

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

Install



Noetic Ninjemys

ROS Noetic Ninjemys is latest ROS 1 LTS Release targeted at the Ubuntu 20.04 (Focal) release, though other systems are supported to varying degrees.

 [LEARN MORE](#)



ROS Iron Irwini

Iron Irwini is the latest ROS 2 release. It installs easily on Ubuntu 22.04 Jammy Jellyfish and Windows 10.

 [LEARN MORE](#)

[1]

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

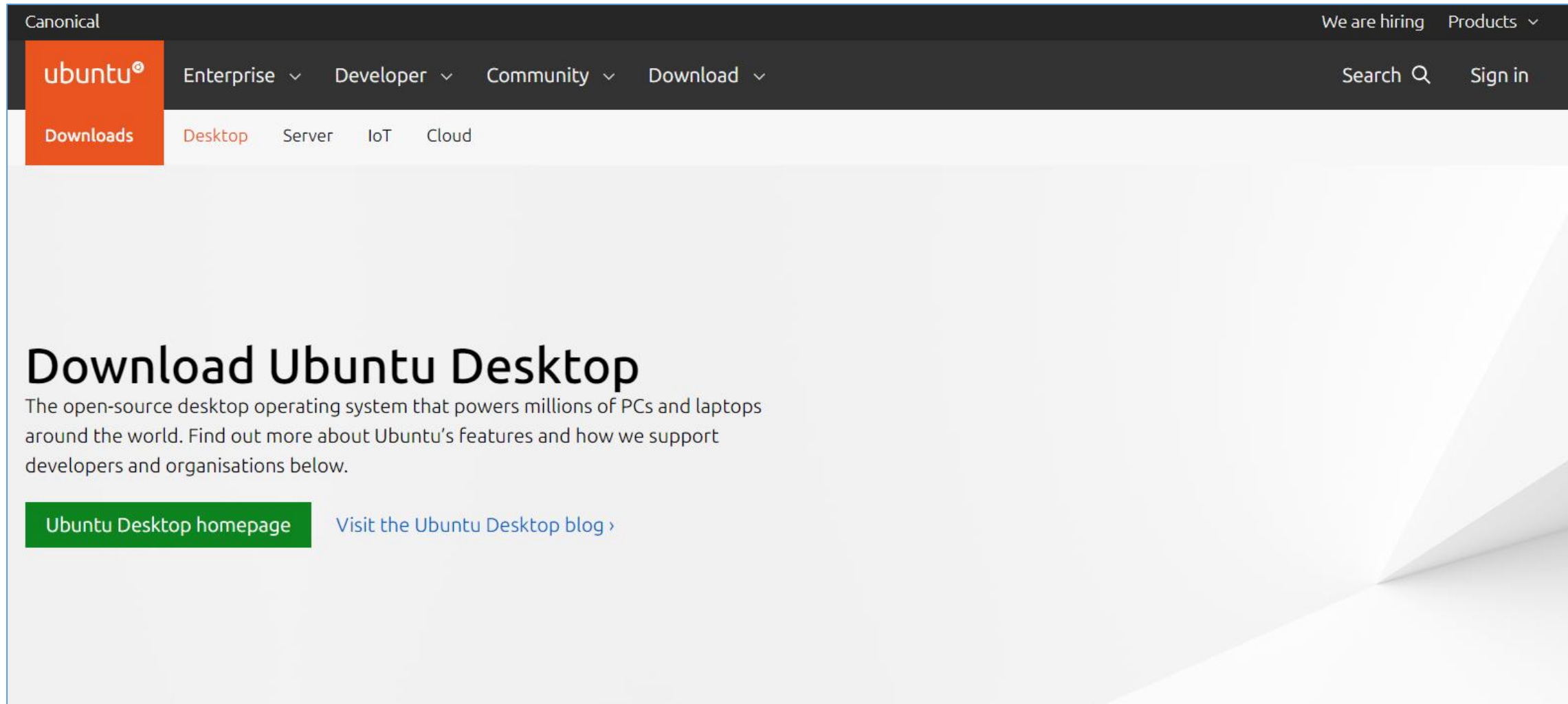
What is Linux ?

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].



About Ubuntu

<https://ubuntu.com/download/desktop>

A screenshot of the Ubuntu website's 'Download Desktop' page. The page has a dark header with the Canonical logo, the Ubuntu logo, and navigation links for Enterprise, Developer, Community, and Download. The Download link is expanded, showing Desktop, Server, IoT, and Cloud. The main content area features the heading 'Download Ubuntu Desktop' and a paragraph describing it as an open-source desktop operating system. There are two buttons: a green 'Ubuntu Desktop homepage' button and a blue 'Visit the Ubuntu Desktop blog' link.

Canonical

ubuntu®

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Downloads

Desktop Server IoT Cloud

Download Ubuntu Desktop

The open-source desktop operating system that powers millions of PCs and laptops around the world. Find out more about Ubuntu's features and how we support developers and organisations below.

[Ubuntu Desktop homepage](#) [Visit the Ubuntu Desktop blog ›](#)



Where to Install Ubuntu?

Virtual box

<https://www.virtualbox.org/>



VirtualBox

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Welcome to VirtualBox.org!

VirtualBox is a powerful x86 and AMD64/Intel64 [virtualization](#) product for enterprise as well as home use. Not only is VirtualBox an extremely feature rich, high performance product for enterprise customers, it is also the only professional solution that is freely available as Open Source Software under the terms of the GNU General Public License (GPL) version 3. See "[About VirtualBox](#)" for an introduction.

Presently, VirtualBox runs on Windows, Linux, macOS, and Solaris hosts and supports a large number of [guest operating systems](#) including but not limited to Windows (NT 4.0, 2000, XP, Server 2003, Vista, Windows 7, Windows 8, Windows 10), DOS/Windows 3.x, Linux (2.4, 2.6, 3.x and 4.x), Solaris and OpenSolaris, OS/2, and OpenBSD.

VirtualBox is being actively developed with frequent releases and has an ever growing list of features, supported guest operating systems and platforms it runs on. VirtualBox is a community effort backed by a dedicated company: everyone is encouraged to contribute while Oracle ensures the product always meets professional quality criteria.

News Flash

■ **New** **October 17th, 2023**
VirtualBox 7.0.12 released!

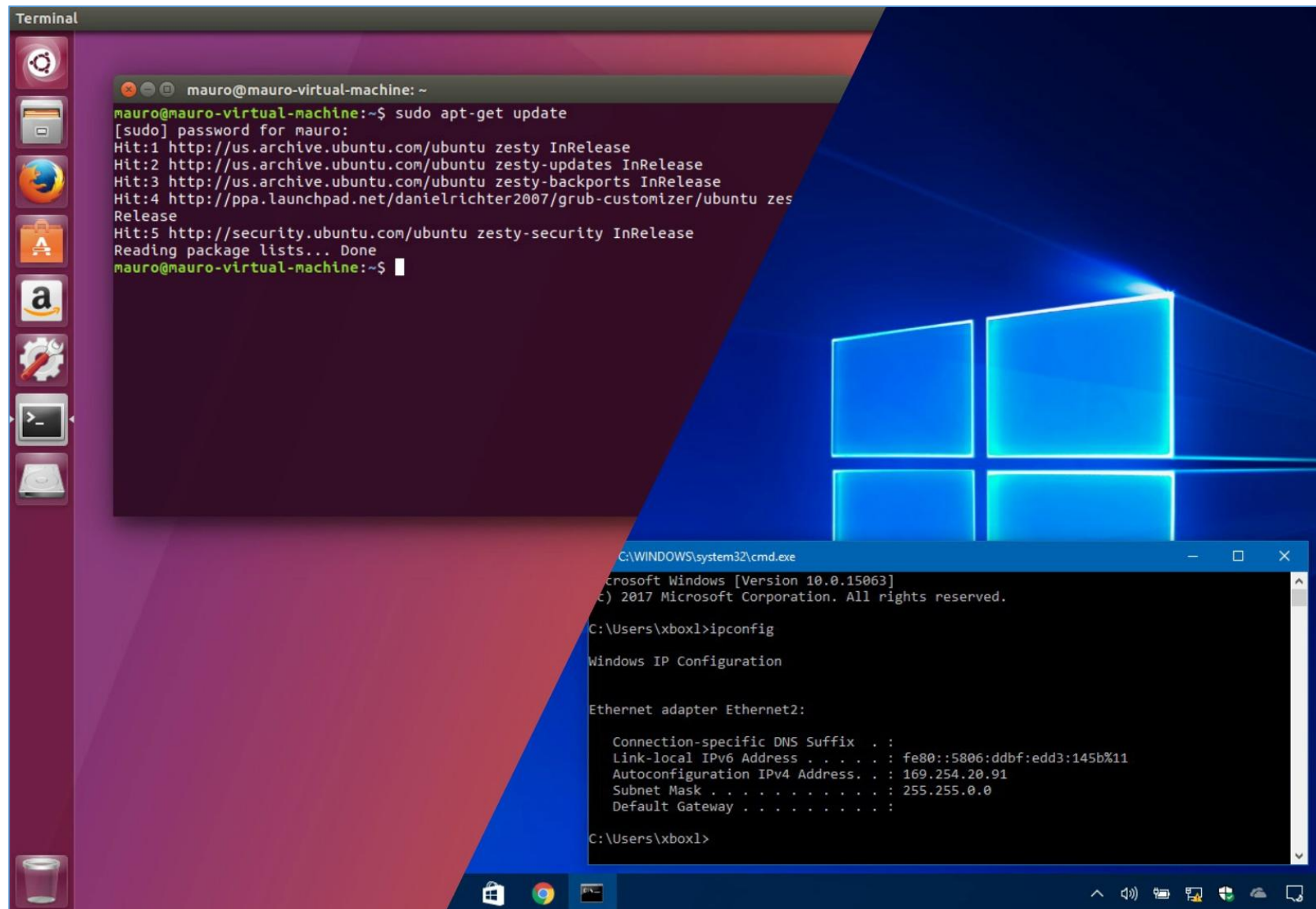
Oracle today released a 7.0 maintenance release which improves stability and fixes regressions. See the [Changelog](#) for details.

■ **New** **October 17th, 2023**
VirtualBox 6.1.48 released!

Oracle today released a 6.1 maintenance release which improves stability and fixes regressions. See the [Changelog](#) for details.


■ **New** **July 18th, 2023**

Dual Boot



How to Install ROS?

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

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noetic/ Installation
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ROS Noetic installation instructions


These instructions will install **ROS Noetic Ninjemys**, which is available for Ubuntu Focal (20.04), Debian Buster (10), and [other platform options](#).

To install our previous long-term support release, **ROS Melodic Morenia**, please see the [ROS Melodic installation instructions](#).

Select Your Platform

Supported:

 [Ubuntu](#) Focal amd64 armhf arm64

 [Debian](#) Buster amd64 arm64


[Source installation](#)

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](#)

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Do

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
```


An abstract graphic on the left side of the slide, consisting of a series of overlapping triangles in various shades of blue, ranging from light sky blue to dark navy blue, creating a low-poly, crystalline effect.

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-requisites to run any ROS-based system. Of debugging importance **rosout** logging node (equivalent of stdout/stderr) which is included in roscore.

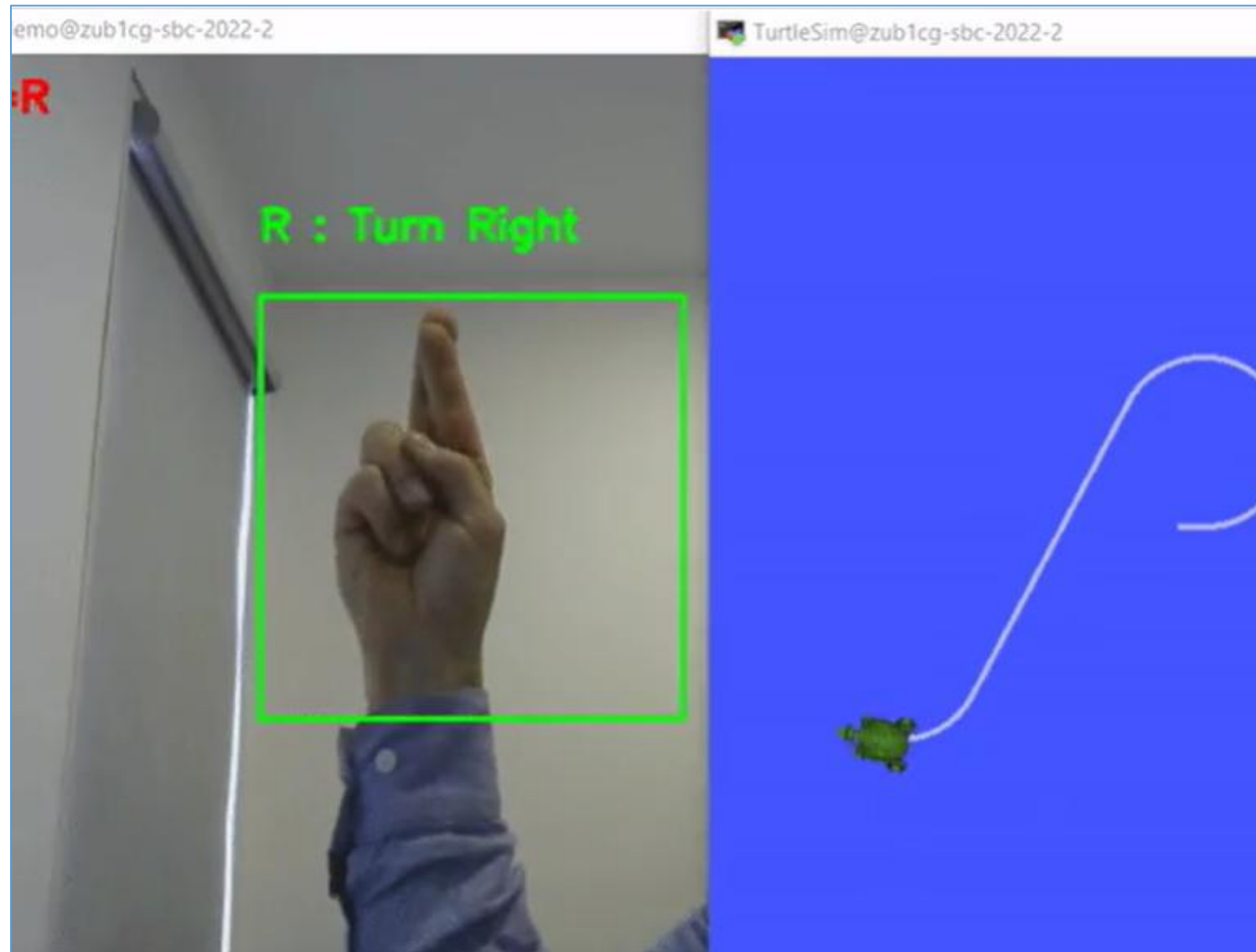
[3]

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



Projects with ROS

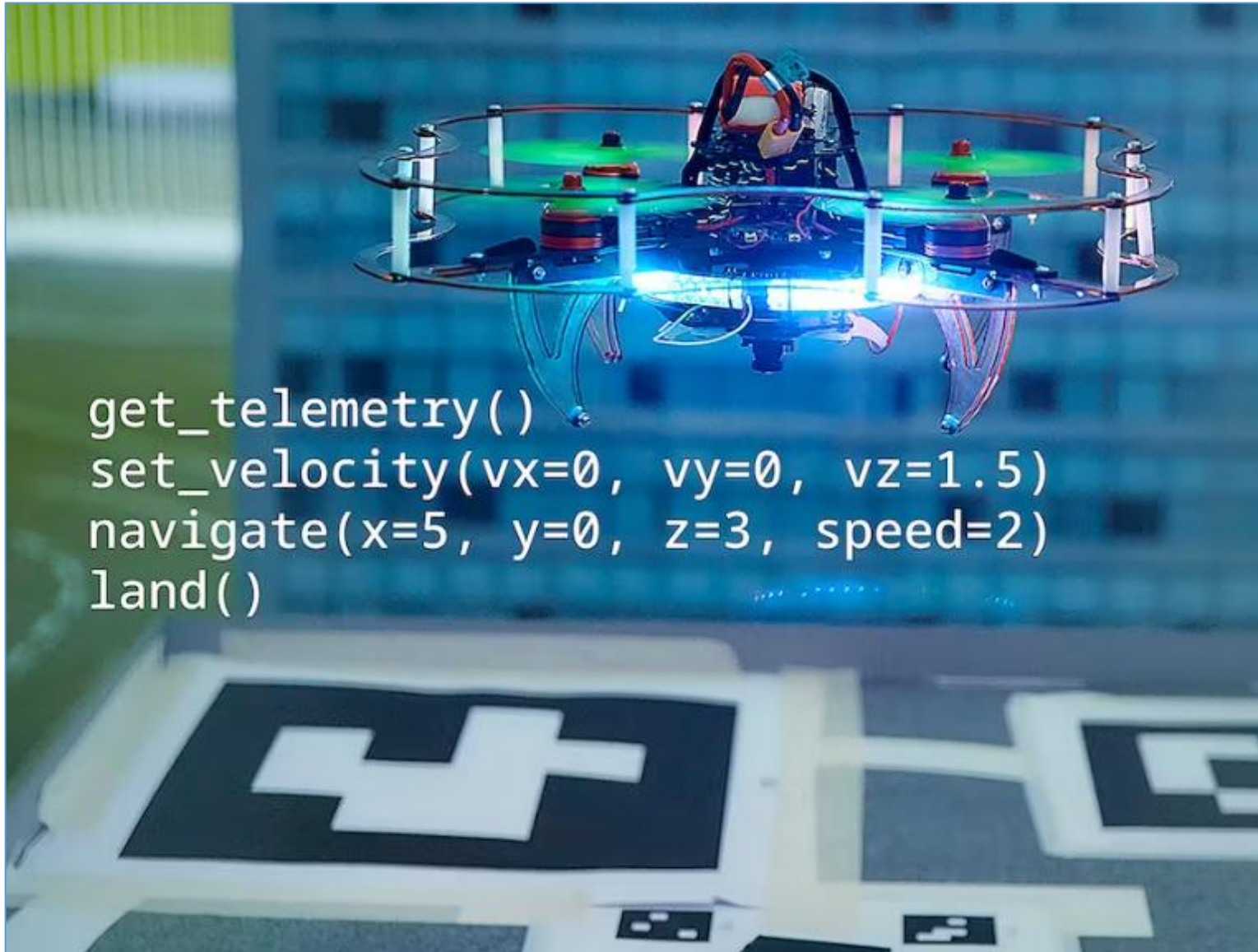
Controlling a Robot with Hand Signs



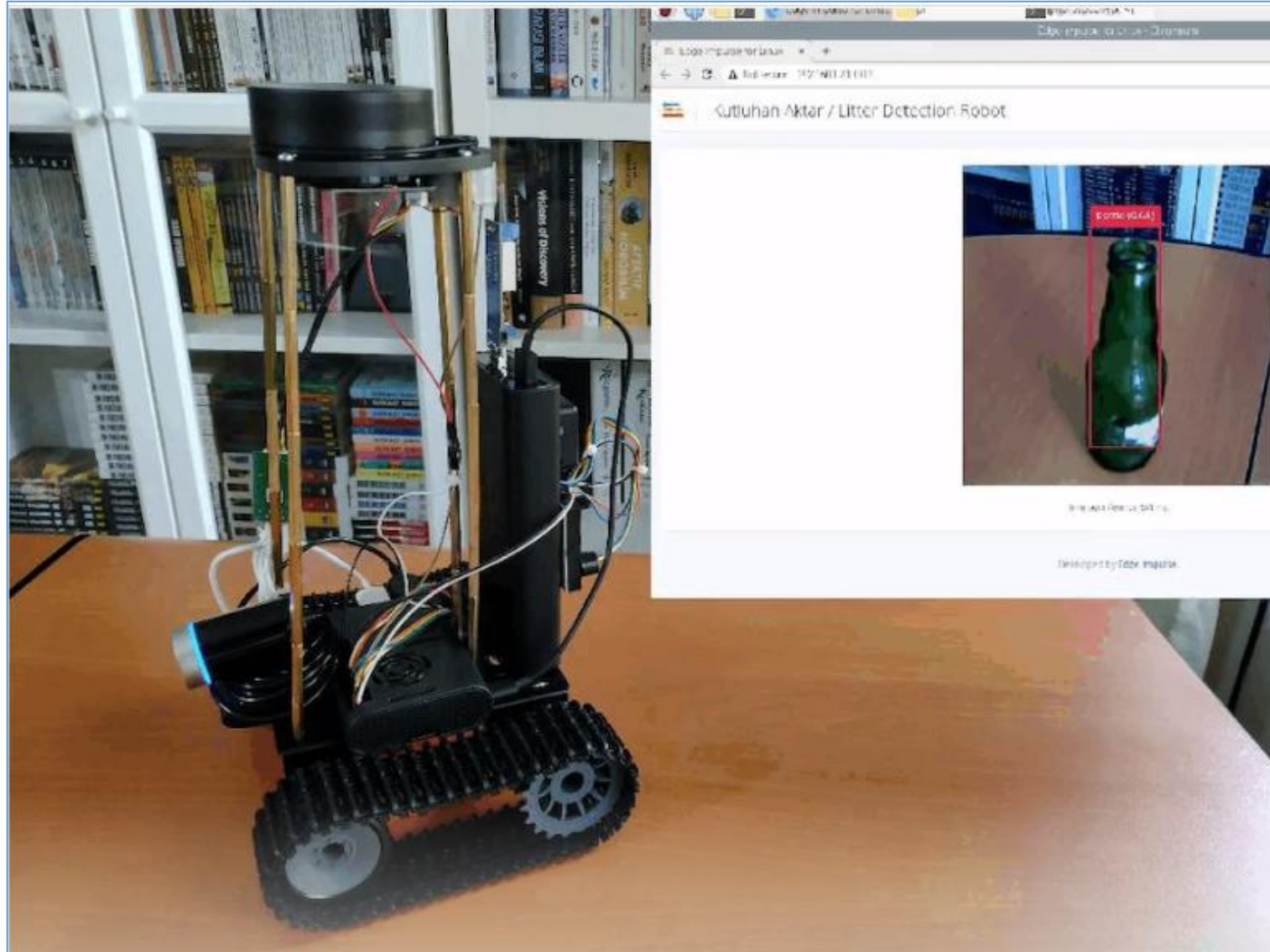
Human-Following Robot



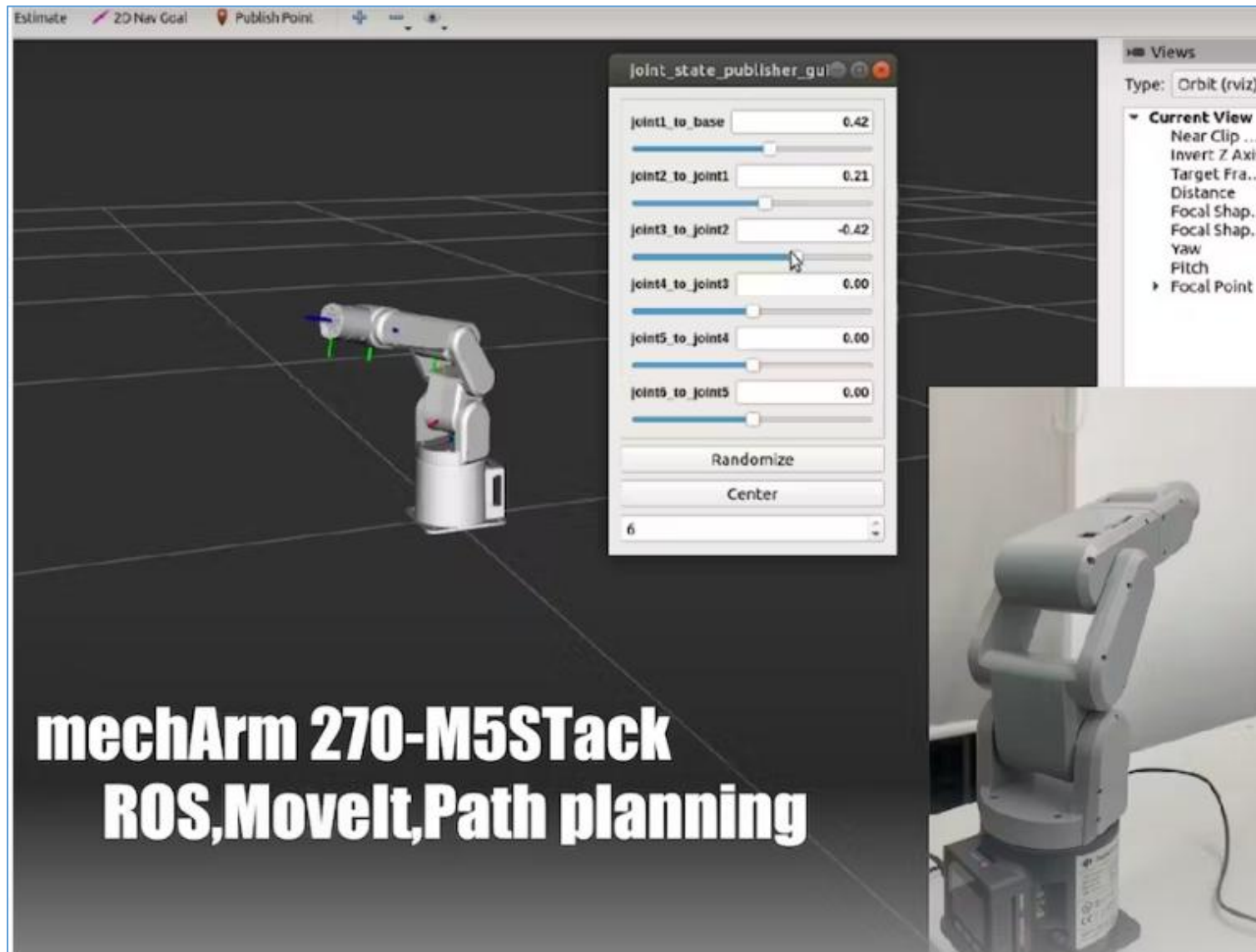
Programming drones with Raspberry Pi on board easily



Autonomous (LIDAR) Litter Detection Robot



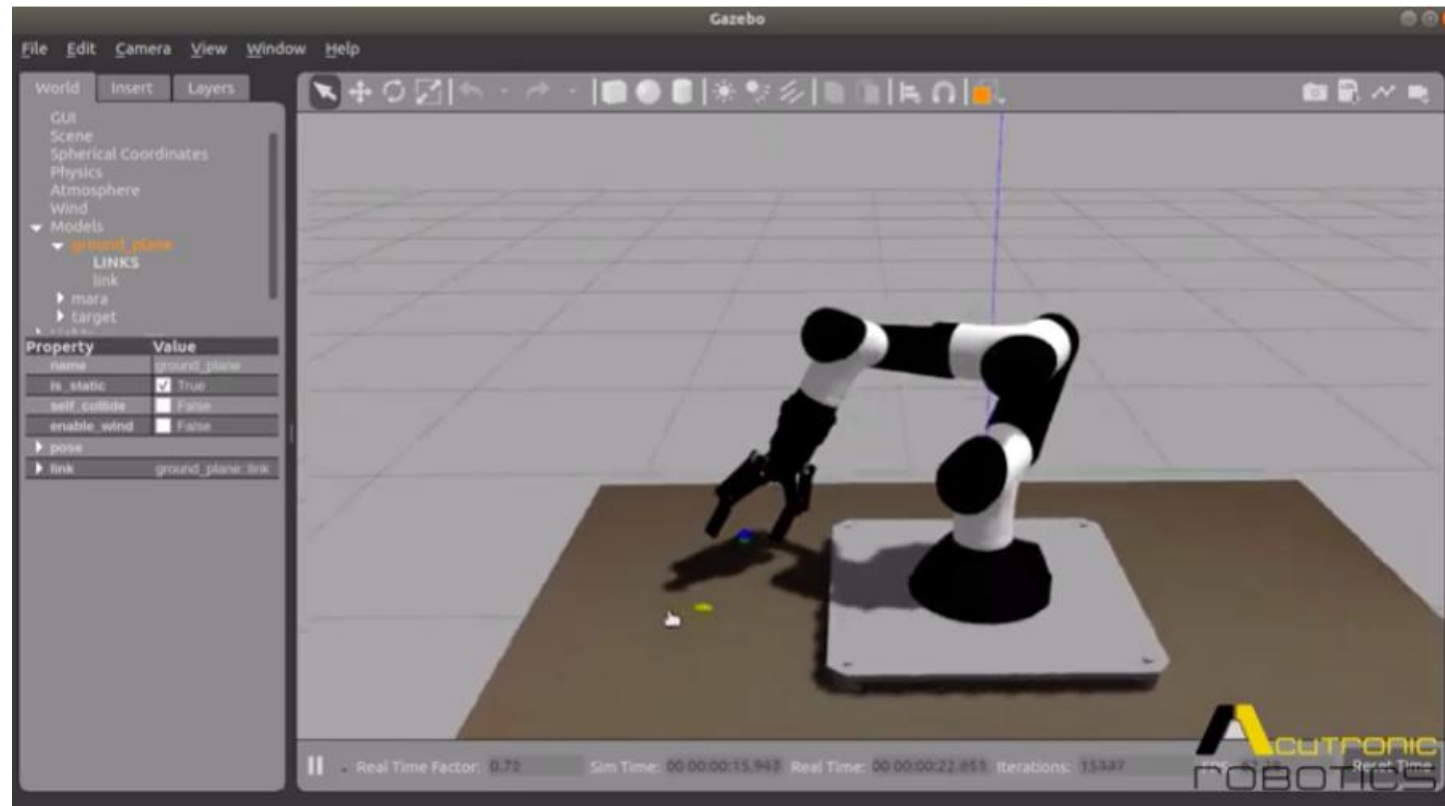
Six-Axis Robotic Arm





What is Gazebo in ROS?

Gazebo



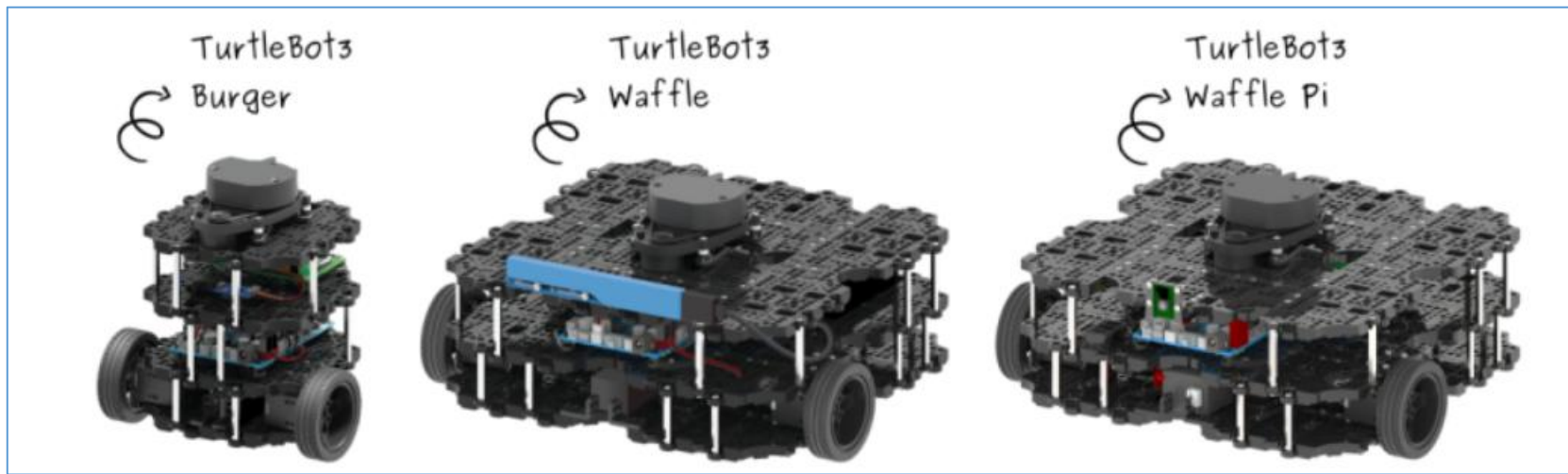
Gazebo is an open-source 3D robotics simulator. It integrated the ODE physics engine, OpenGL rendering, and support code for sensor simulation and actuator control. Gazebo can use multiple high-performance physics engines, such as ODE, Bullet, etc.

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>


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Robots/ TurtleBot

TurtleBot

Original TurtleBot
(Discontinued)






TurtleBot 2 Family



TurtleBot 2TurtleBot 2iTurtleBot 2e

TurtleBot 3 Family



BurgerWaffleWaffle Pi

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User

Installing TurtleBot

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

ROBOTIS e-Manual

DYNAMIXEL
DYNAMIXEL
SYSTEM

EDUCATIONAL
KITS

SOFTWARE

PARTS

TurtleBot3

1. Overview

2. Features

3. Quick Start Guide

3. 1. PC Setup

3. 2. SBC Setup

3. 3. OpenCR Setup

3. 4. Hardware Assembly

3. 5. Bringup

3. 6. Basic Operation

4. SLAM

Kinetic

Melodic

Noetic

Dashing

Foxy

Humble

Windows

O : Available
Δ : Need to check
X : Unavailable

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

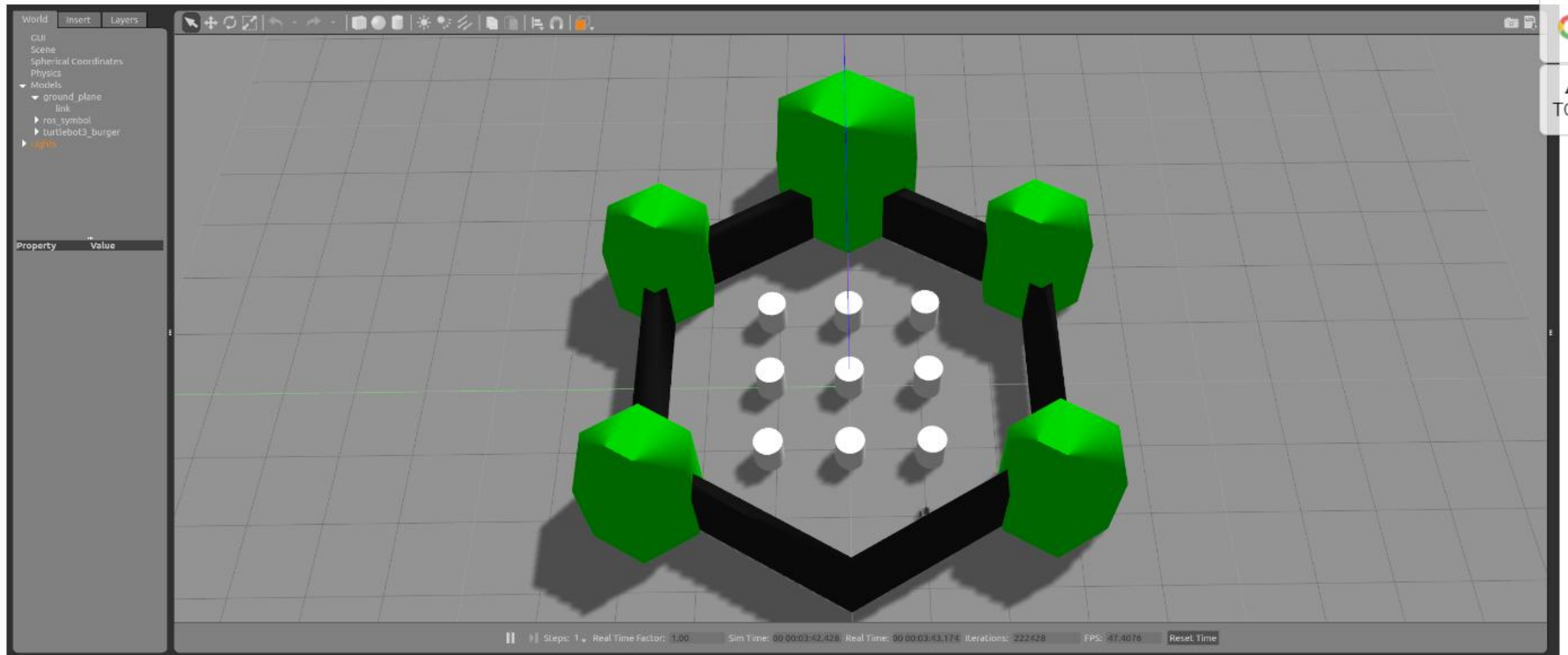
1. Empty World



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

Turtlebot3 world

2. TurtleBot3 World



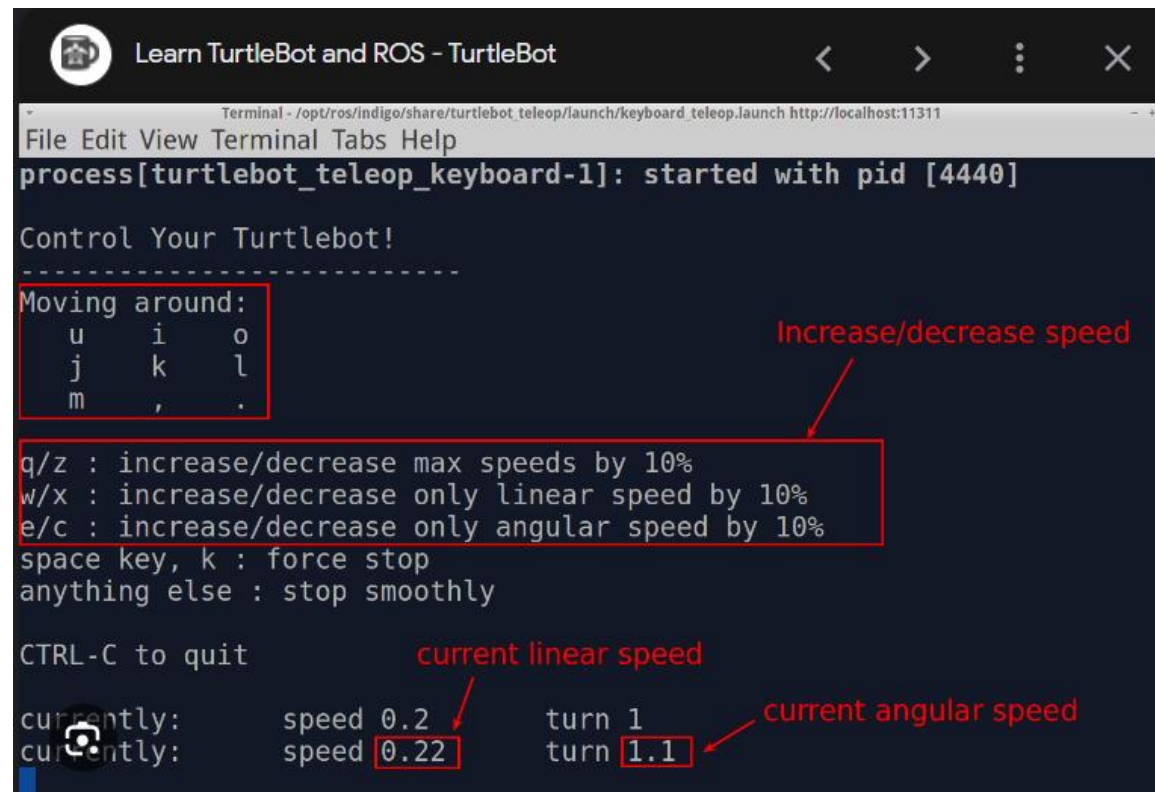
```
$ export TURTLEBOT3_MODEL=waffle
$ roslaunch turtlebot3_gazebo turtlebot3_world.launch
```

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
```



```
Learn TurtleBot and ROS - TurtleBot
Terminal - /opt/ros/indigo/share/turtlebot3_teleop/launch/keyboard_teleop.launch http://localhost:11311
File Edit View Terminal Tabs Help
process[turtlebot3_teleop_keyboard-1]: started with pid [4440]

Control Your Turtlebot!
-----
Moving around:
  u      i      o
  j      k      l
  m      ,      .

q/z : increase/decrease max speeds by 10%
w/x : increase/decrease only linear speed by 10%
e/c : increase/decrease only angular speed by 10%
space key, k : force stop
anything else : stop smoothly

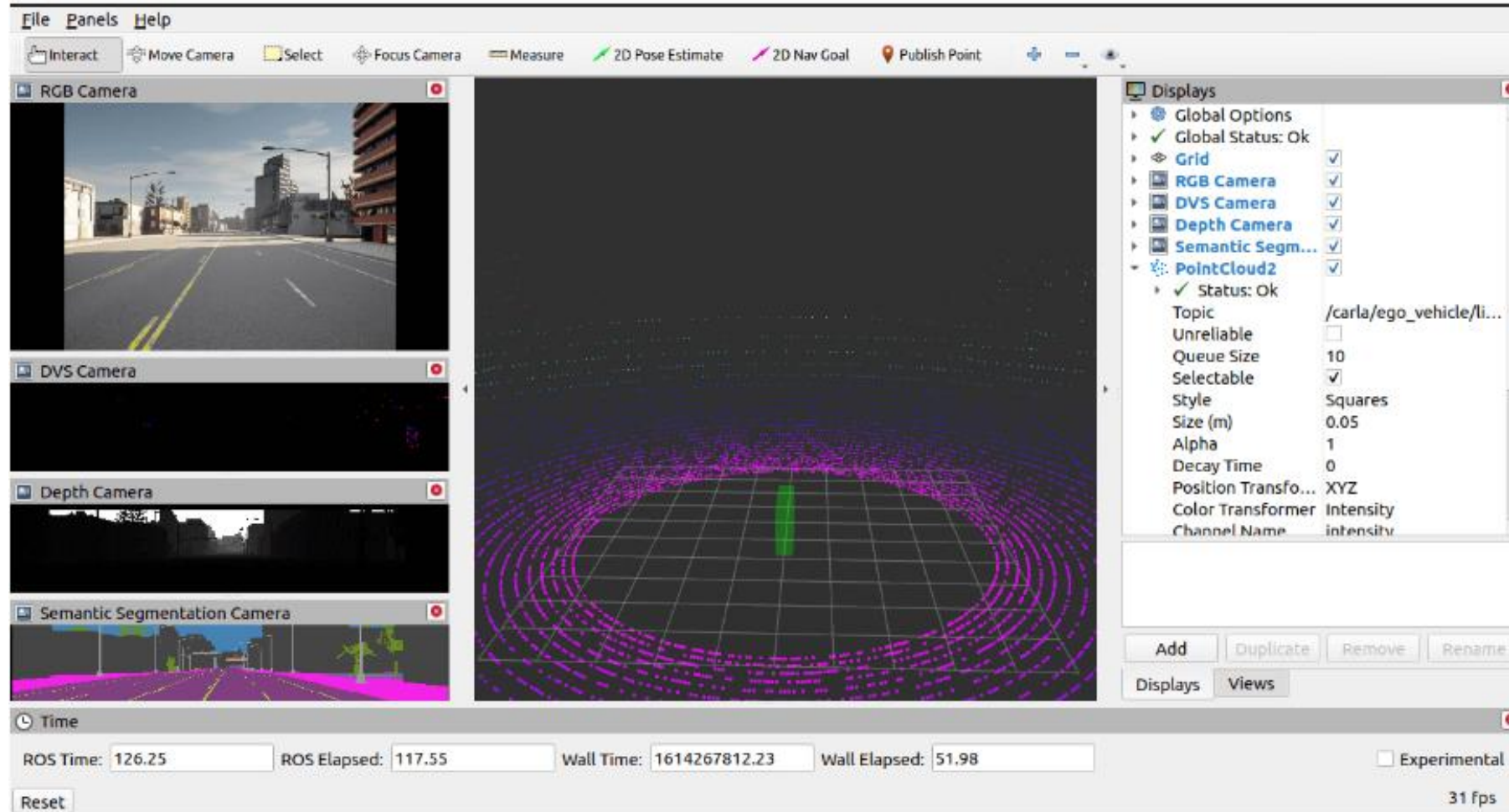
CTRL-C to quit

currently: speed 0.2 turn 1
currently: speed 0.22 turn 1.1
```



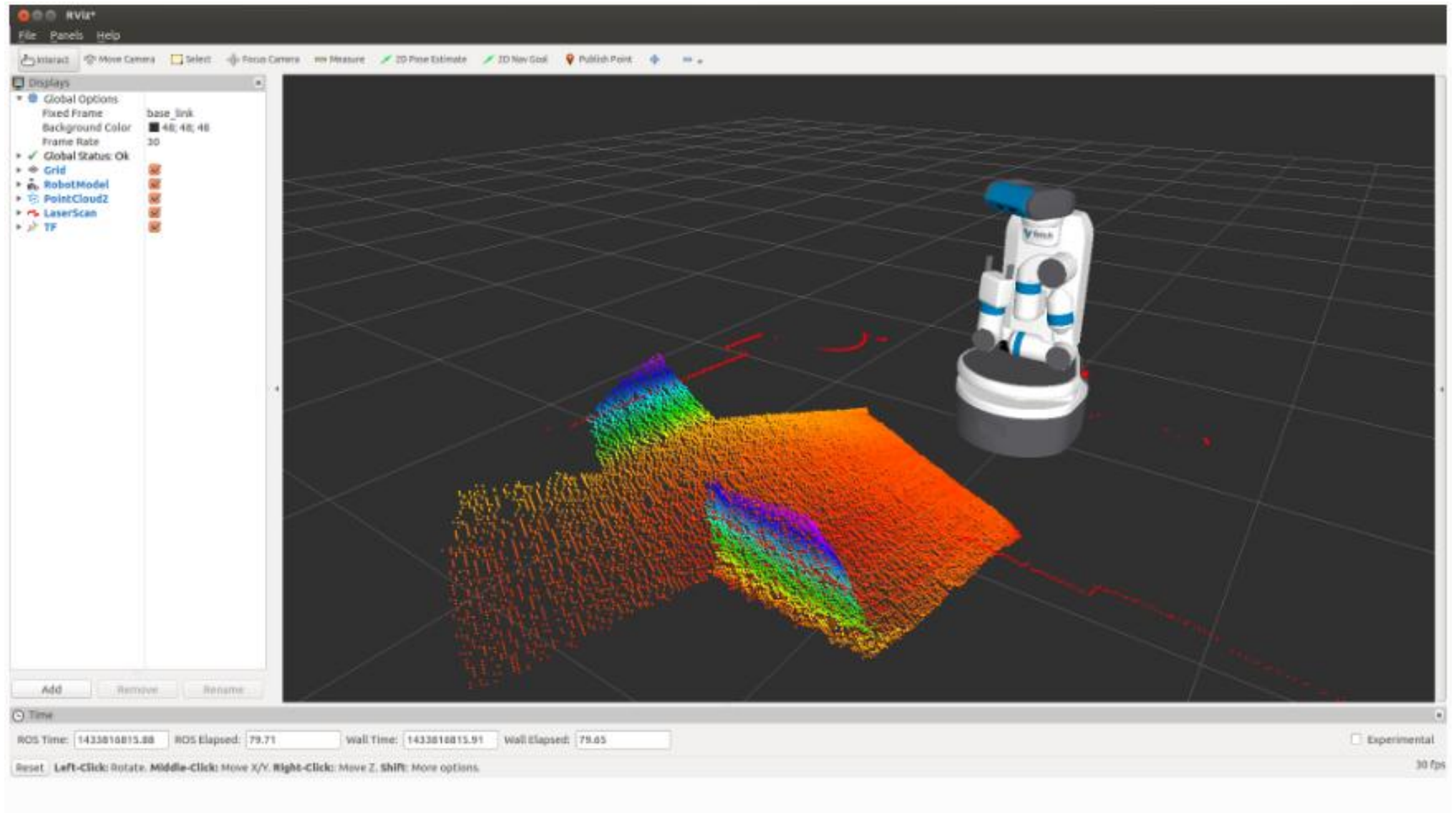
What is RVIZ?

RVIZ

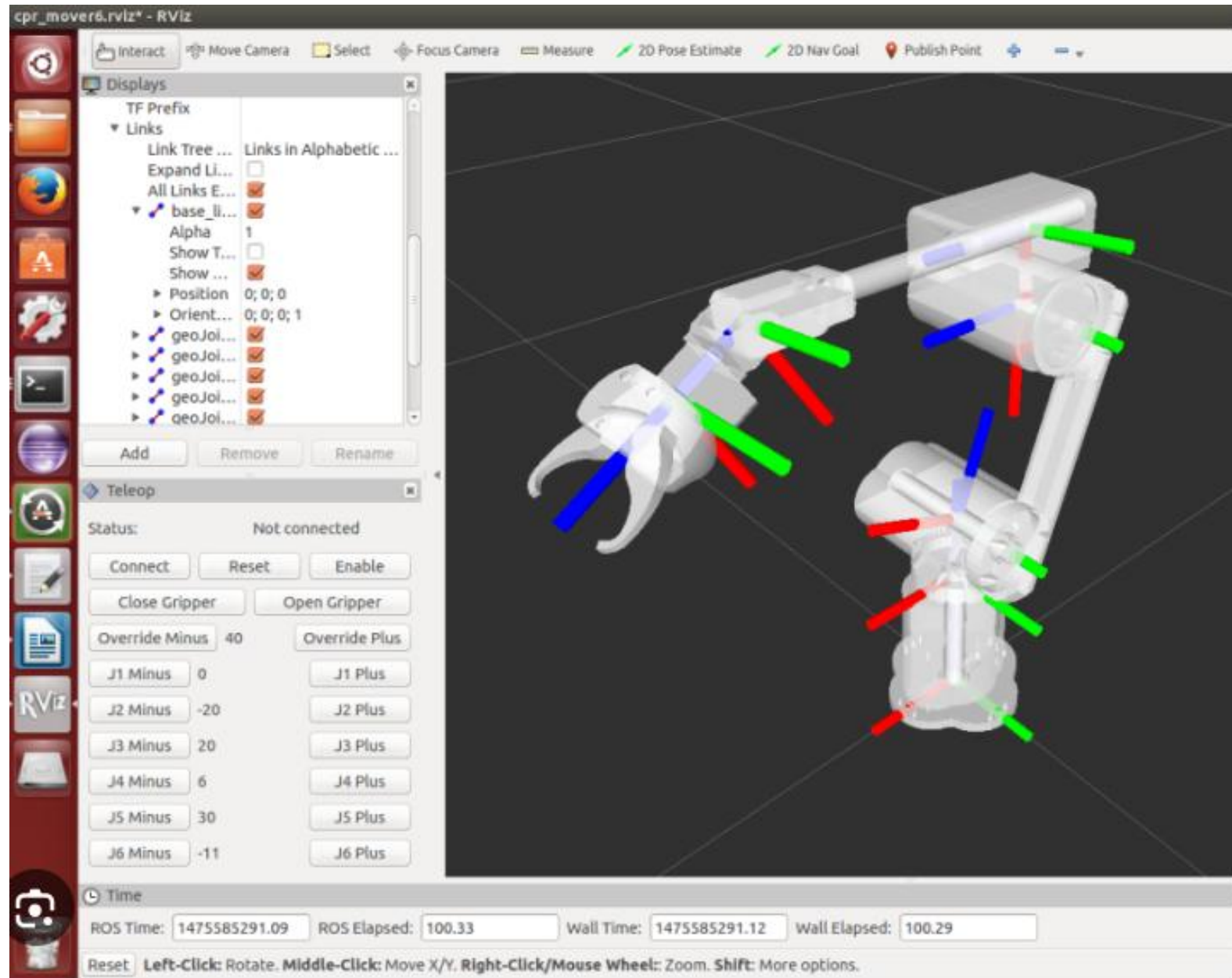


Short for ROS Visualization. It's a 3-dimensional visualization tool for ROS. · It helps to visualize what the robot seeing and doing.

RVIZ



RVIZ



Thanks

THANK YOU FOR LISTENING

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