

# Project log - Robotica

Augello Andrea      Castiglione Francesco Paolo  
La Martina Marco

December 21, 2020

## Contents

<b>1 Setup</b>	<b>1</b>
<b>2 Name</b>	<b>2</b>
<b>3 Libraries and environment</b>	<b>2</b>
<b>4 Task</b>	<b>2</b>
<b>5 Tiago Iron</b>	<b>2</b>
<b>6 Movement primitives</b>	<b>2</b>
<b>7 Positioning</b>	<b>2</b>
<b>8 Projection Matrix</b>	<b>3</b>
<b>9 Dependencies</b>	<b>3</b>
<b>10 Object recognition</b>	<b>3</b>
<b>11 TIAGo Wheels</b>	<b>3</b>
<b>12 Clustering</b>	<b>3</b>
<b>13 ROS</b>	<b>3</b>
<b>14 Bugs found in the Webots ROS Controller</b>	<b>3</b>

## 1 Setup

OS	Ubuntu 18.04 Ubuntu 20.04
ROS version	melodic noetic
Webots	R2020b revision 1
Target hardware	Raspberry Pi 4B Raspberry Pi 3B+

## 2 Name

Our team has chosen the name **Change**, which resembles **Chang’e 4** [2], the spacecraft mission part of the second phase of the Chinese Lunar Exploration Program, which achieved humanity’s first soft landing on the far side of the moon.

## 3 Libraries and environment

We have used the **webots\_ros** [3] package in order to gain deeper understanding of how to interface ROS nodes with the standard ROS controller for Webots. We have also studied the ROS documentation [4] in order to install and configure the ROS environment and also to understand fundamental ROS concepts related to nodes and topics. Moreover, we set-up the ROS interface in Webots following the cyberbotics documentation [4].

## 4 Task

Our robot will be deployed in a room (such as the one showed in our demo) and its aim is to identify humans and estimate their relative positions. If the distance between said humans is less than a specified value, the robot will go towards them and invite them to respect social distancing (with both visual and audio output).

## 5 Tiago Iron

The robot selected for the given task is the **TIAGo Iron**.

**PAL Robotics TIAGo Iron**[1] is a two-wheeled human-like robot with a torso and a head but no articulated arm. The model is a modular mobile platform that allows human-robot interaction. **We use a IMU with 6 degrees of freedom.** IMU:

1. gyro;
2. accelerometer;

We got rid of the compass in the IMU.

## 6 Movement primitives

[8]

## 7 Positioning

Implementing Positioning Algorithms Using Accelerometers.

## 8 Projection Matrix

[7]

## 9 Dependencies

- OpenCV
- Imutils

## 10 Object recognition

We evaluated performance between YOLO V3, TinyYOLO, HoG , HoG + SVG , HoG + SVG + NMS. Yolo wins because it is 443% more efficient. Width and not height. Yolo yields much more tight bounding boxes.

## 11 TIAGo Wheels

We asked the developers: 200mm. We discovered that the webots model is not the same size as the TIAGo datasheet.

## 12 Clustering

We decided to lower the dimensionality of our data. We used cilindric coordinates and the feature vector is 2 dimensional. We used the Density-Based Scan with a threshold. The entities not belonging to the cluster are discarded.

## 13 ROS

## 14 Bugs found in the Webots ROS Controller

Logical values did not allow callbacks.

## References

- [1] <https://cyberbotics.com/doc/guide/tiago-iron>.  
Webots TIAGo Iron documentation.
- [2] <https://www.theguardian.com/science/2019/jan/03/china-probe-change-4-land-far-side-moon-basin-crater>.  
The Guardian, 3 January 2019.
- [3] [https://github.com/cyberbotics/webots\\_ros](https://github.com/cyberbotics/webots_ros).  
Github page for the `webots_ros` package from *cyberbotics*.
- [4] <https://wiki.ros.org/ROS/Tutorials>.  
ROS documentation from ROS.org.
- [5] <https://www.cyberbotics.com/doc/guide/tutorial-8-using-ros>.  
Cyberbotics documentation.
- [6] [https://pal-robotics.com/wp-content/uploads/2019/07/Datasheet\\_TIAGo\\_Complete.pdf](https://pal-robotics.com/wp-content/uploads/2019/07/Datasheet_TIAGo_Complete.pdf).  
Tiago IRON datasheet.
- [7] [https://www.songho.ca/opengl/gl\\_projectionmatrix.html](https://www.songho.ca/opengl/gl_projectionmatrix.html).  
OpenGL Projection Matrix.
- [8] <https://www.nxp.com/docs/en/application-note/AN3397.pdf>.  
Implementing Positioning Algorithms Using Accelerometers.