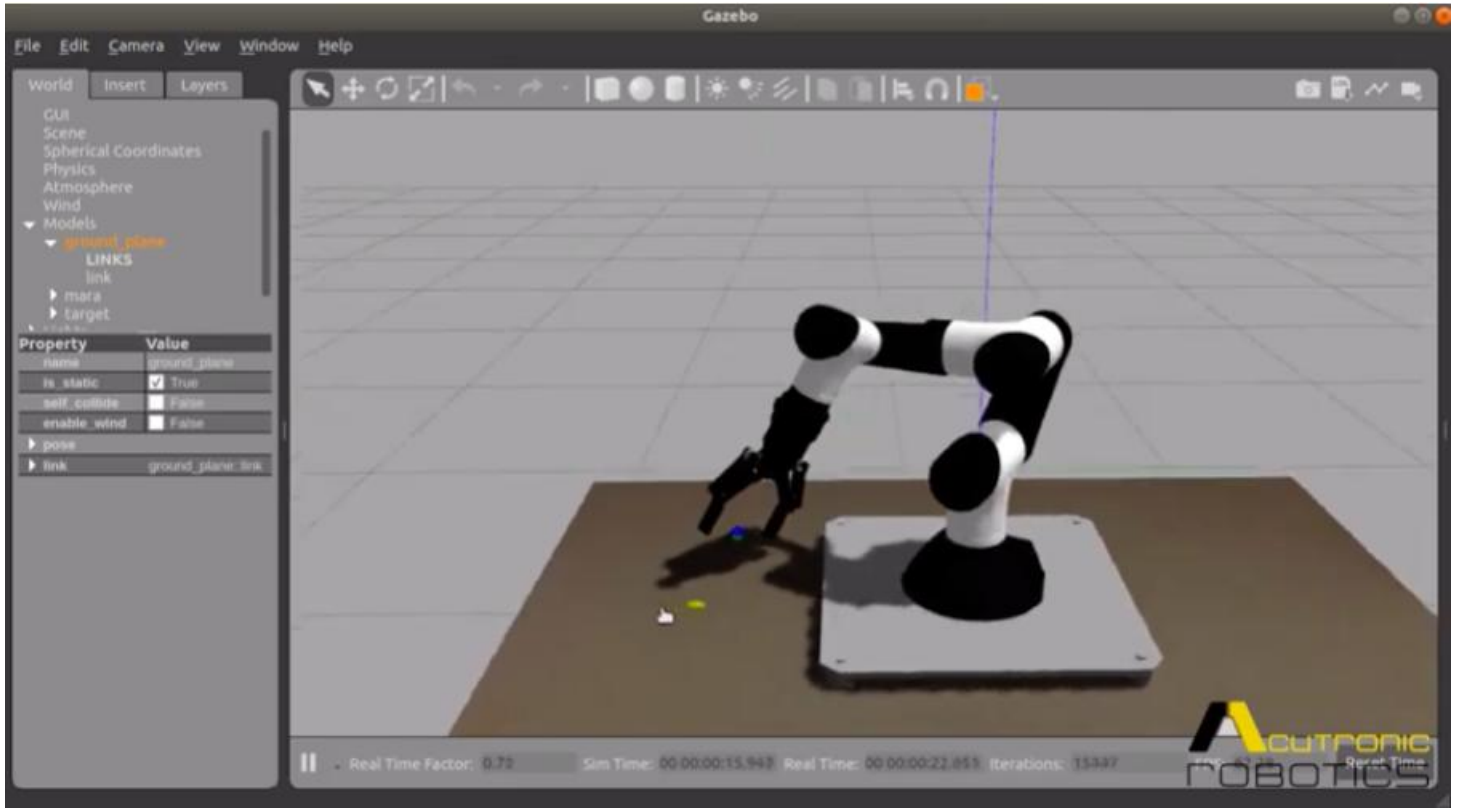


Six-Axis Robotic Arm



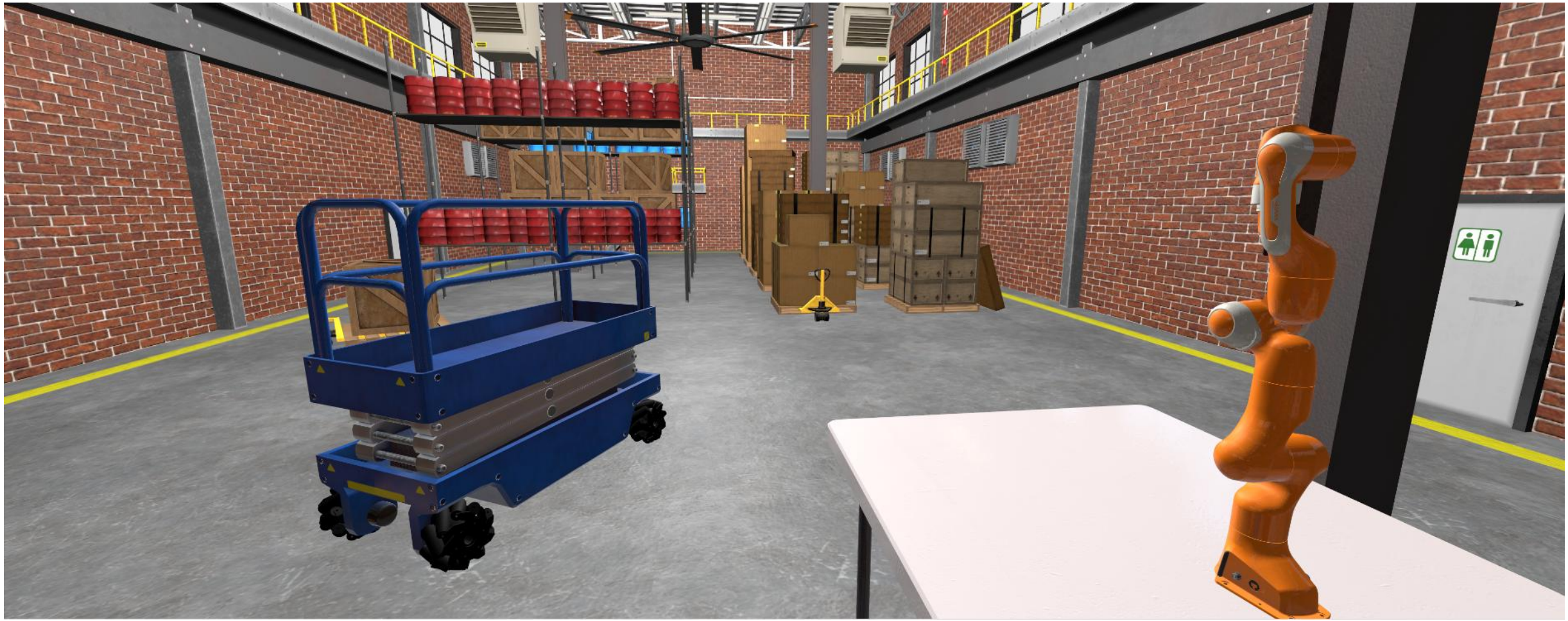
What is Gazebo in ROS?

Gazebo



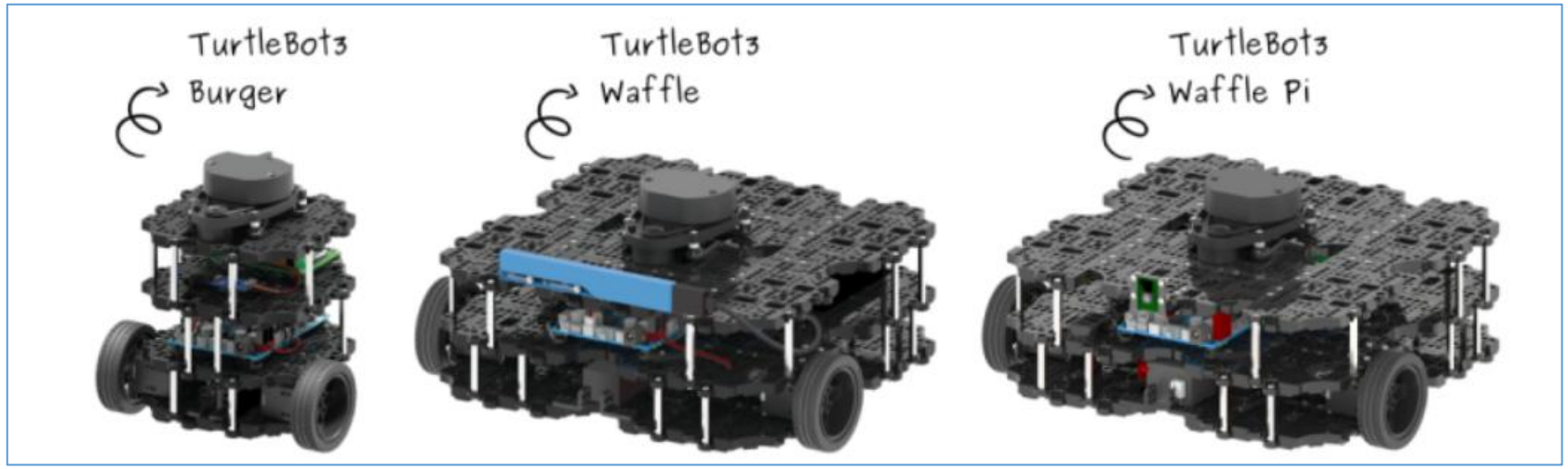
Gazebo is an open-source 3D robotics simulator. It integrated the ODE physics engine, OpenGL rendering, and support code for sensor simulation and actuator control. Gazebo can use multiple high-performance physics engines, such as ODE, Bullet, etc.

Gazebo



What is a TurtleBot?

TurtleBot is a low-cost, personal robot kit with open-source software. TurtleBot was created at Willow Garage by Melonee Wise and Tully Foote in November 2010. With TurtleBot, you'll be able to build a robot that can drive around your house, see in 3D, and have enough horsepower to create exciting applications.



Information about TurtleBot

https://wiki.ros.org/Robots/TurtleBot

ROS.org

About | Support | Discussion Forum | Index | Service Status | Q&A answers.ros.org

Documentation Browse Software News Download

Robots/ TurtleBot

TurtleBot

Original TurtleBot
(Discontinued)

TurtleBot 2 Family

TurtleBot 2

TurtleBot 2i

TurtleBot 2e

TurtleBot 3 Family

Burger

Waffle

Waffle Pi

ROS 2 Documentation

The ROS Wiki is for ROS 1. Are you using ROS 2 (Humble, Iron, or Rolling)?
Check out the ROS 2 Project Documentation
Package specific documentation can be found on index.ros.org

Wiki

Distributions
ROS/Installation
ROS/Tutorials
RecentChanges
Robots/TurtleBot

Page

Immutable Page
Info
Attachments

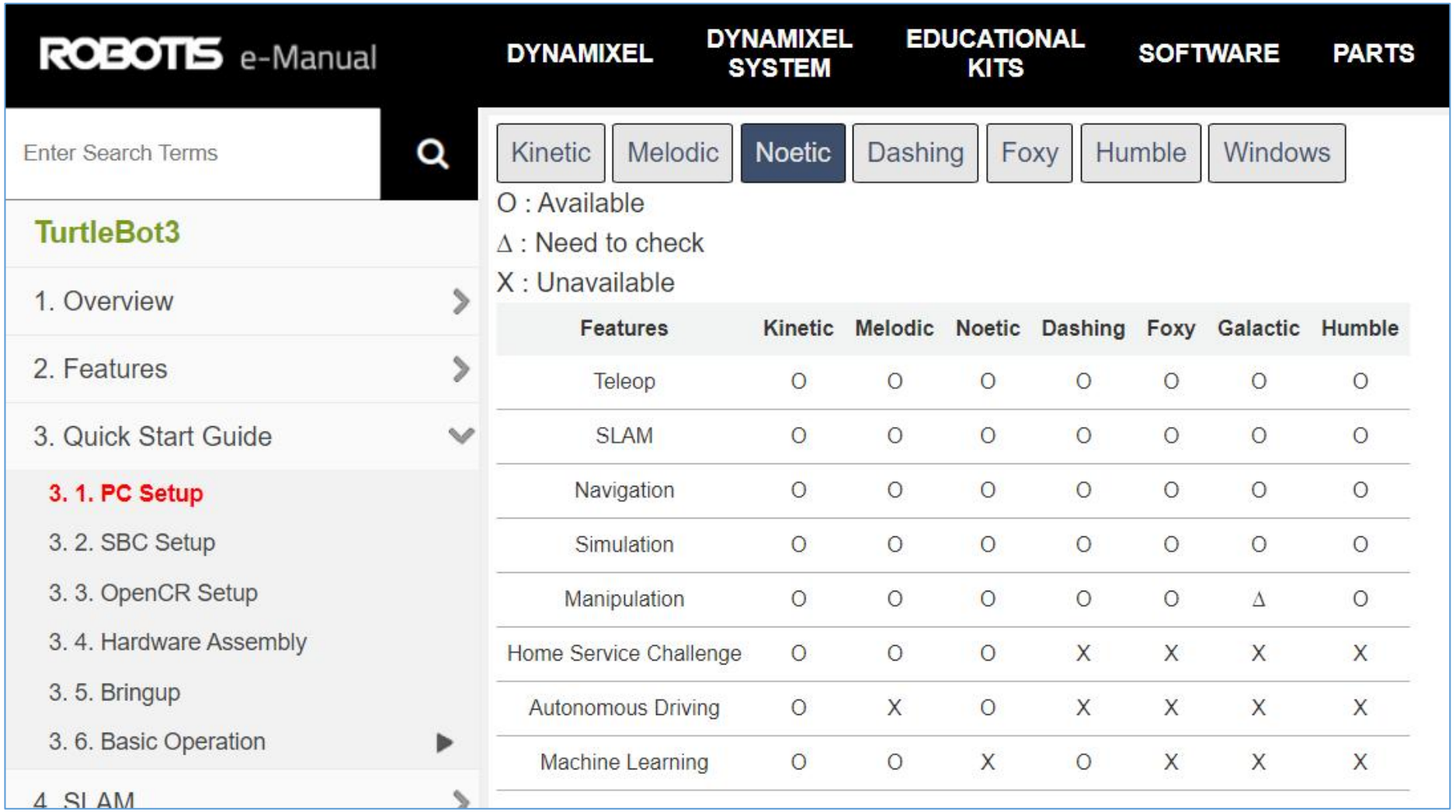
More Actions:

Raw Text
Do

User

Installing TurtleBot

https://emanual.robotis.com/docs/en/platform/turtlebot3/quick-start/



Features	Kinetic	Melodic	Noetic	Dashing	Foxy	Galactic	Humble
Teleop	O	O	O	O	O	O	O
SLAM	O	O	O	O	O	O	O
Navigation	O	O	O	O	O	O	O
Simulation	O	O	O	O	O	O	O
Manipulation	O	O	O	O	O	Δ	O
Home Service Challenge	O	O	O	X	X	X	X
Autonomous Driving	O	X	O	X	X	X	X
Machine Learning	O	O	X	O	X	X	X

Installing TurtleBot

6. 1. 1. Install Simulation Package

The **TurtleBot3 Simulation Package** requires `turtlebot3` and `turtlebot3_msgs` packages as prerequisite. Without these prerequisite packages, the Simulation cannot be launched.

Please follow the PC Setup instructions if you did not install required packages and dependent packages.

```
$ cd ~/catkin_ws/src/
$ git clone -b noetic-devel https://github.com/ROBOTIS-GIT/turtlebot3_simulations.git
$ cd ~/catkin_ws && catkin_make
```

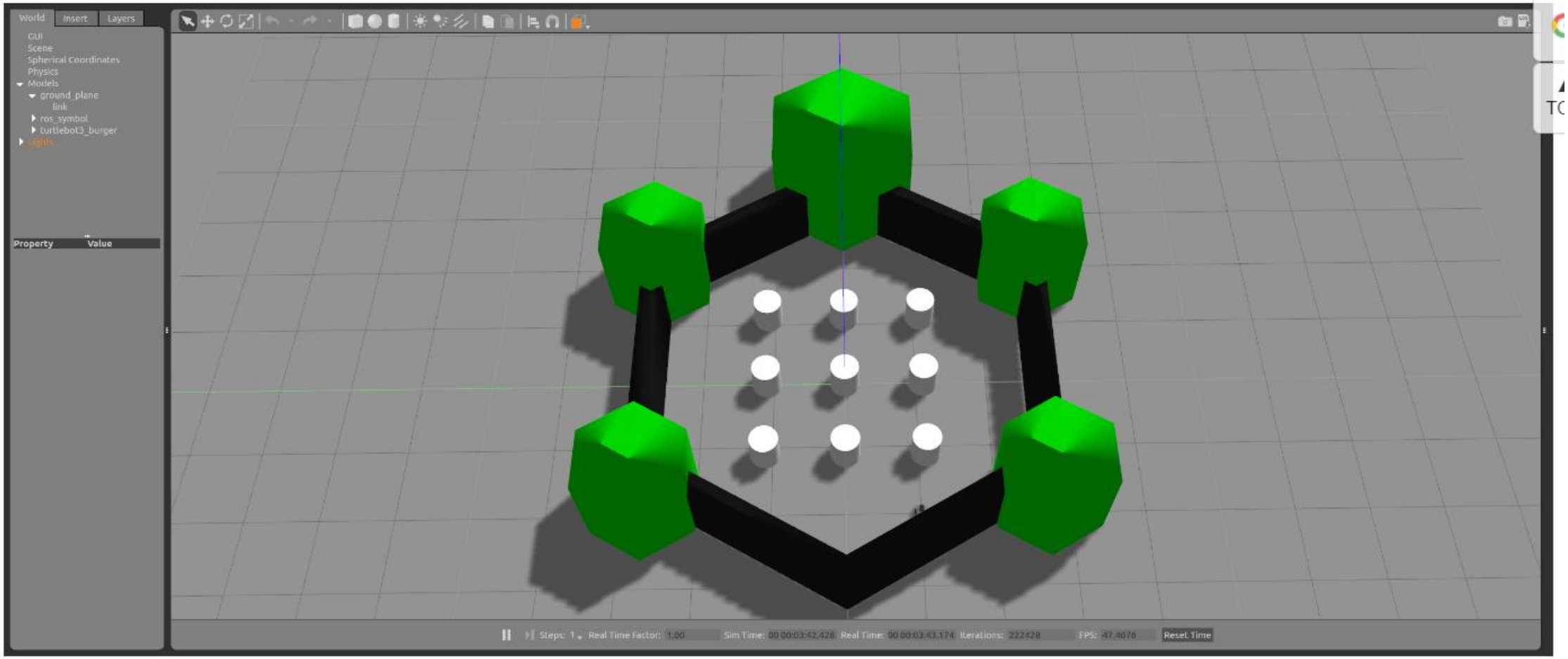
Turtlebot in Empty world

1. Empty World

```
$ export TURTLEBOT3_MODEL=burger
$ roslaunch turtlebot3_gazebo turtlebot3_empty_world.launch
```

Turtlebot3 world

2. TurtleBot3 World



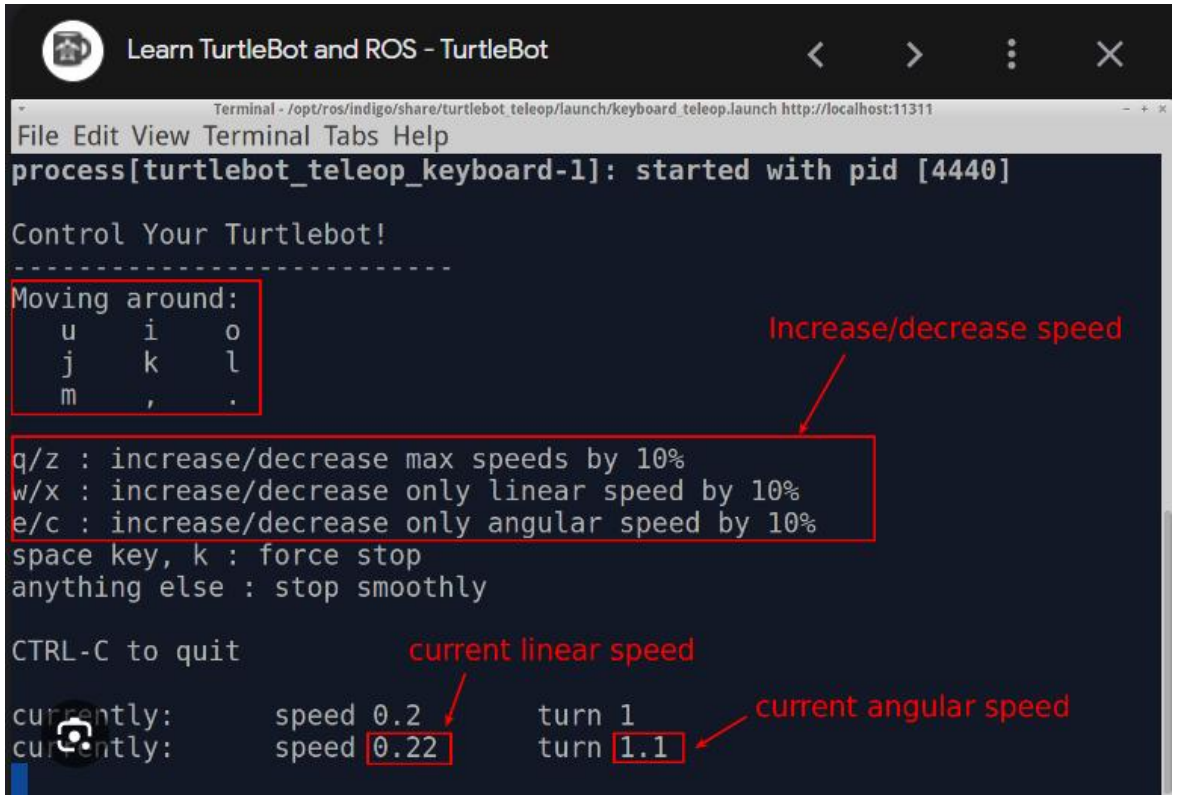

```
$ export TURTLEBOT3_MODEL=waffle
$ roslaunch turtlebot3_gazebo turtlebot3_world.launch
```

Turtlebot Using Teleoperation

6. 1. 3. Operate TurtleBot3

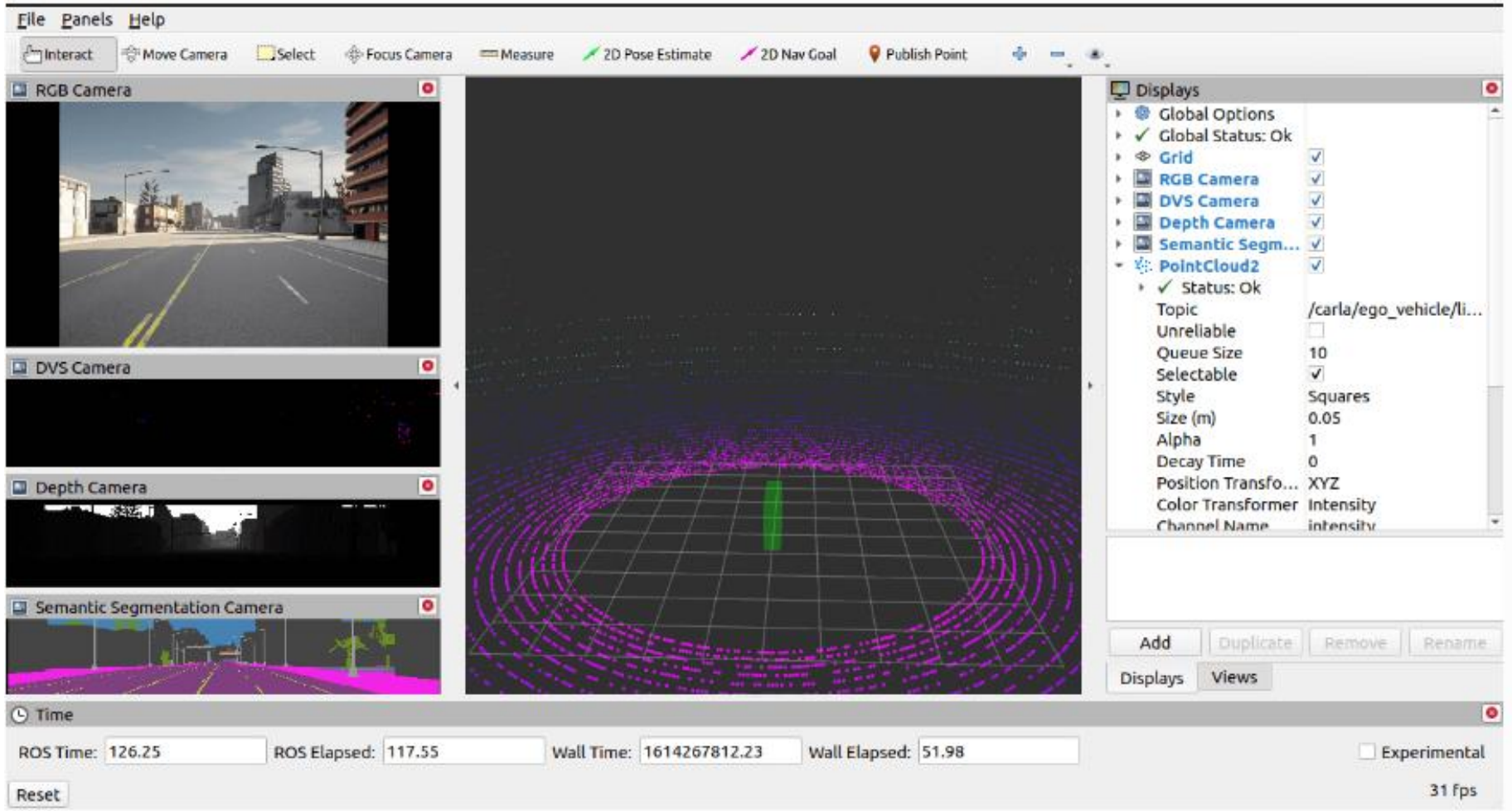
In order to teleoperate the TurtleBot3 with the keyboard, launch the teleoperation node with below command in a new terminal window.

```
$ roslaunch turtlebot3_teleop turtlebot3_teleop_key.launch
```



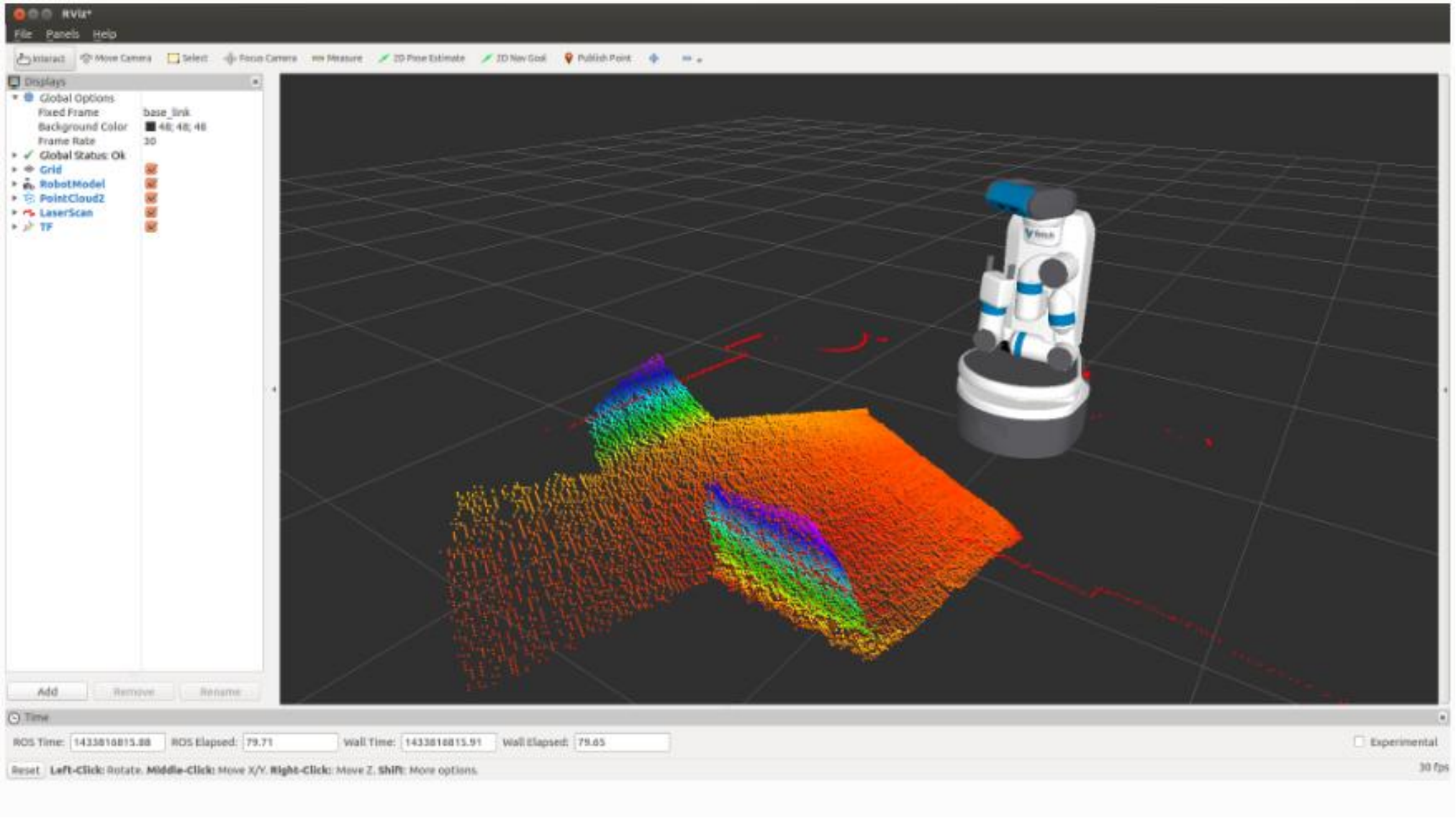
What is RVIZ?

RVIZ

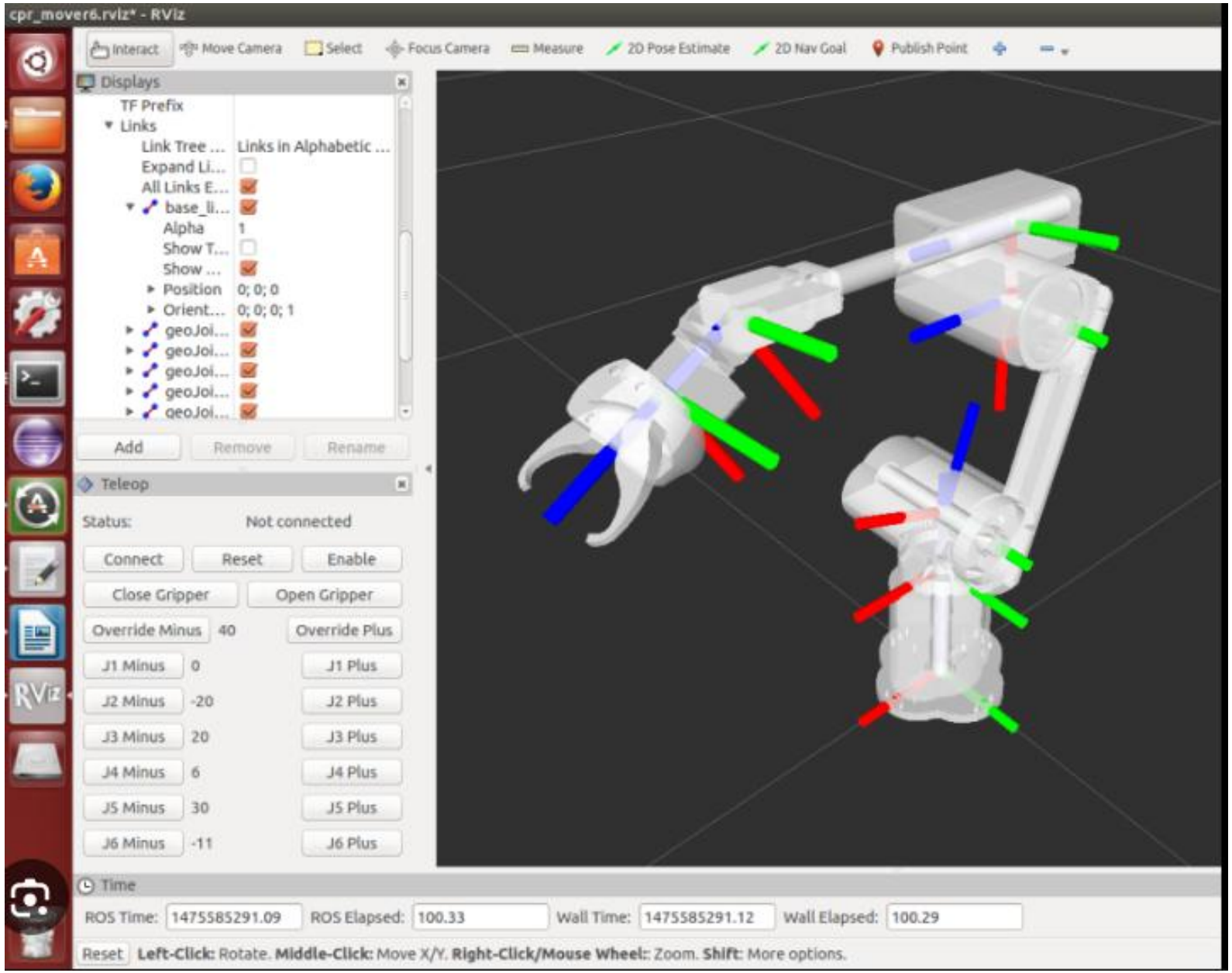


Short for ROS Visualization. It's a 3-dimensional visualization tool for ROS. · It helps to visualize what the robot seeing and doing.

RVIZ


RViz*
File Panels Help
Displays
Global Options
Fixed Frame base_link
Background Color 48; 48; 48
Frame Rate 30
Global Status: Ok
Grid
RobotModel
PointCloud2
LaserScan
TF
Add
Time
ROS Time: 1433810815.88
ROS Elapsed: 79.71
Wall Time: 1433810815.91
Wall Elapsed: 79.65
Experimental
Reset
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click: Move Z. Shift: More options.
30 fps

RVIZ


cpr_mover6.rviz* - RViz
Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
Displays
TF Prefix
Links
Link Tree ...
Links in Alphabetic ...
Expand Li...
All Links E...
base_li...
Alpha
1
Show T...
Show ...
Position
0; 0; 0
Orient...
0; 0; 0; 1
geoJoi...
geoJoi...
geoJoi...
geoJoi...
geoJoi...
Add
Remove
Rename
Teleop
Status:
Not connected
Connect
Reset
Enable
Close Gripper
Open Gripper
Override Minus
40
Override Plus
J1 Minus
0
J1 Plus
J2 Minus
-20
J2 Plus
J3 Minus
20
J3 Plus
J4 Minus
6
J4 Plus
J5 Minus
30
J5 Plus
J6 Minus
-11
J6 Plus
Time
ROS Time:
1475585291.09
ROS Elapsed:
100.33
Wall Time:
1475585291.12
Wall Elapsed:
100.29
Reset
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click/Mouse Wheel: Zoom. Shift: More options.

Thanks

THANK YOU FOR LISTENING

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