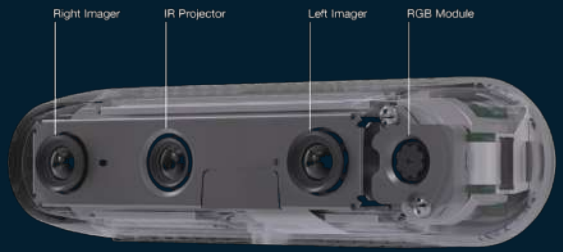
COGNITIVE ROBOTICS PROJECT

OBJECT GRASPING

Project requirements



Intel® RealSense™ Depth Camera D435

NVIDIA® Jetson Nano™

Niryo One

ROS

Robot Operating System

Constraints

Camera

The only camera used is fixed on the end effector of the arm, making the environment more compact.

Boxes

Once the program has started, the boxes cannot be moved anymore.

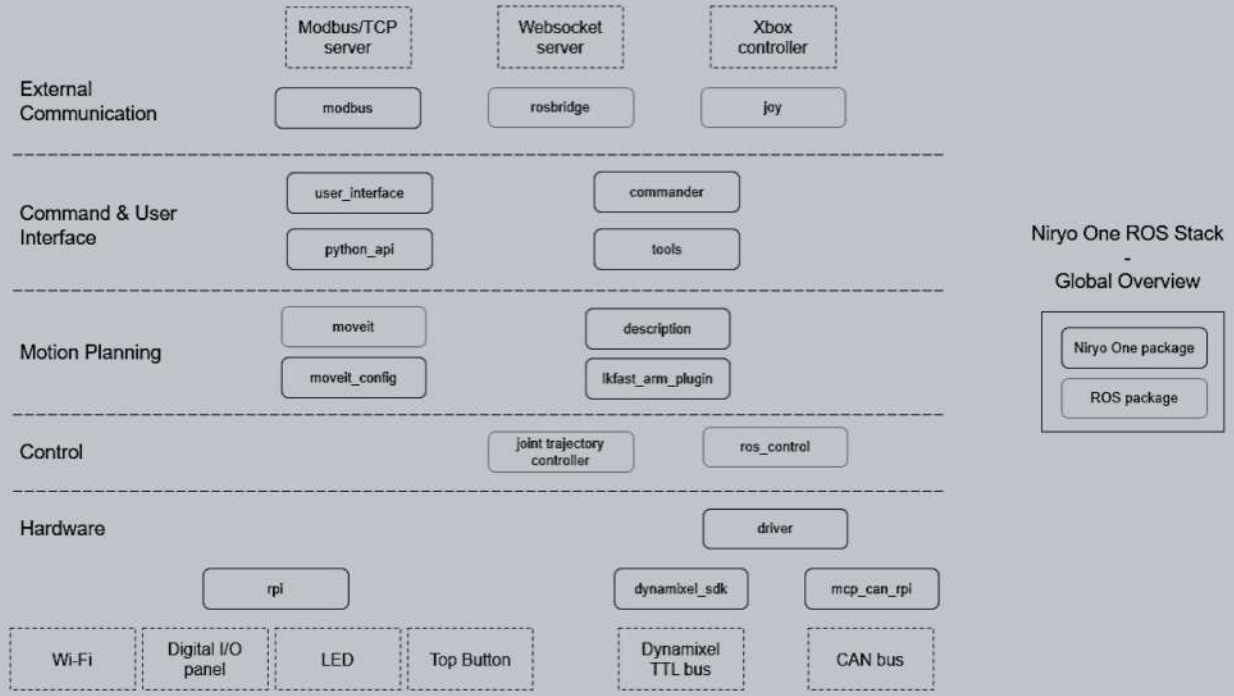
Balls

You can add, remove and move the balls between each operating cycle.

Software design

TRAJECTORY LISTENER NODE

Moving Niryo One.



NIRYO ONE ROS STACK overview

ROBOT MANAGER NODE

Choose how to move.

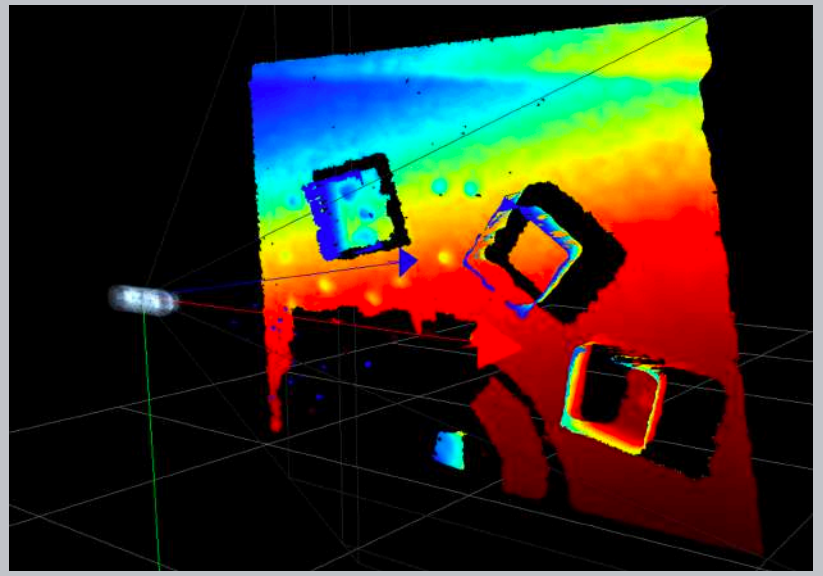
```
[INFO] [1562578605.349447]: ============== ENGINE RECEIVED =============
[INFO] [1562578605.356714]: ============ ENGINE CMD RECEIVED ===========
[INFO] [1562578605.364628]: ============= PUBLISH STARTED ==============
[INFO] [1562578605.372807]:  > Wait for execution...
[INFO] [1562578605.404931]: ============= VERBOSE RECEIVED =============
[INFO] [1562578606.383161]: ============ END COMMAND PUBLISH ===========

Accepted answers: 'Y, N, y, n.' Insert another command?[Y/N] > y
[0]  AUTOMOVE FIXED          [1]  Auto calibration        [2]  Manual calibration
[3]  Change learning mode    [4]  MOVE POSE               [5]  Move joints
[6]  Shift pose              [7]  Set arm velocity        [8]  Get joints
[9]  Get arm pose            [10] Open gripper            [11] Close gripper
[12] STOP
Insert command:
```

ROBOT MANAGER command list

VISION NODE

Look around.



Intel® RealSense™

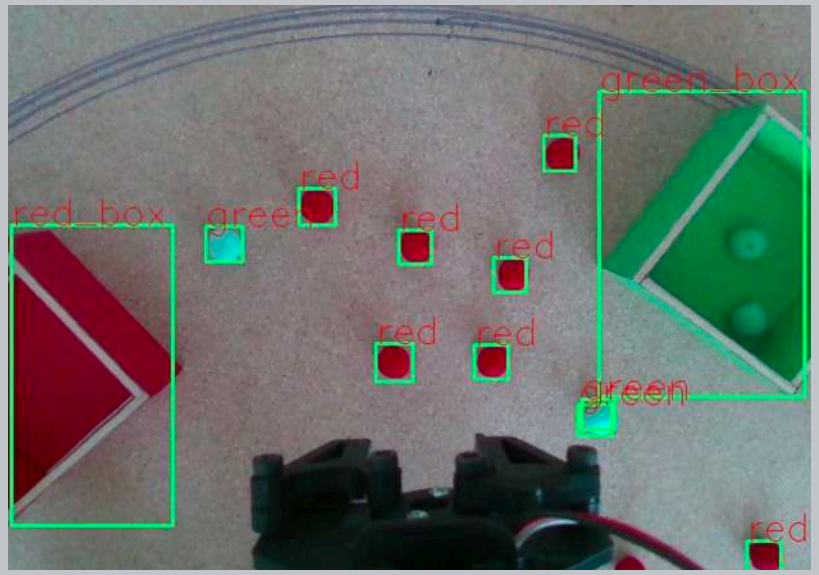
Stereo Depth Technology

In a similar way to how human vision works, stereo depth is used to provide the distance of a precise point in the visual field.

RGB VIDEO and POINT CLOUD acquisition

VISION NODE

Look around.



MobileNet SSD v2 (COCO)

Pre-trained to detect the location of 90 types objects from COCO dataset.

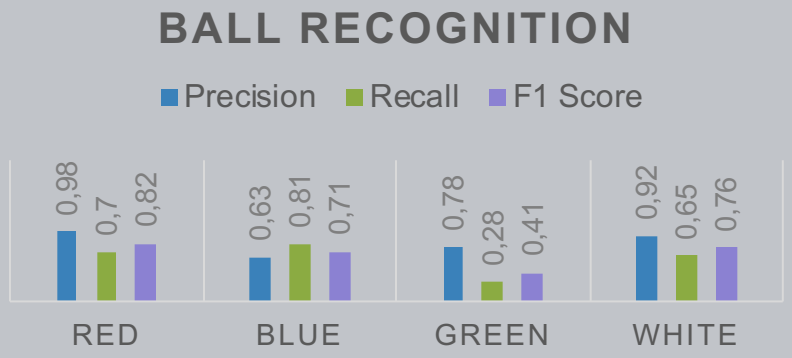
Input size: 300x300

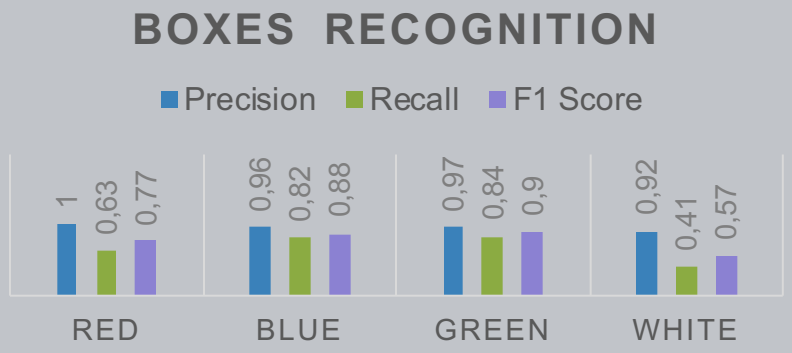
Fine tuning for 8-classes target.

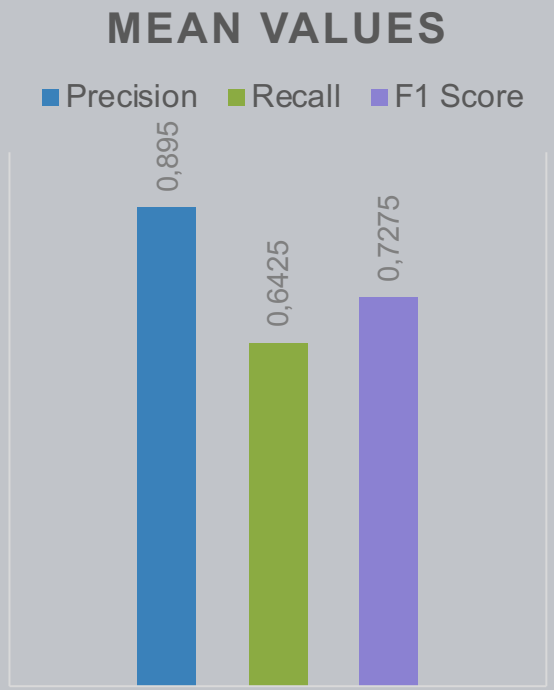
DEEP NEURAL NETWORK recognition

VISION NODE

Look around.







VISION NODE

Look around.

PREDICTED

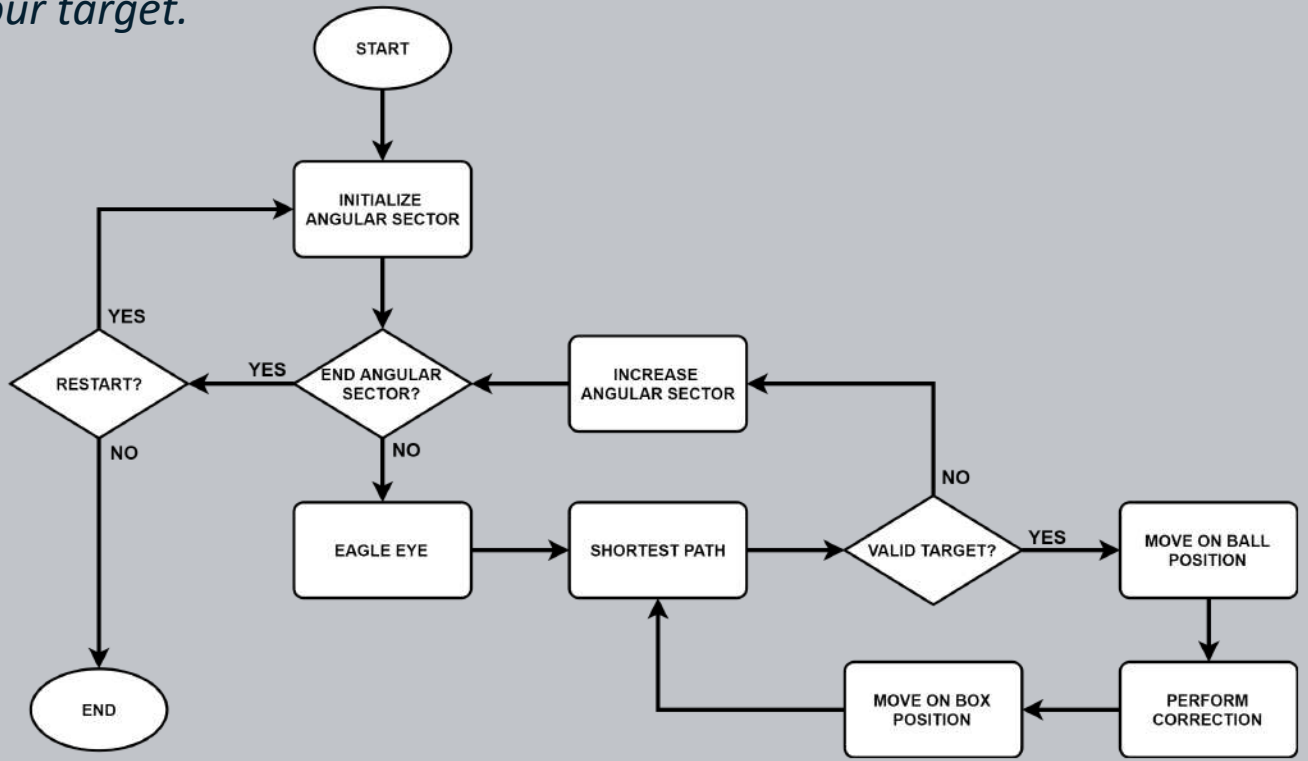
EXPECTED

	Red Ball	Blue Ball	Green Ball	White Ball	Red Box	Blue Box	Green Box	White Box	Not Detected
Red Ball	114	4	0	0	0	0	0	0	44
Blue Ball	0	172	0	0	0	0	0	0	40
Green Ball	0	68	31	0	0	0	0	0	12
White Ball	1	9	0	114	0	0	0	0	51
Red Box	0	0	0	0	37	0	0	0	22
Blue Box	0	0	0	0	0	45	0	0	10
Green Box	0	0	0	0	0	2	65	0	10
White Box	0	0	0	0	0	0	0	23	33
Extra Detected	1	18	9	10	0	0	2	2	0

DEEP NEURAL NETWORK confusion matrix

ENGINE NODE

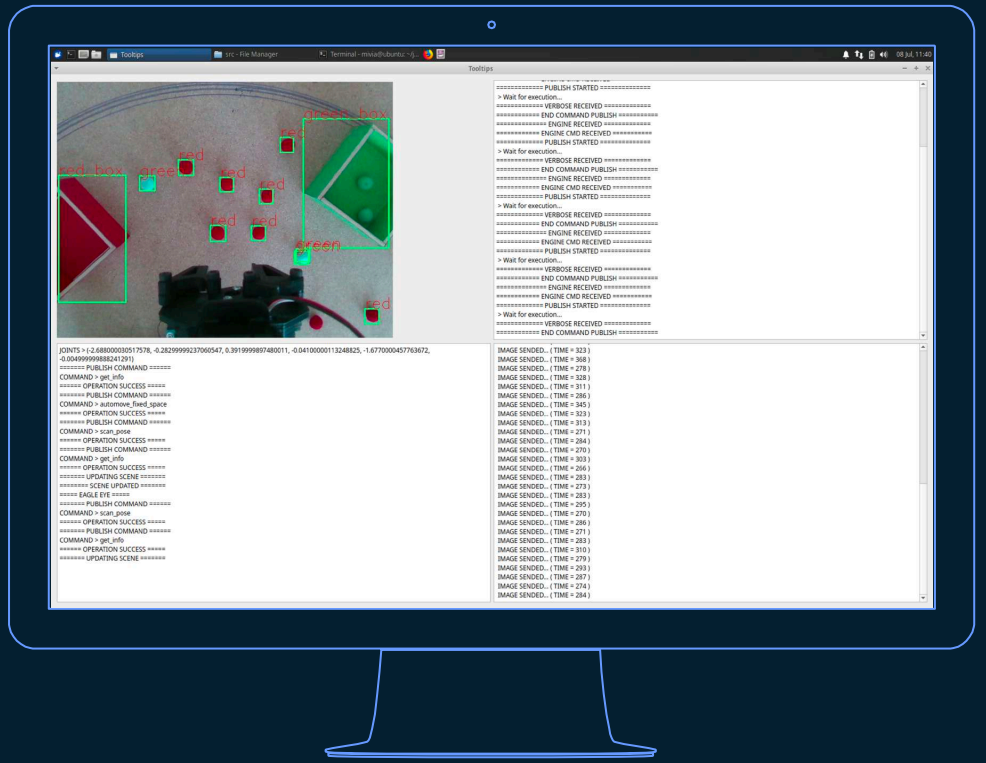
Achieve your target.



ENGINE FLOWCHART

VISUAL VERBOSE NODE

Let me show you
what I'm doing.



PLANNED IMPROVEMENTS

- Managing an even more dynamic workspace
- Improve the recognition of targets
- Speed up the use of **Niryo One Python API**

… and surely contemplate a new and nicer hardware structure.

THANKS!

OBJECT GRASPING *for Cognitive Robotics*

Allegretti Giovanni

Di Prisco Giovanni

Scaldaferri Antonello

Schettini Marco