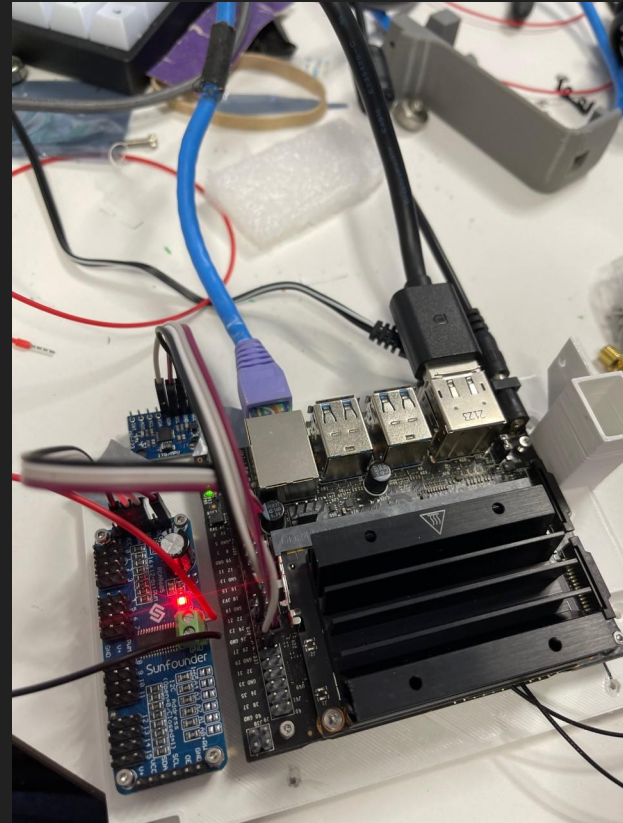
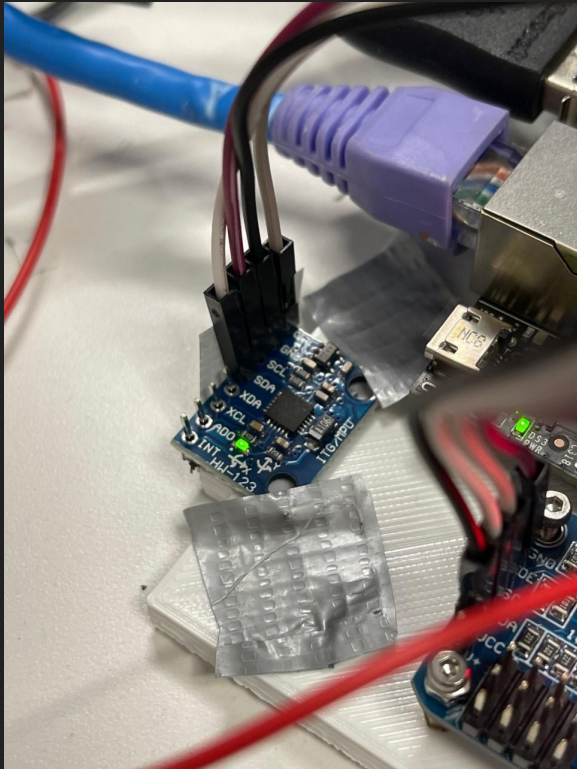


Gyroscope on Robot

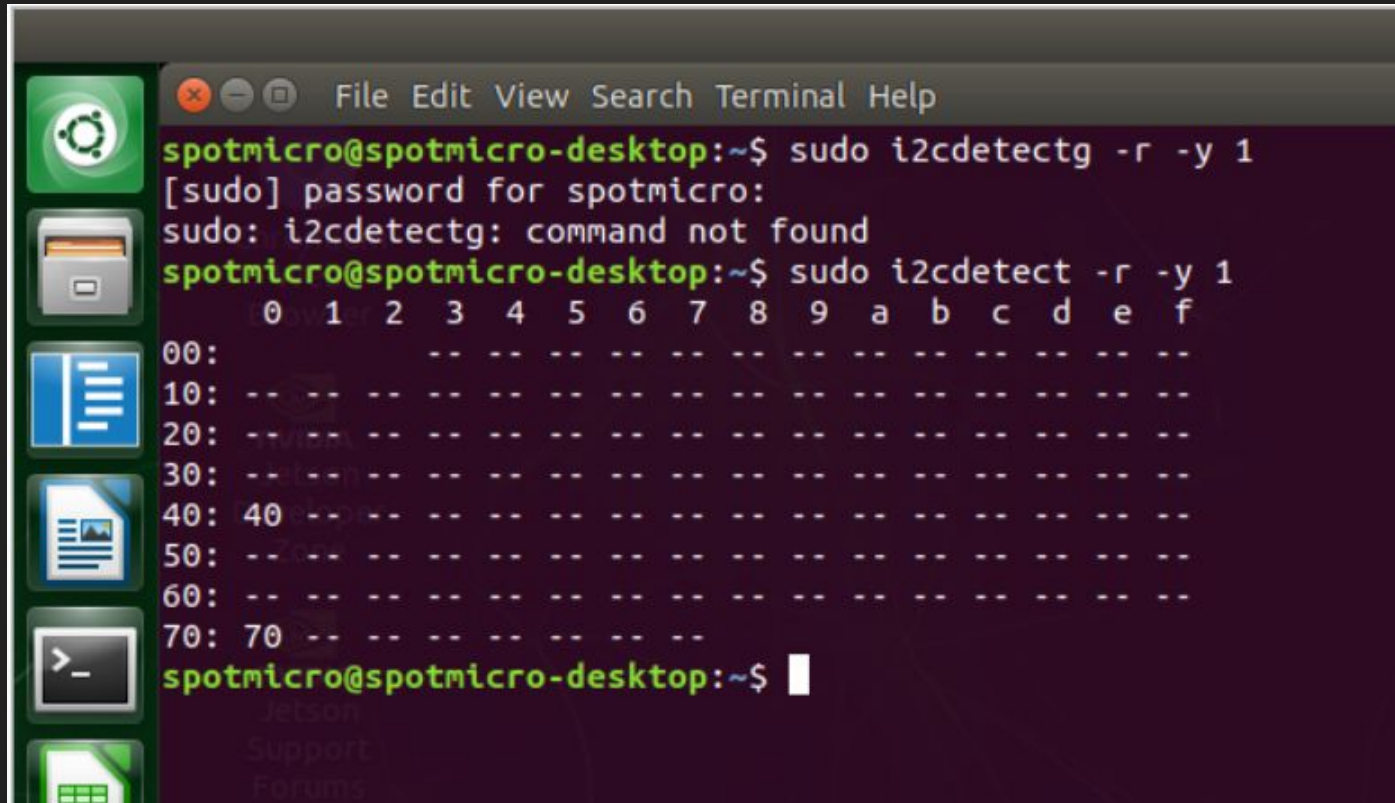
Samuel Lee, Christian

4/7/23

Physical component



Need more SDA/SCL pins (previously sunfounder)



A terminal window titled "Terminal" with a menu bar (File, Edit, View, Search, Terminal, Help) and a sidebar with icons for various applications. The terminal shows the following commands and output:

```
spotmicro@spotmicro-desktop:~$ sudo i2cdetectg -r -y 1
[sudo] password for spotmicro:
sudo: i2cdetectg: command not found
spotmicro@spotmicro-desktop:~$ sudo i2cdetect -r -y 1
```

	0	1	2	3	4	5	6	7	8	9	a	b	c	d	e	f
00:																
10:	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
20:	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
30:	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
40:	40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
50:	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
60:	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
70:	70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

```
spotmicro@spotmicro-desktop:~$
```

Test adafruit blinka repository (code source in final slide)

```
File Edit View Search Terminal Help
-py3-none-any.whl
Collecting pyusb!=1.2.0,>=1.0.0 (from pyftdi>=0.40.0->adafruit-blinka)
Using cached https://files.pythonhosted.org/packages/15/a8/4982498b2ab44d1fcd5
c49f07ea3795eab01601dc143b009d333fcace3b9/pyusb-1.2.1-py3-none-any.whl
Collecting pyserial>=3.0 (from pyftdi>=0.40.0->adafruit-blinka)
Using cached https://files.pythonhosted.org/packages/07/bc/587a445451b253b2856
29263eb51c2d8e9bcea4fc97826266d186f96f558/pyserial-3.5-py2.py3-none-any.whl
Installing collected packages: Adafruit-PureIO, adafruit-circuitpython-busdevice
, typing-extensions, adafruit-circuitpython-requests, adafruit-circuitpython-typ
ing, Adafruit-PlatformDetect, pyusb, pyserial, pyftdi, adafruit-blinka
Successfully installed Adafruit-PlatformDetect-3.42.0 Adafruit-PureIO-1.1.10 ada
fruit-blinka-8.16.1 adafruit-circuitpython-busdevice-5.2.3 adafruit-circuitpytho
n-requests-1.13.0 adafruit-circuitpython-typing-1.9.0 pyftdi-0.54.0 pyserial-3.5
pyusb-1.2.1 typing-extensions-4.5.0
spotmicro@spotmicro-desktop:~$ mkdir mpu6050_test
spotmicro@spotmicro-desktop:~$ cd mpu6050_test
spotmicro@spotmicro-desktop:~/mpu6050_test$ gedit blinkatest.py
spotmicro@spotmicro-desktop:~/mpu6050_test$ python3 blinkatest.py
Hello blinka!
i2c 2 ok!
done!
Exiting...
Cleaning up pins
spotmicro@spotmicro-desktop:~/mpu6050_test$
```


```
File Edit View Search Tools Docum
Open
import board
import busio


print("Hello blinka!")




#trying to create i2c
i2c = busio.I2C(board.SCL, board.SDA)
print("i2c 2 ok!")

print("done!")
```

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   

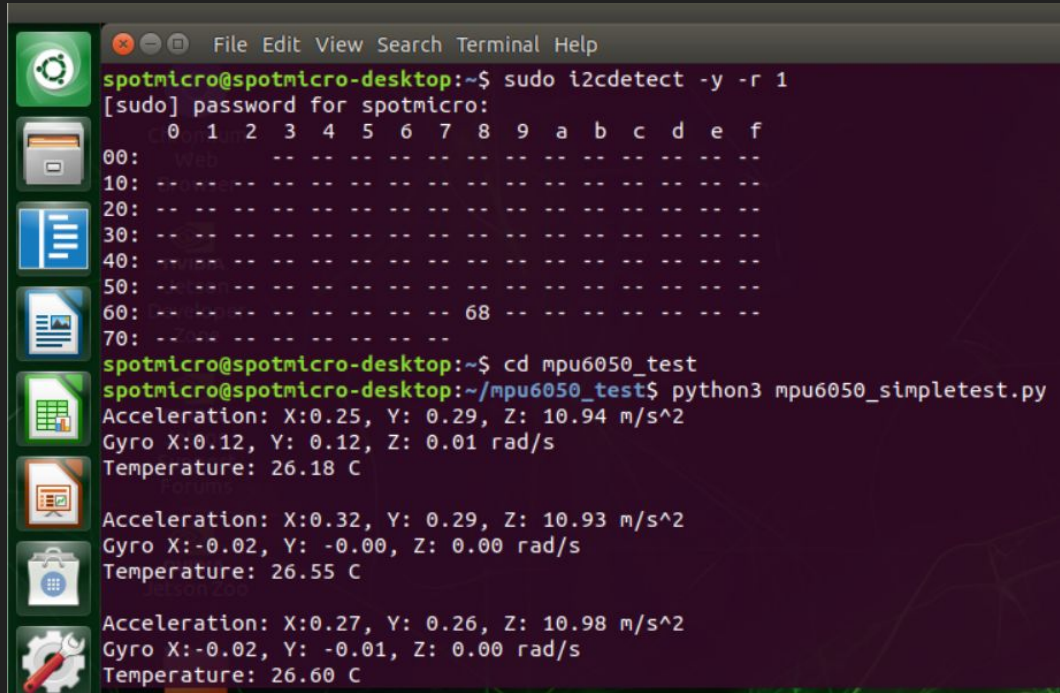
17 lines (14 sloc) | 562 Bytes

```
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 STEMMMA 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



A terminal window titled "spotmicro@spotmicro-desktop:~\$ sudo i2cdetect -y -r 1" displays the output of the i2cdetect command. The output shows a grid of addresses from 00 to 70, with the value 68 appearing at address 60. Below the grid, the user runs "cd mpu6050_test" and "python3 mpu6050_simpletest.py". The script outputs sensor data for three different runs, including acceleration, gyro, and temperature readings.

```
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

Chromium
Web
BrowserNVIDIA
Jetson
Developer
ZoneNVIDIA
Jetson
Support
ForumsNVIDIA
Jetson ZooL4T-
READMENVIDIA
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: Error
 - 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

Time

ROS Time: 330327.53 ROS Elapsed: 375.69 Wall Time: 1681330327.57 Wall Elapsed: 375.63 Experimental

Reset

Views

- Type: Orbit (rviz) Zero
- Current View
 - 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

```
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$
```

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$ rosrn mpu_6050_driver tf_broadcaster_imu.py
```

```
INFO: Starting new master
[process[master]]: started with pid [21237]
ROS_MASTER_URI=http://spot-desktop:11311/

setting /run_id to 80491398-d98c-11ed-9f81-48002d3c307b
[process[roscout]]: started with pid [21238]
[roscout] started core service [/roscout]
```

Click to add title

Click to add icon

spot@spot-desktop: ~/catkin_ws

```
#### Running command: "make cnaek_check_build_system" in "/home/spot/catkin_ws/b
uild"
####
####
#### 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$ rosrn mpu_6050_driver imu_node.py
```


Terminal

default.rviz* - RViz

Interact Move Camera Select Focus Camera Measure 2D Pose Estimate 2D Nav Goal Publish Point

Displays Views

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$
```

ROS Time: 1681330410.54 ROS Elapsed: 458.70 Wall Time: 1681330410.57 Wall Elapsed: 458.70

Base

Installing previously unselected package python-robotics. (Reading database ... 120040 files and directories currently installed.)
Preparing to unpack .../python-robotics_1.8.2_armhf.deb ...
Unpacking python-robotics (1.8.2) ...
Setting up python-robotics (1.8.2) ...
ros@spot-desktop:~/catkin_ws\$ rosdep check --ignore-src --rosdistro kinetic
All system dependencies have been satisfied
ros@spot-desktop:~/catkin_ws\$

Orbit (rviz) Zero

Current V... Orbit (rviz)

Near Cl...	0.01
Invert ...	<input type="checkbox"/>
Target ...	imu_link
Distance	10
Focal S...	0.05
Focal S...	<input checked="" type="checkbox"/>
Yaw	0.785398
Pitch	0.785398
Focal P...	-9.5367e-7; 1.9073e...
Orbit	Orbit (rviz)

Remove Rename

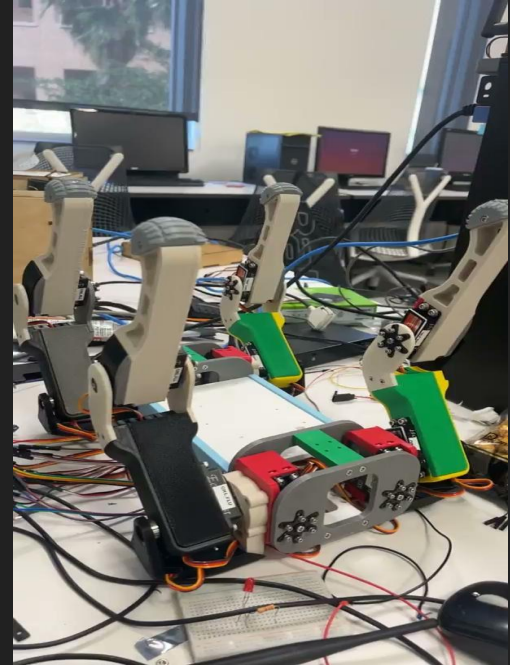
Experimental

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/... 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+ X
src > commander > scripts > DDQN_learning.py > ...
1  #!/usr/bin/env python3
2
3  import rospy
4  import random
5  import time
6  import numpy as np
7  import matplotlib.pyplot as plt
8  from collections import namedtuple
9
10 import torch
11 import torch.nn as nn
12 import torch.optim as optim
13 import torch.nn.functional as F
14
15 from std_msgs.msg import Float64
16 from gazebo_msgs.msg import LinkStates
17 from geometry_msgs.msg import Pose, Twist
18 from std_srvs.srv import Empty
19
20 cart_pose = Pose()
21 pole_pose = Pose()
22 pole_twist = Twist()
23 y_angular = 0
24 cart_pose_x = 0
25
26 cart_pose = 0
27 cart_pose_x = 0
28 y_angular = 0
29 cart_vel_x = 0
30
31 pub_cart = rospy.Publisher('/cart_controller/command', Float64, queue_size = 10)
32 reset_simulation_client = rospy.ServiceProxy('/gazebo/reset_simulation', Empty)
33
34 obs_num = 4
35 acts_num = 10
36 total_rewards = []
37 number_of_steps = []
38
39 Transition = namedtuple('Transition', ('state', 'action', 'next_state', 'reward'))
40
```

