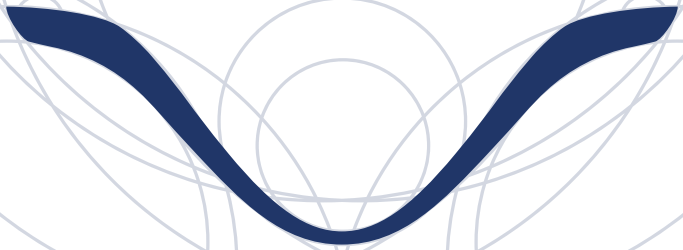

NIRYO

HUMAN - MOTION - ROBOT

TCP PYTHON API

DOCUMENTATION

V1

INTRODUCTION

There are many ways to control the Niryo One. In this document, we will focus on the TCP Python interface, which allow you to send commands to the robot through the network.

Advantages

- Compared to Blockly:
  - More functions available,
  - Improved modularity of the code,
  - Better readability: Blocks are very convenient for simple sequences but become hard to read when creating complex sequences,
- Compared to Python API:
  - No need to connect via SSH,
  - No need to use the terminal,
- Compared to any other method:
  - Possibility of developing and testing your script on your favorite IDE,
  - Possibility of creating your own image processing scripts.

Prerequisites

Niryo One Version ≥ 2.3 (this version is installed on every Niryo One bought from the 30/06/2020)

SETUP

Python interface installation

Your workspace must have a Python interpreter with Python 3 (3,6 or greater) or Python 2 (2,7 or greater).

Official Python website: https://www.python.org/

Installing Python tutorial: https://realpython.com/installing-python/

Python packages installation

This installation will require the use of **pip**, the package manager included in Python.

To use the **TCP API**, you will need to install **numpy**:

"pip install numpy"

Optional: to customize your **image processing pipelines**, you will also need **opencv-python**:

"pip install opencv-python"

Notes:

- Pip can require administrator authorizations to install packages. In this case, add “sudo” before your command lines on Linux.
- If pip is not automatically installed with Python, please visit the following website: https://pip.pypa.io/en/stable/installing/

Niryo One packages

To use our TCP Python API, and so, command the robot with your Python scripts, you need to get the source packages and place them in a directory of your computer.

Direct and easy method

- Get the archive directly on our website: https://niryo.com/tcp-python-api-latestversion/
- Extract the files.

GitHub method

- Download the ROS stack: https://github.com/NiryoRobotics/niryo_one_ros
- Create an empty directory on your computer and copy in its root the following folders:
    - **niryo_one_camera**, in niryo_one_camera/src/ (please note that this folder is not at the root but under src). This folder contains the Vision related functions.
    - **niryo_one_tcp_client**, in niryo_one_tcp_server/clients/python/, which contains the necessary files for the communication through the TCP API.
    - **examples**, in niryo_one_tcp_server/clients/python/, which contains several examples of TCP API uses.
    - **README.md**, in niryo_one_tcp_server/clients/python/, which is the documentation of the TCP API.

Installation test

You should know be able to use the Python TCP API. To verify your installation:

- Go to the directory that contains the downloaded folders (niryo_one_camera, niryo_one_tcp_client, example, etc.),
- Open the file examples/simples_scripts/first_use_example.py
- Modify the line that contains *niryo_one_client.connect(“...”)* by replacing the suspension points by the IP address of your Niryo One,
- Save the file,
- Execute the following command line:
  PYTHONPATH=. python examples/simple_scripts/first_use_example.py

This procedure will launch a series of actions to confirm if you Python TCP API is correctly configured.

CREATE YOUR FIRST SCRIPTS

Documentation

You can use the README.md file that you previously downloaded, which contains every detail needed to understand every function available:

https://github.com/NiryoRobotics/niryo_one_ros/tree/master/niryo_one_tcp_server/clients/python

Examples

In the **examples** folder, you can find several example scripts that control the Niryo One. These scripts are commented to help you understanding every step.

First use example

Uses many functions of the TCP API.

Simple pick and place

3 methods to make a pick and place with the Niryo One.

Simple vision pick and place

2 methods to make a pick and place with the Vision Set. This script requires an already set workspace, a Vision Set and every asset required for Vision related functions.

Simple pick and place with conveyor

This script shows how to control the Conveyor Belt using the IR sensor and create a pick and place process.

Video stream

This script uses the TCP API to get and show the video stream of the Niryo One. The process is composed of:

- The correction of the distortion created by the lens of the camera,
- The detection of the landmarks,
- The extraction of the workspace.

This script requires an already set workspace, a Vision Set and every asset required for Vision related functions.

Workspace creation

This script gets the positions of 4 landmarks to create a workspace.

GOING FURTHER

Creating complex image processing pipelines

Direct control functions

The variable “niryo_one_client” allows to control the Niryo One by simple command lines:

- **niryo_one_client**.vision_pick(workspace, height_offset, shape, color)

  The Niryo One will catch a specific object according to function’s parameters.

- **niryo_one_client**.move_to_object(workspace, height_offset, shape, color)

  The Niryo One will place its tool over a specific object according to function’s parameters.

- **niryo_one_client**.detect_object(workspace, shape, color)

  This function returns the position of an object which corresponds to function’s parameters.

- **niryo_one_client**.get_image_compressed()

  Return the last stream image.

- **niryo_one_client**.get_target_from_rel(workspace, height_offset, x_rel, y_rel, yaw_rel)

  Convert a relative workspace’s position to a end effector position

- **niryo_one_client**.get_target_from_cam(workspace, height_offset, shape, color)

  Get the end effector position to reach to catch a specific object according to function’s parameters.

These functions are detailed in the README file.

Pure image processing functions

Niryo works on advanced functions to make image processing easy by wrapping OpenCV. The available functions allow the users to do their own image processing pipeline easily:

- Apply thresholding
- Apply morphological transformations
- Extract workspace from image using Niryo’s markers
- Display Image

- Undistort raw image
- Etc.

These functions are available and commented in the file **image_functions.py** in **niryo_one_camera/src/niryo_one_camera**.

Implement an industrial demonstrator

In the **examples** folder, the **vision_demonstrators** contains 4 functional scripts that can be used for packaging products (with the Vision Set, the squared objects are designed to contain the circular ones as boxes would contain products).

These scripts can help you with such processes and are detailed in the README.md file.