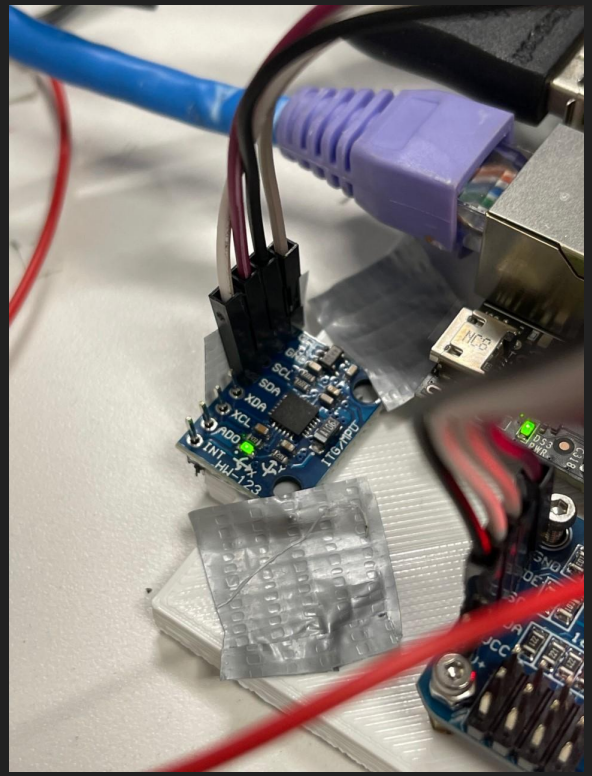
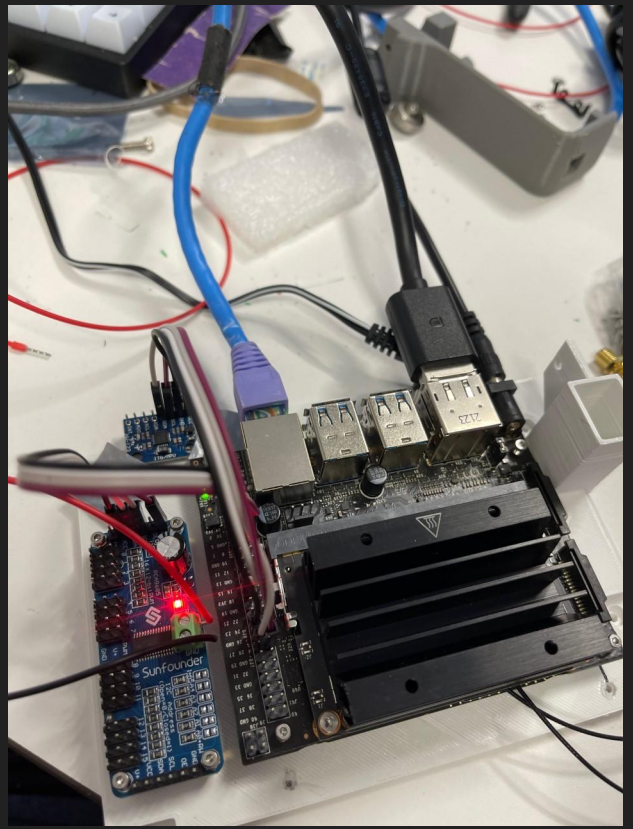
Gyroscope on Robot

Samuel Lee, Christian

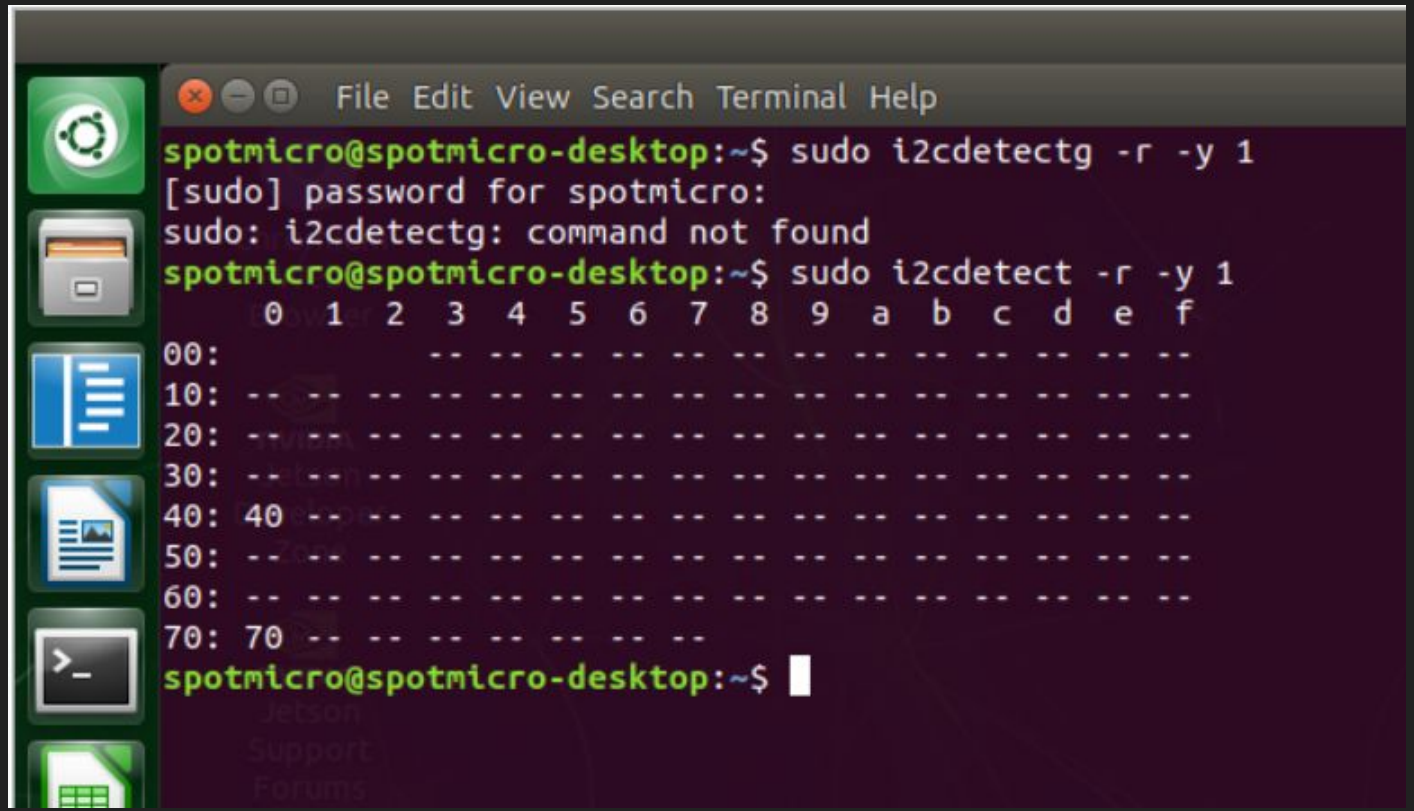
4/7/23

Physical component

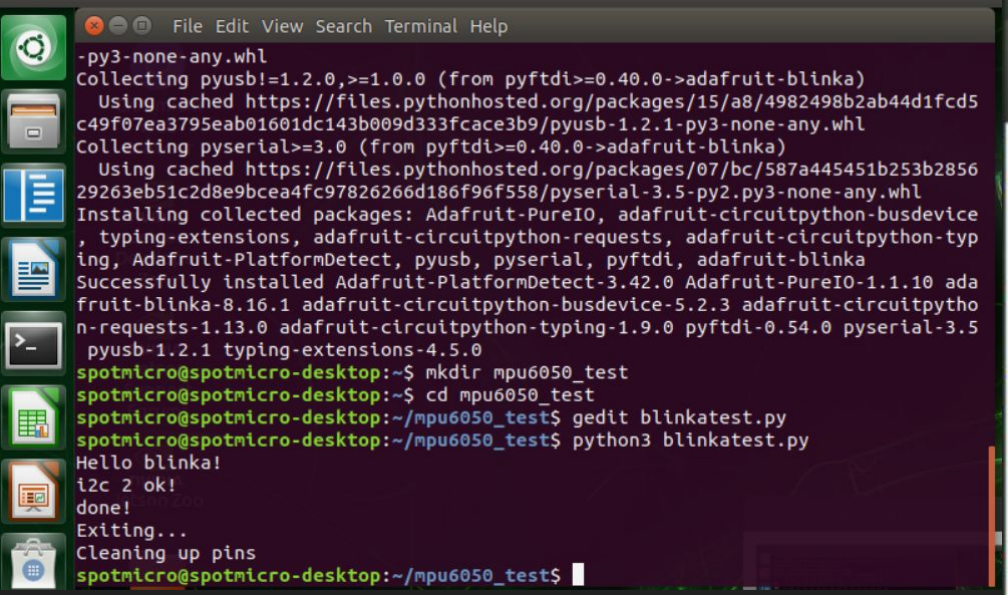


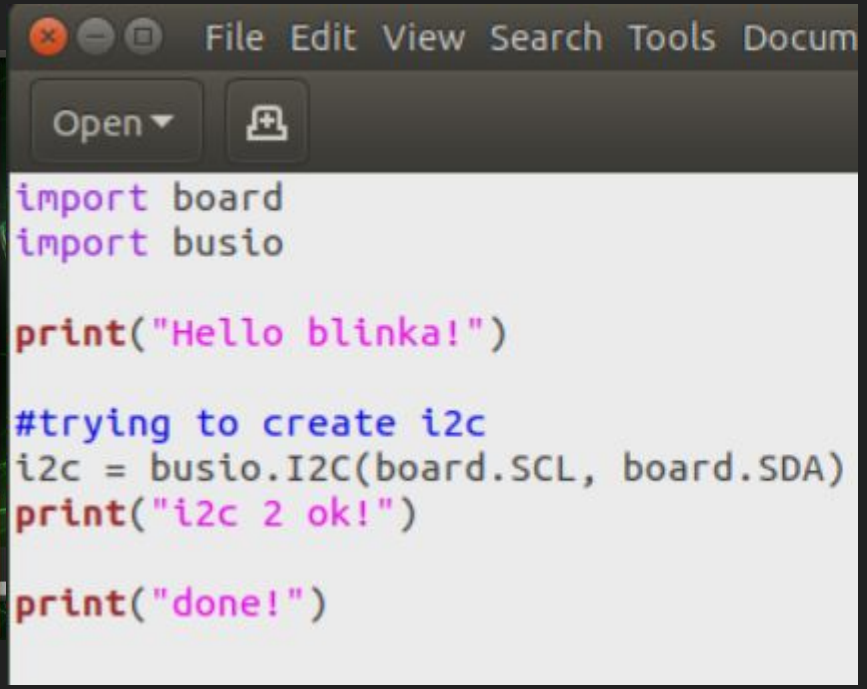


Need more SDA/SCL pins (previously sunfounder)

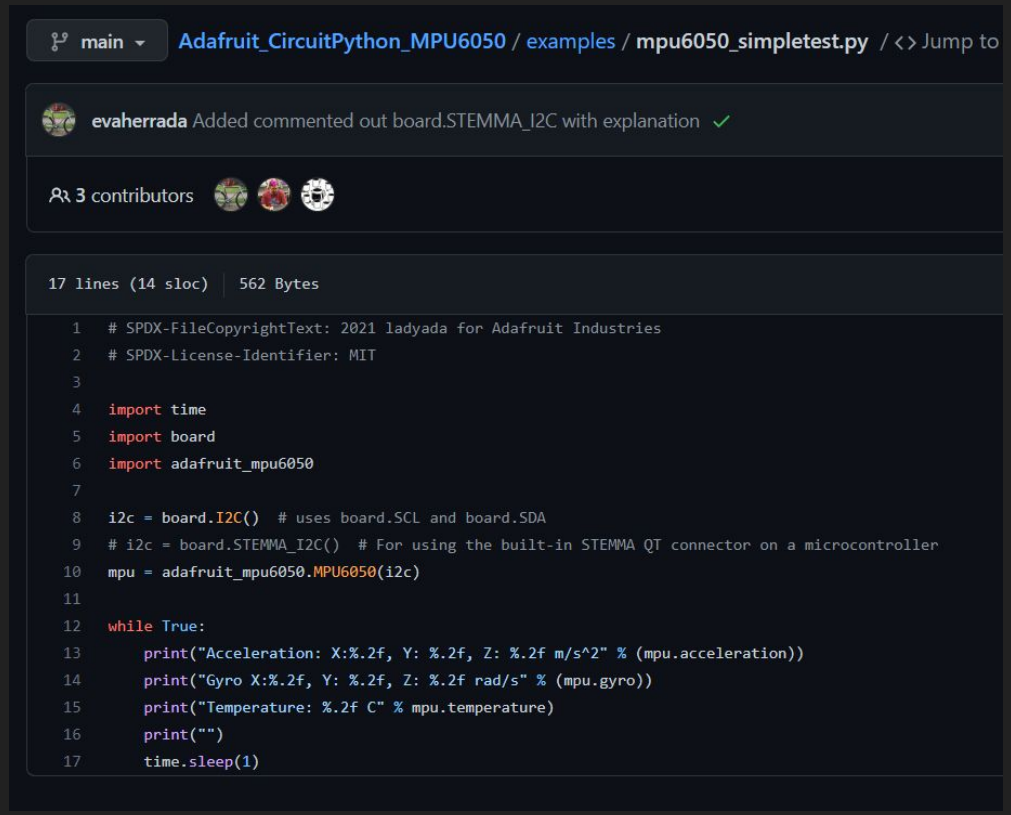


Test adafruit blinka repository (code source in final slide)





Second test program - temperature, acceleration, etc



main Adafruit_CircuitPython_MPU6050 / examples / mpu6050_simpletest.py / <> Jump to

evaherrada Added commented out board.STEMMA_I2C with explanation ✓

3 contributors

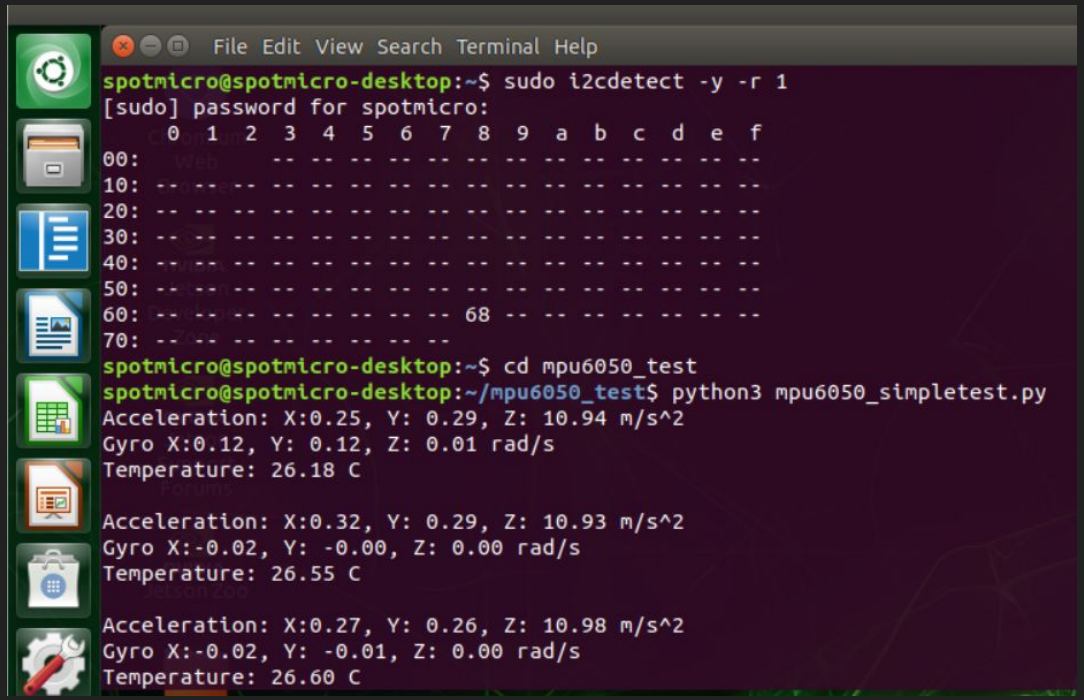
17 lines (14 sloc) | 562 Bytes

```
1  # SPDX-FileCopyrightText: 2021 ladyada for Adafruit Industries
2  # SPDX-License-Identifier: MIT
3
4  import time
5  import board
6  import adafruit_mpu6050
7
8  i2c = board.I2C()  # uses board.SCL and board.SDA
9  # i2c = board.STEMMA_I2C()  # For using the built-in STEMMA QT connector on a microcontroller
10 mpu = adafruit_mpu6050.MPU6050(i2c)
11
12 while True:
13     print("Acceleration: X:%.2f, Y: %.2f, Z: %.2f m/s^2" % (mpu.acceleration))
14     print("Gyro X:%.2f, Y: %.2f, Z: %.2f rad/s" % (mpu.gyro))
15     print("Temperature: %.2f C" % mpu.temperature)
16     print("")
17     time.sleep(1)
```

tried:
python3 mpu6050_simpletest.py

```
Traceback (most recent call last):
File "mpu6050_simpletest.py", line 10, in <module>
mpu = adafruit_mpu6050.MPU6050(i2c)
File "/home/spotmicro/.local/lib/python3.8/site-packages/adafruit_mpu6050.py", line 205, in __init__
self.i2c_device = i2c_device.I2CDevice(i2c_bus, address)
File "/home/spotmicro/.local/lib/python3.8/site-packages/adafruit_bus_device/i2c_device.py", line 63, in __init__
self.__probe_for_device()
File "/home/spotmicro/.local/lib/python3.8/site-packages/adafruit_bus_device/i2c_device.py", line 185, in __probe_for_device
raise ValueError("No I2C device at address: 0x%x" % self.device_address)
ValueError: No I2C device at address: 0x68
```

success


File Edit View Search Terminal Help
spotmicro@spotmicro-desktop:~$ sudo i2cdetect -y -r 1
[sudo] password for spotmicro:
0 1 2 3 4 5 6 7 8 9 a b c d e f
00: -- -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
40: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
50: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- -- 68 -- -- -- -- -- -- --
70: -- -- -- -- -- -- -- --
spotmicro@spotmicro-desktop:~$ cd mpu6050_test
spotmicro@spotmicro-desktop:~/mpu6050_test$ python3 mpu6050_simpletest.py
Acceleration: X:0.25, Y: 0.29, Z: 10.94 m/s^2
Gyro X:0.12, Y: 0.12, Z: 0.01 rad/s
Temperature: 26.18 C
Acceleration: X:0.32, Y: 0.29, Z: 10.93 m/s^2
Gyro X:-0.02, Y: -0.00, Z: 0.00 rad/s
Temperature: 26.55 C
Acceleration: X:0.27, Y: 0.26, Z: 10.98 m/s^2
Gyro X:-0.02, Y: -0.01, Z: 0.00 rad/s
Temperature: 26.60 C

Attempt to Connect to HC-SR04

Need parts to safely add ultrasonic sensor.

Regardless, have added ROS to Jetson Nano to get data from sensors and move servos with it

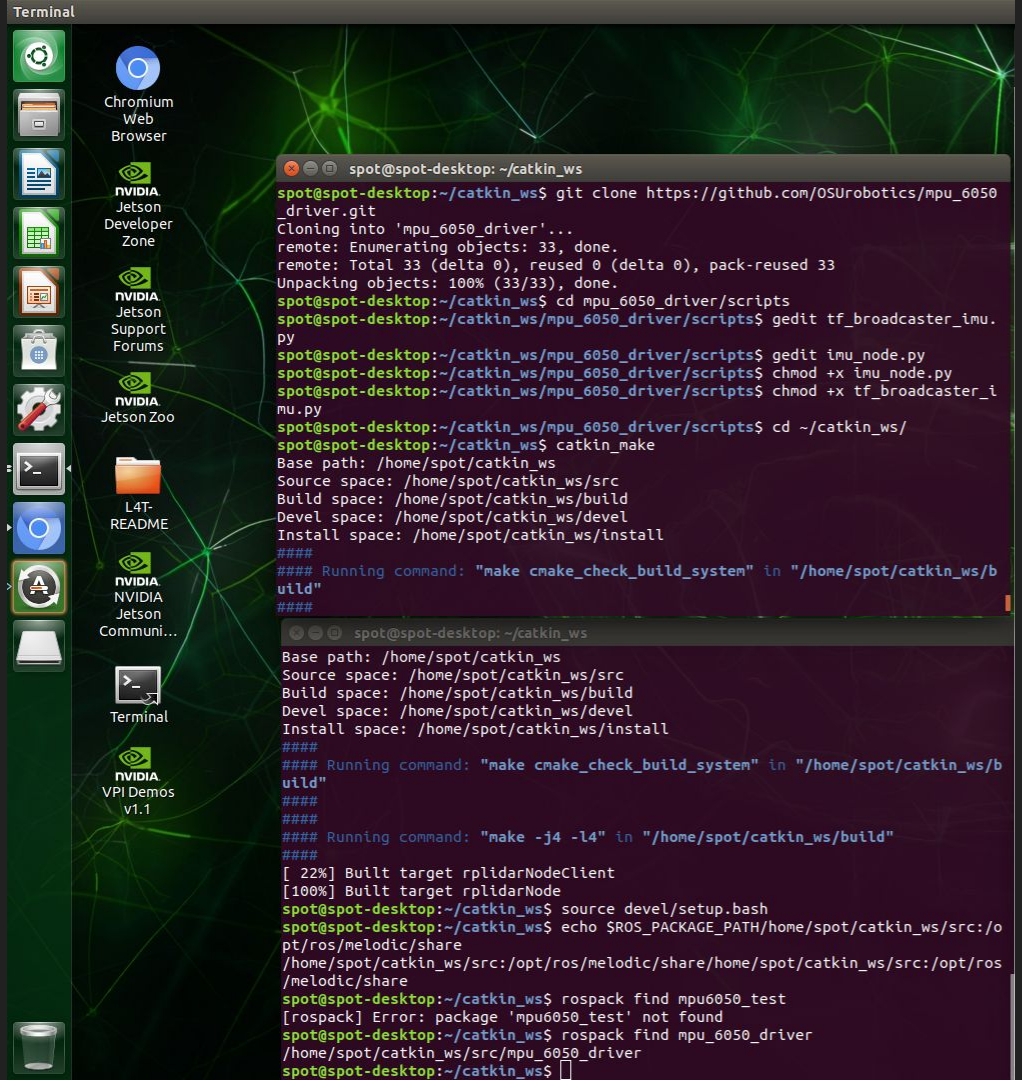
Sources

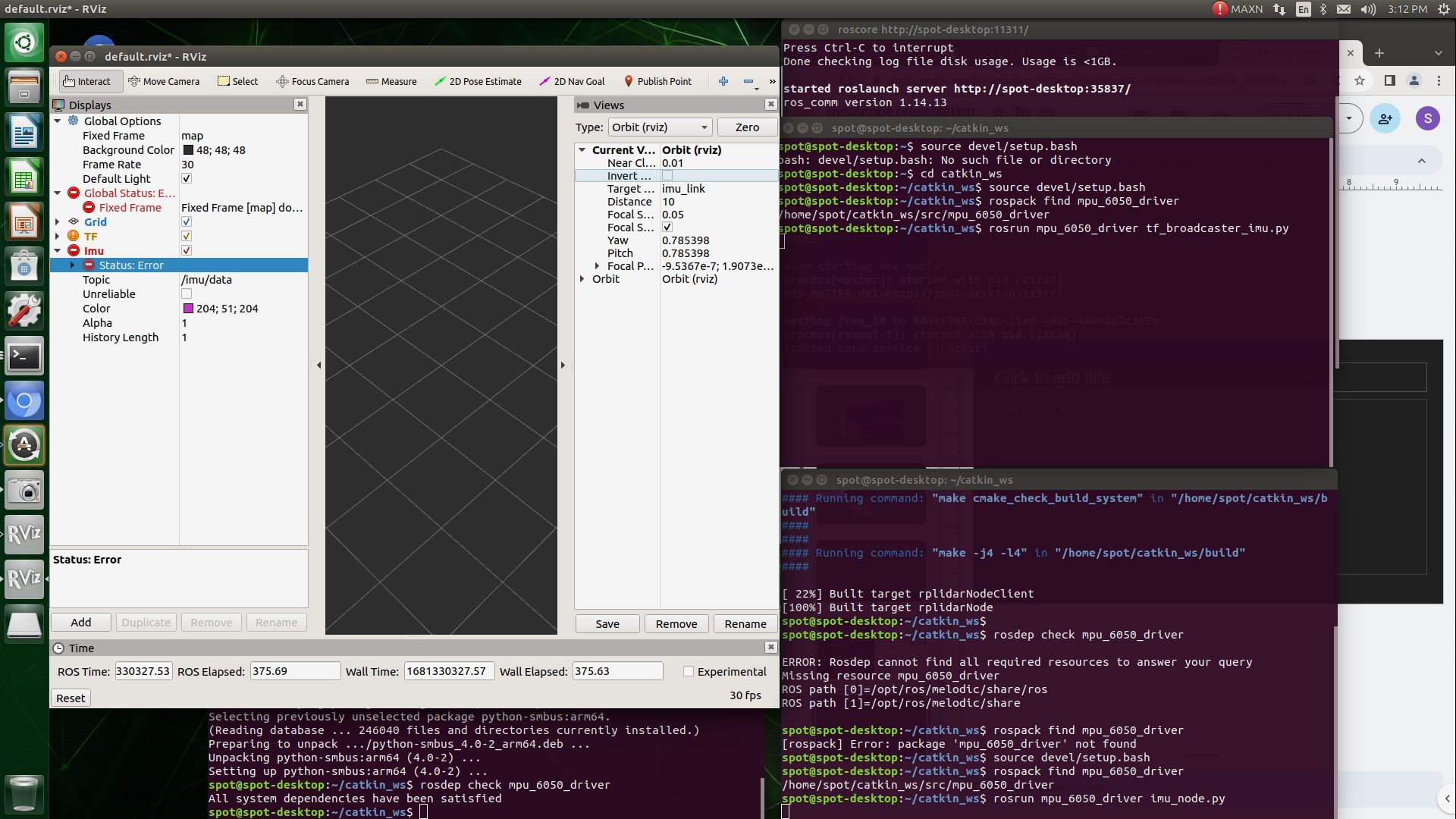
https://automaticaddison.com/visualize-imu-data-using-the-mpu6050-ros-and-jetson-nano/ - first test program, all commands/installation of gyroscope

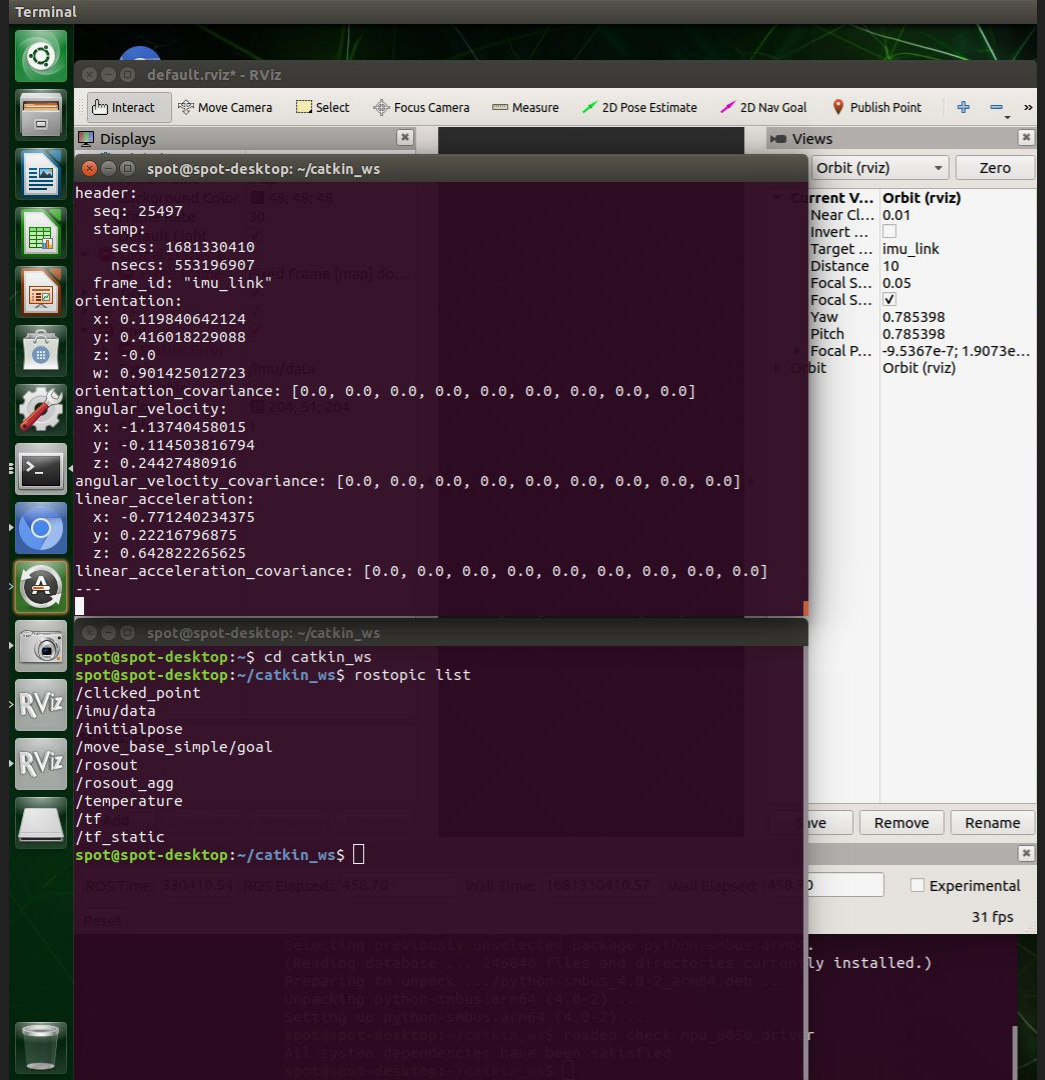
https://github.com/adafruit/Adafruit_CircuitPython_MPU6050/blob/main/examples/mpu6050_simpletest.py - second test program

both accessed 3/28/23

4/14/23


Terminal
Chromium Web Browser
NVIDIA Jetson Developer Zone
NVIDIA Jetson Support Forums
NVIDIA Jetson Zoo
L4T-README
NVIDIA NVIDIA Jetson Communi...
Terminal
NVIDIA VPI Demos v1.1
spot@spot-desktop: ~/catkin_ws
spot@spot-desktop:~/catkin_ws$ git clone https://github.com/OSUrobotics/mpu_6050_driver.git
Cloning into 'mpu_6050_driver'...
remote: Enumerating objects: 33, done.
remote: Total 33 (delta 0), reused 0 (delta 0), pack-reused 33
Unpacking objects: 100% (33/33), done.
spot@spot-desktop:~/catkin_ws$ cd mpu_6050_driver/scripts
spot@spot-desktop:~/catkin_ws/mpu_6050_driver/scripts$ gedit tf_broadcaster_imu.py
spot@spot-desktop:~/catkin_ws/mpu_6050_driver/scripts$ gedit imu_node.py
spot@spot-desktop:~/catkin_ws/mpu_6050_driver/scripts$ chmod +x imu_node.py
spot@spot-desktop:~/catkin_ws/mpu_6050_driver/scripts$ chmod +x tf_broadcaster_imu.py
spot@spot-desktop:~/catkin_ws/mpu_6050_driver/scripts$ cd ~/catkin_ws/
spot@spot-desktop:~/catkin_ws$ catkin_make
Base path: /home/spot/catkin_ws
Source space: /home/spot/catkin_ws/src
Build space: /home/spot/catkin_ws/build
Devel space: /home/spot/catkin_ws/devel
Install space: /home/spot/catkin_ws/install
####
Running command: "make cmake_check_build_system" in "/home/spot/catkin_ws/build"
####
spot@spot-desktop: ~/catkin_ws
Base path: /home/spot/catkin_ws
Source space: /home/spot/catkin_ws/src
Build space: /home/spot/catkin_ws/build
Devel space: /home/spot/catkin_ws/devel
Install space: /home/spot/catkin_ws/install
####
Running command: "make cmake_check_build_system" in "/home/spot/catkin_ws/build"
####
####
Running command: "make -j4 -l4" in "/home/spot/catkin_ws/build"
####
[22%] Built target rplidarNodeClient
[100%] Built target rplidarNode
spot@spot-desktop:~/catkin_ws$ source devel/setup.bash
spot@spot-desktop:~/catkin_ws$ echo $ROS_PACKAGE_PATH/home/spot/catkin_ws/src:/opt/ros/melodic/share
/home/spot/catkin_ws/src:/opt/ros/melodic/share/home/spot/catkin_ws/src:/opt/ros/melodic/share
spot@spot-desktop:~/catkin_ws$ rospack find mpu6050_test
[rospack] Error: package 'mpu6050_test' not found
spot@spot-desktop:~/catkin_ws$ rospack find mpu_6050_driver
/home/spot/catkin_ws/src/mpu_6050_driver
spot@spot-desktop:~/catkin_ws$

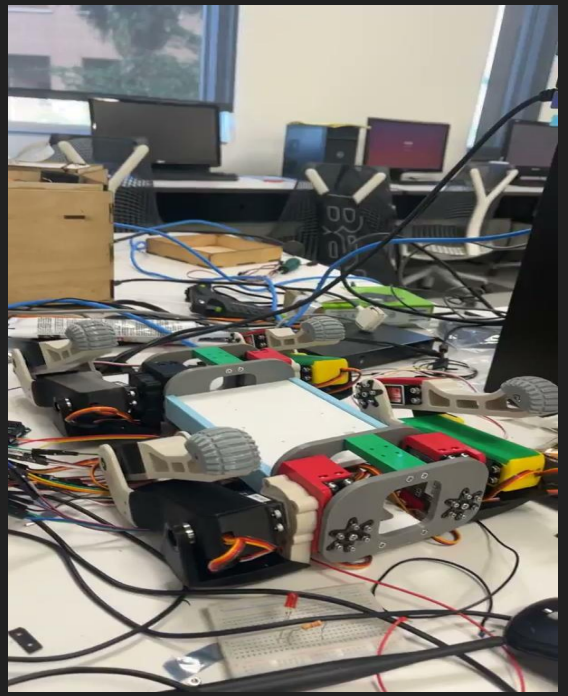

default.rviz* - RViz
Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
Displays
Global Options
Fixed Frame map
Background Color 48; 48; 48
Frame Rate 30
Default Light
Global Status: E...
Fixed Frame Fixed Frame [map] do...
Grid
TF
Imu
Status: Error
Topic /imu/data
Unreliable
Color 204; 51; 204
Alpha 1
History Length 1
Status: Error
Add
Duplicate
Remove
Rename
Views
Type: Orbit (rviz)
Zero
Current V... Orbit (rviz)
Near Cl... 0.01
Invert ...
Target ... imu_link
Distance 10
Focal S... 0.05
Focal S...
Yaw 0.785398
Pitch 0.785398
Focal P... -9.5367e-7; 1.9073e...
Orbit Orbit (rviz)
Save
Remove
Rename
Time
ROS Time: 330327.53
ROS Elapsed: 375.69
Wall Time: 1681330327.57
Wall Elapsed: 375.63
Experimental
Reset
30 fps
roscore http://spot-desktop:11311/
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.
started roslaunch server http://spot-desktop:35837/
ros_comm version 1.14.13
spot@spot-desktop: ~/catkin_ws
spot@spot-desktop:~$ source devel/setup.bash
bash: devel/setup.bash: No such file or directory
spot@spot-desktop:~$ cd catkin_ws
spot@spot-desktop:~/catkin_ws$ source devel/setup.bash
spot@spot-desktop:~/catkin_ws$ rospack find mpu_6050_driver
/home/spot/catkin_ws/src/mpu_6050_driver
spot@spot-desktop:~/catkin_ws$ rosrun mpu_6050_driver tf_broadcaster_imu.py
spot@spot-desktop: ~/catkin_ws
Running command: "make cmake_check_build_system" in "/home/spot/catkin_ws/build"
Running command: "make -j4 -l4" in "/home/spot/catkin_ws/build"
[22%] Built target rplidarNodeClient
[100%] Built target rplidarNode
spot@spot-desktop:~/catkin_ws$
spot@spot-desktop:~/catkin_ws$ rosdep check mpu_6050_driver
ERROR: Rosdep cannot find all required resources to answer your query
Missing resource mpu_6050_driver
ROS path [0]=/opt/ros/melodic/share/ros
ROS path [1]=/opt/ros/melodic/share
spot@spot-desktop:~/catkin_ws$ rospack find mpu_6050_driver
[rospack] Error: package 'mpu_6050_driver' not found
spot@spot-desktop:~/catkin_ws$ source devel/setup.bash
spot@spot-desktop:~/catkin_ws$ rospack find mpu_6050_driver
/home/spot/catkin_ws/src/mpu_6050_driver
spot@spot-desktop:~/catkin_ws$ rosrun mpu_6050_driver imu_node.py
Selecting previously unselected package python-smbus:arm64.
(Reading database ... 246040 files and directories currently installed.)
Preparing to unpack .../python-smbus_4.0-2_arm64.deb ...
Unpacking python-smbus:arm64 (4.0-2) ...
Setting up python-smbus:arm64 (4.0-2) ...
spot@spot-desktop:~/catkin_ws$ rosdep check mpu_6050_driver
All system dependencies have been satisfied
spot@spot-desktop:~/catkin_ws$

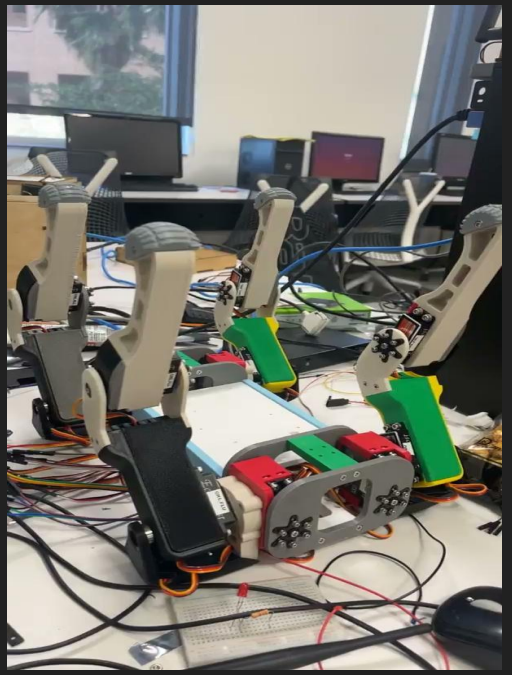

Terminal
default.rviz* - RViz
Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
Displays
Views
Orbit (rviz)
Zero
spot@spot-desktop: ~/catkin_ws
header:
seq: 25497
stamp:
secs: 1681330410
nsecs: 553196907
frame_id: "imu_link"
orientation:
x: 0.119840642124
y: 0.416018229088
z: -0.0
w: 0.901425012723
orientation_covariance: [0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0]
angular_velocity:
x: -1.13740458015
y: -0.114503816794
z: 0.24427480916
angular_velocity_covariance: [0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0]
linear_acceleration:
x: -0.771240234375
y: 0.22216796875
z: 0.642822265625
linear_acceleration_covariance: [0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0]
---
spot@spot-desktop: ~/catkin_ws
spot@spot-desktop:~$ cd catkin_ws
spot@spot-desktop:~/catkin_ws$ rostopic list
/clicked_point
/imu/data
/initialpose
/move_base_simple/goal
/rosout
/rosout_agg
/temperature
/tf
/tf_static
spot@spot-desktop:~/catkin_ws$
Current V... Orbit (rviz)
Near Cl... 0.01
Invert ...
Target ... imu_link
Distance 10
Focal S... 0.05
Focal S...
Yaw 0.785398
Pitch 0.785398
Focal P... -9.5367e-7; 1.9073e...
bit Orbit (rviz)
Remove
Rename
Experimental
31 fps

Servos

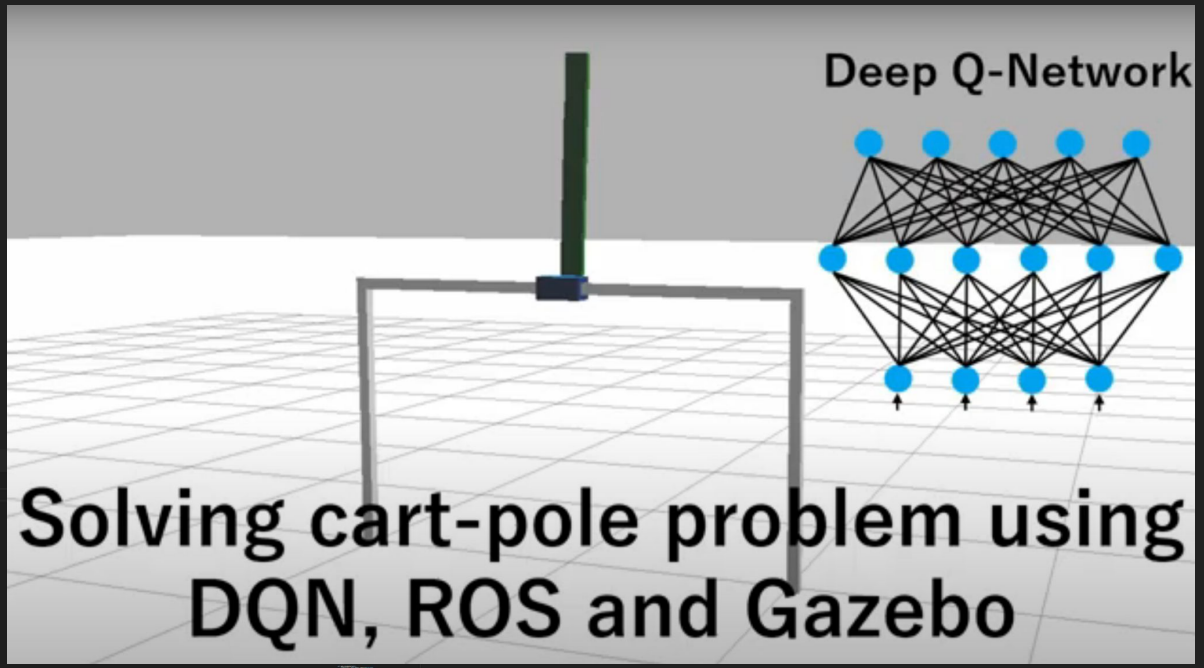
All 12 servos are “Subscribed” through ROS

All we do is “Publish” actions to them





Simulation



EXPLORER

OPEN EDITORS
- DDQN_learning.py src/c... 9+

CART_POLE_DDQN 2
- src
  - commander
    - launch
      - commander.launch
    - scripts
      - DDQN_learning.py 9+
    - CMakeLists.txt
    - package.xml
  - robot_control
    - config
      - controller.yaml
    - launch
      - robot_control.launch
    - CMakeLists.txt
    - package.xml
  - robot_description
    - meshes
      - DAE
      - STL
    - robot
      - cart_pole.sdf
      - cart_pole.urdf
      - cart_pole.urdf.xacro
    - urdf
      - base
      - cart
      - pole
      - tip
    - CMakeLists.txt

OUTLINE

DDQN_learning.py 9+

src > commander > scripts > DDQN_learning.py > ...

```python
#!/usr/bin/env python3

import rospy
import random
import time
import numpy as np
import matplotlib.pyplot as plt
from collections import namedtuple

import torch
import torch.nn as nn
import torch.optim as optim
import torch.nn.functional as F

from std_msgs.msg import Float64
from gazebo_msgs.msg import LinkStates
from geometry_msgs.msg import Pose, Twist
from std_srvs.srv import Empty

cart_pose = Pose()
pole_pose = Pose()
pole_twist = Twist()
y_angular = 0
cart_pose_x = 0

cart_pose = 0
cart_pose_x = 0
y_angular = 0
cart_vel_x = 0

pub_cart = rospy.Publisher('/cart_controller/command', Float64, queue_size = 10)
reset_simulation_client = rospy.ServiceProxy('/gazebo/reset_simulation',Empty)

obs_num = 4
acts_num = 10
total_rewards = []
number_of_steps = []

Transition = namedtuple('Transition', ('state', 'action', 'next_state', 'reward'))
```