

ECE 180DA
Lab 3
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IMU and Speech Recognition

The first thing that I worked on was setting up the WiFi connection again because I had set up my Pi at home. After I connected to eduroam, I checked whether everything was connecting and checked the same using “ping google.com”.

After this, I went on to set up the IMU. I downloaded all the libraries and stuff but the conda was not working and the solving environment kept getting killed. So, I used pip to install whatever was left and ran it using python3.9 instead and it worked. This is what I got once I got the IMU running.

```
Aryan — pi@raspberrypi: ~/BerryIMU/python-BerryIMU-gyro-accel-compass-filters — ssh pi@raspberrypi.local — 151x44
CFangleY Angle -24.54 # # HEADING 201.05 tiltCompensatedHeading 197.51 ## kalmanX 2.09 kalmanY -24.47 #
Loop Time 0.05 # ACCX Angle 2.09 ACCY Angle -24.45 # # GRYX Angle 77.34 GYRY Angle -319.56 GYZ Angle 180.97 # # CFangleX Angle 2.11
CFangleY Angle -24.53 # # HEADING 201.03 tiltCompensatedHeading 197.50 ## kalmanX 2.10 kalmanY -24.47 #
Loop Time 0.04 # ACCX Angle 2.12 ACCY Angle -24.44 # # GRYX Angle 77.36 GYRY Angle -319.68 GYZ Angle 181.01 # # CFangleX Angle 2.13
CFangleY Angle -24.52 # # HEADING 201.03 tiltCompensatedHeading 197.51 ## kalmanX 2.10 kalmanY -24.47 #
Loop Time 0.04 # ACCX Angle 2.12 ACCY Angle -24.45 # # GRYX Angle 77.42 GYRY Angle -319.72 GYZ Angle 181.04 # # CFangleX Angle 2.14
CFangleY Angle -24.49 # # HEADING 201.03 tiltCompensatedHeading 197.50 ## kalmanX 2.13 kalmanY -24.42 #
Loop Time 0.04 # ACCX Angle 2.09 ACCY Angle -24.44 # # GRYX Angle 77.43 GYRY Angle -319.84 GYZ Angle 181.07 # # CFangleX Angle 2.12
CFangleY Angle -24.51 # # HEADING 201.04 tiltCompensatedHeading 197.51 ## kalmanX 2.11 kalmanY -24.44 #
Loop Time 0.04 # ACCX Angle 2.08 ACCY Angle -24.43 # # GRYX Angle 77.50 GYRY Angle -319.93 GYZ Angle 181.17 # # CFangleX Angle 2.12
CFangleY Angle -24.50 # # HEADING 201.05 tiltCompensatedHeading 197.52 ## kalmanX 2.12 kalmanY -24.43 #
Loop Time 0.05 # ACCX Angle 2.08 ACCY Angle -24.43 # # GRYX Angle 77.54 GYRY Angle -320.01 GYZ Angle 181.21 # # CFangleX Angle 2.11
CFangleY Angle -24.49 # # HEADING 201.05 tiltCompensatedHeading 197.52 ## kalmanX 2.12 kalmanY -24.41 #
Loop Time 0.05 # ACCX Angle 2.07 ACCY Angle -24.42 # # GRYX Angle 77.54 GYRY Angle -320.14 GYZ Angle 181.20 # # CFangleX Angle 2.09
CFangleY Angle -24.50 # # HEADING 201.10 tiltCompensatedHeading 197.56 ## kalmanX 2.08 kalmanY -24.43 #
Loop Time 0.05 # ACCX Angle 2.06 ACCY Angle -24.42 # # GRYX Angle 77.55 GYRY Angle -320.27 GYZ Angle 181.20 # # CFangleX Angle 2.07
CFangleY Angle -24.51 # # HEADING 201.08 tiltCompensatedHeading 197.54 ## kalmanX 2.06 kalmanY -24.44 #
Loop Time 0.05 # ACCX Angle 2.05 ACCY Angle -24.42 # # GRYX Angle 77.65 GYRY Angle -320.42 GYZ Angle 181.21 # # CFangleX Angle 2.10
CFangleY Angle -24.52 # # HEADING 201.09 tiltCompensatedHeading 197.55 ## kalmanX 2.11 kalmanY -24.47 #
Loop Time 0.05 # ACCX Angle 2.05 ACCY Angle -24.43 # # GRYX Angle 77.66 GYRY Angle -320.56 GYZ Angle 181.29 # # CFangleX Angle 2.07
CFangleY Angle -24.52 # # HEADING 201.08 tiltCompensatedHeading 197.54 ## kalmanX 2.07 kalmanY -24.48 #
Loop Time 0.04 # ACCX Angle 2.03 ACCY Angle -24.42 # # GRYX Angle 77.67 GYRY Angle -320.73 GYZ Angle 181.31 # # CFangleX Angle 2.05
CFangleY Angle -24.53 # # HEADING 201.13 tiltCompensatedHeading 197.58 ## kalmanX 2.05 kalmanY -24.50 #
Loop Time 0.05 # ACCX Angle 2.03 ACCY Angle -24.38 # # GRYX Angle 77.67 GYRY Angle -320.78 GYZ Angle 181.31 # # CFangleX Angle 2.04
CFangleY Angle -24.46 # # HEADING 201.13 tiltCompensatedHeading 197.58 ## kalmanX 2.02 kalmanY -24.42 #
Loop Time 0.05 # ACCX Angle 2.03 ACCY Angle -24.38 # # GRYX Angle 77.71 GYRY Angle -320.90 GYZ Angle 181.37 # # CFangleX Angle 2.05
CFangleY Angle -24.47 # # HEADING 201.13 tiltCompensatedHeading 197.58 ## kalmanX 2.03 kalmanY -24.42 #
Loop Time 0.05 # ACCX Angle 2.05 ACCY Angle -24.38 # # GRYX Angle 77.72 GYRY Angle -321.00 GYZ Angle 181.40 # # CFangleX Angle 2.05
CFangleY Angle -24.45 # # HEADING 201.13 tiltCompensatedHeading 197.60 ## kalmanX 2.03 kalmanY -24.40 #
Loop Time 0.05 # ACCX Angle 2.05 ACCY Angle -24.38 # # GRYX Angle 77.78 GYRY Angle -321.10 GYZ Angle 181.45 # # CFangleX Angle 2.07
CFangleY Angle -24.45 # # HEADING 201.10 tiltCompensatedHeading 197.60 ## kalmanX 2.05 kalmanY -24.39 #
Loop Time 0.05 # ACCX Angle 2.06 ACCY Angle -24.39 # # GRYX Angle 77.79 GYRY Angle -321.17 GYZ Angle 181.52 # # CFangleX Angle 2.07
CFangleY Angle -24.44 # # HEADING 201.07 tiltCompensatedHeading 197.57 ## kalmanX 2.04 kalmanY -24.37 #
Loop Time 0.05 # ACCX Angle 2.07 ACCY Angle -24.38 # # GRYX Angle 77.75 GYRY Angle -321.32 GYZ Angle 181.62 # # CFangleX Angle 2.05
CFangleY Angle -24.46 # # HEADING 201.00 tiltCompensatedHeading 197.52 ## kalmanX 2.01 kalmanY -24.40 #
Loop Time 0.05 # ACCX Angle 2.07 ACCY Angle -24.37 # # GRYX Angle 77.77 GYRY Angle -321.45 GYZ Angle 181.64 # # CFangleX Angle 2.07
CFangleY Angle -24.46 # # HEADING 201.01 tiltCompensatedHeading 197.52 ## kalmanX 2.03 kalmanY -24.40 #
Loop Time 0.05 # ACCX Angle 2.07 ACCY Angle -24.38 # # GRYX Angle 77.84 GYRY Angle -321.51 GYZ Angle 181.66 # # CFangleX Angle 2.10
CFangleY Angle -24.43 # # HEADING 200.93 tiltCompensatedHeading 197.45 ## kalmanX 2.07 kalmanY -24.36 #
Loop Time 0.04 # ACCX Angle 2.09 ACCY Angle -24.38 # # GRYX Angle 77.84 GYRY Angle -321.62 GYZ Angle 181.68 # # CFangleX Angle 2.09
CFangleY Angle -24.44 # # HEADING 200.88 tiltCompensatedHeading 197.41 ## kalmanX 2.06 kalmanY -24.37 #
Loop Time 0.04 # ACCX Angle 2.10 ACCY Angle -24.40 # # GRYX Angle 77.83 GYRY Angle -321.75 GYZ Angle 181.75 # # CFangleX Angle 2.09
CFangleY Angle -24.47 # # HEADING 200.93 tiltCompensatedHeading 197.44 ## kalmanX 2.05 kalmanY -24.40 #
```

I played around with this for a while to figure out what changed when I move the IMU around. We had to develop a system so it detected whether it is going forward or backward. I used the ACCx and ACCy for this. Very similarly, I developed the same system for left and right turns as well. Following is the screenshot from when I made it detect forward push and backward push.

```
Aryan — pi@raspberrypi: ~/BerryIMU/python-BerryIMU-gyro-accel-compass-filters — ssh pi@raspberrypi.local — 215x52
forward
forward
backward
backward
backward
backward
backward
backward
forward
forward
forward
backward
backward
backward
backward
backward
backward
backward
backward
backward
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backward
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backward
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backward
backward
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backward
backward
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forward
forward
forward
forward
forward
forward
forward
forward
forward
forward
forward
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forward
forward
forward
backward
backward
backward
backward
backward
backward
forward
forward
forward
forward
backward
backward
backward
backward
backward
```

After I got this set up, we started on section 3 which was related to speech detection. I used *pocketsphinx* which is not very accurate. There was a lot of background noise but it recognized some of the words I was saying. I mainly said “left” and “right”. This is the result I got from it.

```
((base) Aryan@Aryans-MacBook-Pro pocketsphinx % python3 livenesspeech.py
the ago
what is new to new and i hired was current of
what do that and not it is
it left
i'd night and it burned all
we left
is
night
fi
```

Communication

For this, we first learned about TCP/IP (server-client) and MQTT (publisher-subscriber). I used the RasPi as the client and my computer as the server and sent a message between the two. This was the result.

```
[pi@raspberrypi:~ $ cd 180DA-WarmUp
pi@raspberrypi:~/180DA-WarmUp $ nano clientTest.py
pi@raspberrypi:~/180DA-WarmUp $ nano clientTest.py
pi@raspberrypi:~/180DA-WarmUp $ nano clientTest.py
pi@raspberrypi:~/180DA-WarmUp $ python3.9 clientTest.py
b'I am SERVER\n'
pi@raspberrypi:~/180DA-WarmUp $
```

```
((base) Aryan@Aryans-MBP 180DA-WarmUp % nano serverTest.py
((base) Aryan@Aryans-MBP 180DA-WarmUp % python3.9 serverTest.py
I am CLIENT

client disconnected
```

I then set up the MQTT communication between my RasPi and my computer. I did this using my RasPi as a subscriber and my computer as the publisher. The result was as follows.


```
180DA-WarmUp — pi@raspberrypi: ~/180DA-WarmUp — ssh pi@raspberr...

Downloading https://www.piwheels.org/simple/dnspython/dnspython-2.2.1-py3-none-any.whl (269 kB)
| 269 kB 226 kB/s
Requirement already satisfied: urllib3>=1.7.1 in /home/pi/berryconda3/lib/python3.6/site-packages (from python-etcd) (1.21.1)
Installing collected packages: dnspython, python-etcd
Successfully installed dnspython-2.2.1 python-etcd-0.4.5
pi@raspberrypi:~/180DA-WarmUp $ python3.9 mqttsubscriber.py
Traceback (most recent call last):
  File "/home/pi/180DA-WarmUp/mqttsubscriber.py", line 1, in <module>
    import paho.mqtt.client as mqtt
ModuleNotFoundError: No module named 'paho'
pi@raspberrypi:~/180DA-WarmUp $ python mqttsubscriber.py
Connection returned result: 0
Received message: "b'0.054898832962881006'" on topic "ece180d/test" with QoS 1
Received message: "b'0.5167903726137075'" on topic "ece180d/test" with QoS 1
Received message: "b'0.8273297499942227'" on topic "ece180d/test" with QoS 1
Received message: "b'0.7252558653343143'" on topic "ece180d/test" with QoS 1
Received message: "b'0.3318905125705959'" on topic "ece180d/test" with QoS 1
Received message: "b'0.39347797486636915'" on topic "ece180d/test" with QoS 1
Received message: "b'0.9182975816420057'" on topic "ece180d/test" with QoS 1
Received message: "b'0.36447815561234076'" on topic "ece180d/test" with QoS 1
Received message: "b'0.48751596955606546'" on topic "ece180d/test" with QoS 1
Received message: "b'0.8587673987392468'" on topic "ece180d/test" with QoS 1
Received message: "b'0.5055427897817412'" on topic "ece180d/test" with QoS 1
Received message: "b'0.7579028447904018'" on topic "ece180d/test" with QoS 1
Received message: "b'0.8175272248775979'" on topic "ece180d/test" with QoS 1
Received message: "b'0.9572711049096737'" on topic "ece180d/test" with QoS 1
Received message: "b'0.07446872359358403'" on topic "ece180d/test" with QoS 1
Received message: "b'0.16917942004984743'" on topic "ece180d/test" with QoS 1
Received message: "b'0.8577345470970107'" on topic "ece180d/test" with QoS 1
Received message: "b'0.5504444884207722'" on topic "ece180d/test" with QoS 1
Received message: "b'0.45427448499771694'" on topic "ece180d/test" with QoS 1
Received message: "b'0.9069016068176999'" on topic "ece180d/test" with QoS 1
Received message: "b'0.9922649119259508'" on topic "ece180d/test" with QoS 1
Received message: "b'0.4495094078791728'" on topic "ece180d/test" with QoS 1
Received message: "b'0.8473535925581931'" on topic "ece180d/test" with QoS 1
Received message: "b'0.6371915013597302'" on topic "ece180d/test" with QoS 1
Received message: "b'0.026991447050134676'" on topic "ece180d/test" with QoS 1
Received message: "b'0.7075205056850852'" on topic "ece180d/test" with QoS 1
Received message: "b'0.775133686720824'" on topic "ece180d/test" with QoS 1
Received message: "b'0.5512654823447136'" on topic "ece180d/test" with QoS 1
Received message: "b'0.041289456641723676'" on topic "ece180d/test" with QoS 1
Received message: "b'0.6507606580355241'" on topic "ece180d/test" with QoS 1

```

```

180DA-WarmUp -- zsh -- 114x45
^
SyntaxError: invalid character "'" (U+2019)
(base) Aryan@Aryans-MBP 180DA-WarmUp % nano serverTest.py
(base) Aryan@Aryans-MBP 180DA-WarmUp % python3.9 serverTest.py
File "/Users/Aryan/180DA-WarmUp/serverTest.py", line 9
    conn, addr = serv.accept()
    ^
IndentationError: expected an indented block
(base) Aryan@Aryans-MBP 180DA-WarmUp % nano serverTest.py
(base) Aryan@Aryans-MBP 180DA-WarmUp % python3.9 serverTest.py
I am CLIENT

client disconnected
^Z
zsh: suspended python3.9 serverTest.py
(base) Aryan@Aryans-MBP 180DA-WarmUp % conda activate venv
(venv) Aryan@Aryans-MBP 180DA-WarmUp % pip install paho-mqtt
Collecting paho-mqtt
  Downloading paho-mqtt-1.6.1.tar.gz (99 kB)
    99.4/99.4 kB 1.5 MB/s eta 0:00:00
  Preparing metadata (setup.py) ... done
Building wheels for collected packages: paho-mqtt
  Building wheel for paho-mqtt (setup.py) ... done
  Created wheel for paho-mqtt: filename=paho_mqtt-1.6.1-py3-none-any.whl size=62118 sha256=0d55a4ebbde9320fd69550742550c829398f0fd000896d8ce2f1df10ac204991
  Stored in directory: /Users/Aryan/Library/Caches/pip/wheels/0f/90/29/db29bb8ddc98ec5f2363b959130c9ddbcf5cfd4a00b6184dd
Successfully built paho-mqtt
Installing collected packages: paho-mqtt
Successfully installed paho-mqtt-1.6.1
(venv) Aryan@Aryans-MBP 180DA-WarmUp % nano mqttpublisher.py
(venv) Aryan@Aryans-MBP 180DA-WarmUp % python3.9 mqttpublisher.py
Connection returned result: 0
Expected Disconnect
(venv) Aryan@Aryans-MBP 180DA-WarmUp % nano mqttpublisher.py
(venv) Aryan@Aryans-MBP 180DA-WarmUp % python3.9 mqttpublisher.py
Connection returned result: 0
Expected Disconnect
(venv) Aryan@Aryans-MBP 180DA-WarmUp % python3.9 mqttpublisher.py
Connection returned result: 0
Expected Disconnect
(venv) Aryan@Aryans-MBP 180DA-WarmUp % python3.9 mqttpublisher.py
Connection returned result: 0
Expected Disconnect
(venv) Aryan@Aryans-MBP 180DA-WarmUp %

```