RADAR

RADAR CONFIGURATION

REQUIREMENTS

Name	Quantity	Description	Part Number
PCAN-USB-x6	1	Short-range RADAR interface board	IPEH-004064-002940
Cable Socket 8 pin Automotive Connector	24	Female Reverse Sensor connector for LR Radar	1-1534229-1
Yazaki HS025 WPC 8P	24	Female Reverse Sensor connector for SR Radar	7298-2755-30
Connector pins (0.25-0.35mm²)	500	Terminal	7116-4415-02
Single wire seal for above pin, blue	250	Single wire seal	7158-3165-90
Cavity seal, gray	250	Cavity seal	7158-3169-40
Connector pins (0.25-0.35mm²)	500	TE MQS contact	5-962885-1
Single wire seal for above pin, yellow	125	TE single wire seal	967067-2
Single wire seal for above pin, green	125	TE single wire seal	967067-1
Cavity seal, blue	250	For cavity diameter 3.45mm	967056-1
Technica gateway	1	Long range RADAR interface board	TE-1100

SYSTEM SETUP

The PDK is built, developed and tested for Linux Ubuntu starting from version 18.04. Generally, it supports x86_64 and arm64 architecture. It is recommended that the customer uses the same system setup to ensure a smooth operation of the PDK. For general compatibility matrices, refer to the page page_system_overview.

INSTALL COMMANDS

Install Base PDK

$ cd downlods/files/ (pdk-document file)

$ tar -xavf pdk_base_0.7.5-4773fac-bionic_amd64.tar.gz

$ sudo apt install ./eCAL-5.9.1-Linux.deb

for ubuntu 20 find eCAL https://eclipse-ecal.github.io/ecal/getting_started/setup.html

$ sudo apt install ./codemeter-lite_6.90.3691.500_amd64.deb

$ sudo apt install ./pdk_base_0.7.5-4773fac-bionic_amd64.deb

LONG RANGE RADAR

TECHNICA GATEWAY PRECONFIGURATION (for new)

1. Assign the IP address 192.168.0.10 to your ethernet interface.
2. Open a web browser and access the media gateways config page on IP address 192.168.0.49.
3. Use the web interface to upload the media gateway config file /opt/pdk/etc/mediaGatewayConfig.cfg
4. Save and reset the media gateway using the web interface
5. To confirm radar required installation

    - /opt/pdk/bin/pdk_monitoring_tool

CONNECTIONS

Note: every BroadR-Reach port on the MediaGateway supports up to 4 BroadR-Reach sensors. This means that sensor 1-4 has to be connected to BroadR-Reach ethernet port 1 whereas sensor 5-8 has to be connected to BroadR-Reach ethernet port 2, etc.

The BR+ port of the sensor has to be connected to the respective BR+ port on the MediaGateway.

The BR- port of the sensor has to be connected to the respective BR- port on the MediaGateway.

Blue connector on MediaGateway (blue cap with black insert), repeat for every required BroadR-Reach data port on the MediaGateway:

1: +12V

2: GND

3: BR Port 1 Negative (BR-)

4: BR Port 1 Positive (BR+)

6: BR Port 2 Positive (BR+)

7: BR Port 2 Negative (BR-)

10: BR Port 3 Positive (BR+)

11: BR Port 3 Negative (BR-)

17: BR Port 4 Negative (BR-)

18: BR Port 4 Positive (BR+)

RADAR PINNING

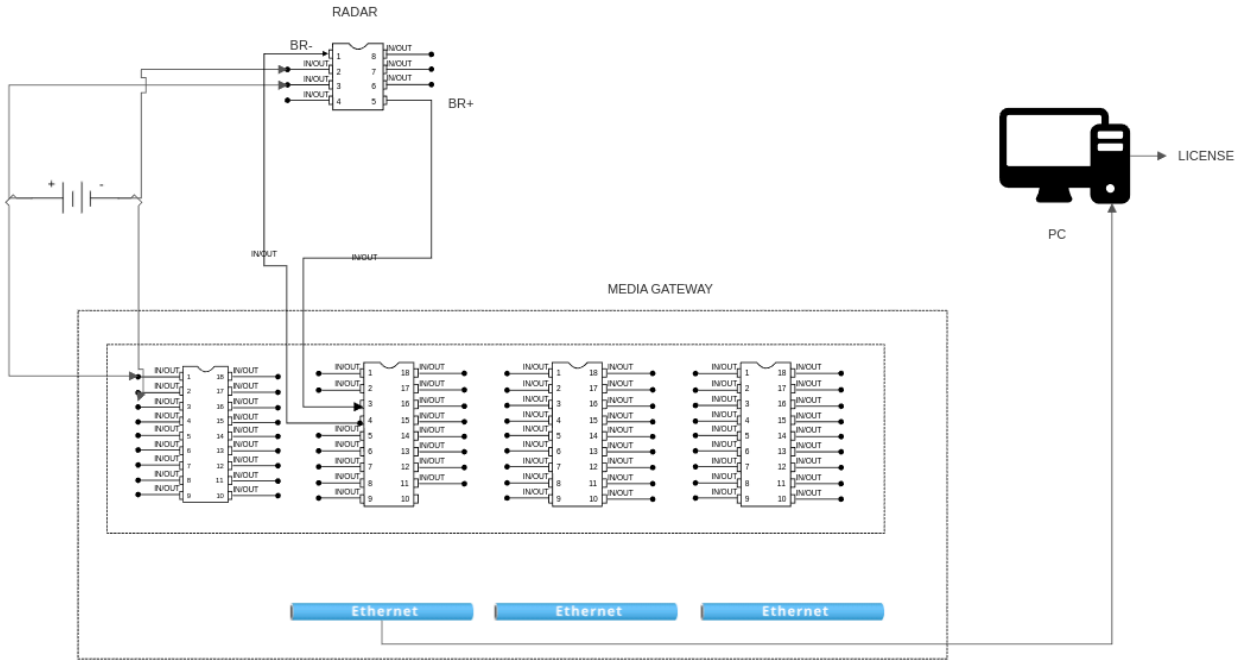
1: BR Negative

2: Ground

3: +12V

5: BR Positive

ARS430DI Radar Connector (Exemplary Illustration)



LINE DIAGRAM

To see the radar output

/opt/pdk/bin/pdk_start.sh

mention radar id

/opt/pdk/etc/pdk_config.json

To edit pdk-config.json file

gedit /opt/pdk/etc/pdk_config.json

example

```
        {
        "name": "ars_3",
        "type": "ars430di",
        "id": 22,
        "mounting_parameters": {
          "xyz": [1, 0, 0.5],
          "pitch": 0,
          "yaw": 0,
          "orientation": "PLUG_RIGHT"
        }
```

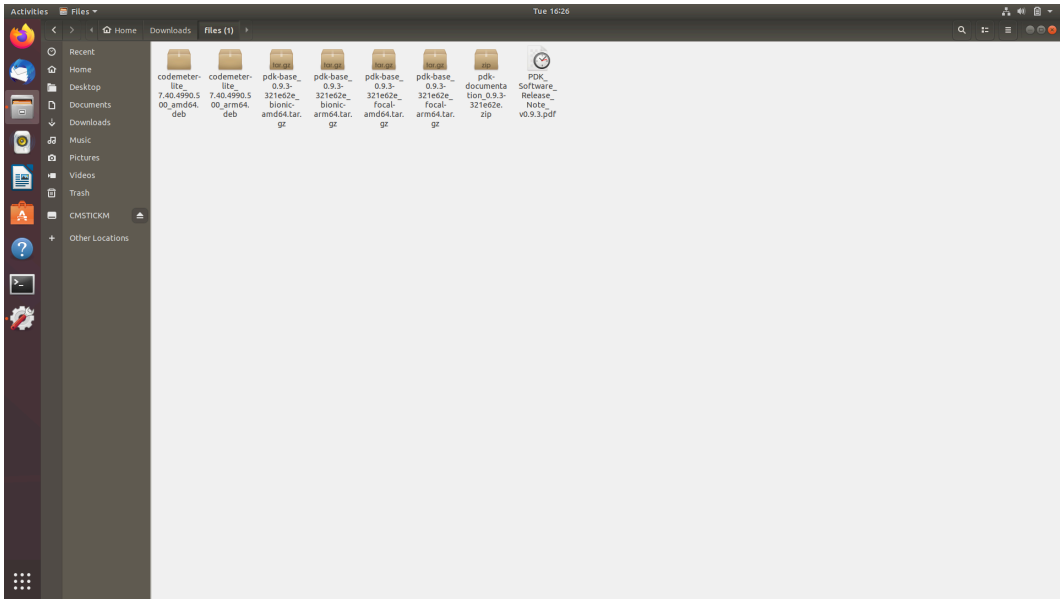
Requirements

- For long
  - Technica media gateway
  - Long range radar
  - 12v power
  - Connectors
  - Ethernet cable
  - Pc
- For short
  - Pcan usb

- ➢ Short range radar
- ➢ 12v power for both radar and pcan usb device
- ➢ Connectors
- ➢ Db9 connector
- ➢ Internet connection

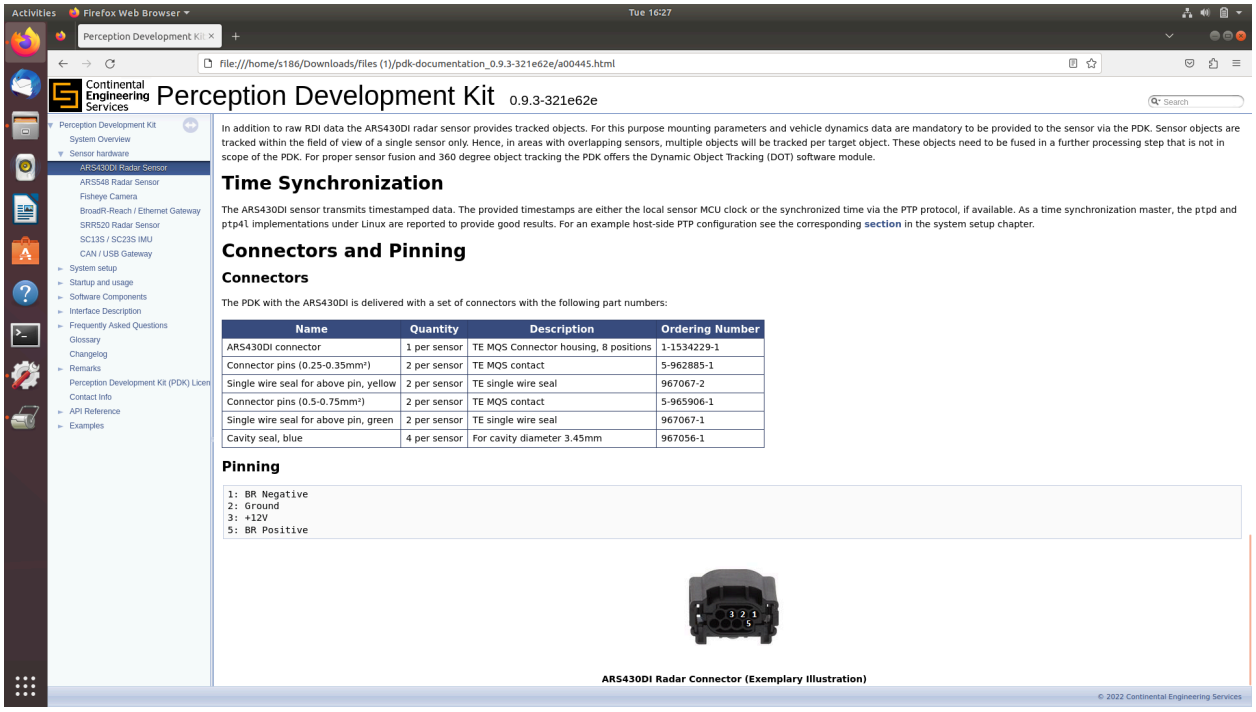
The following steps to be followed

1. Download and extract the pdk file
2. You'll be seen some zip files after extracting the pdk file

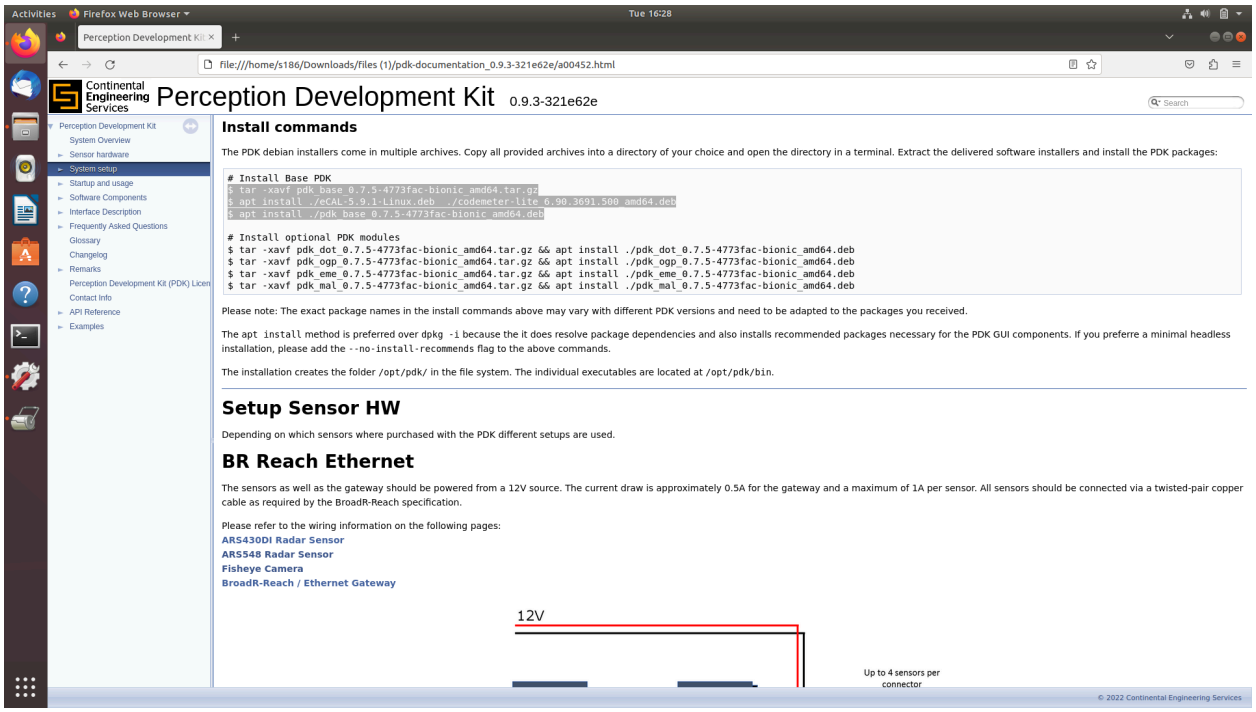


3. From the extracted the /home/s186/Downloads/files/pdk-documentation_0.9.3-321e62e.zip
4. pdk-documentation file in that go to Doc /home/s186/Downloads/files/doc/a00371_source.html

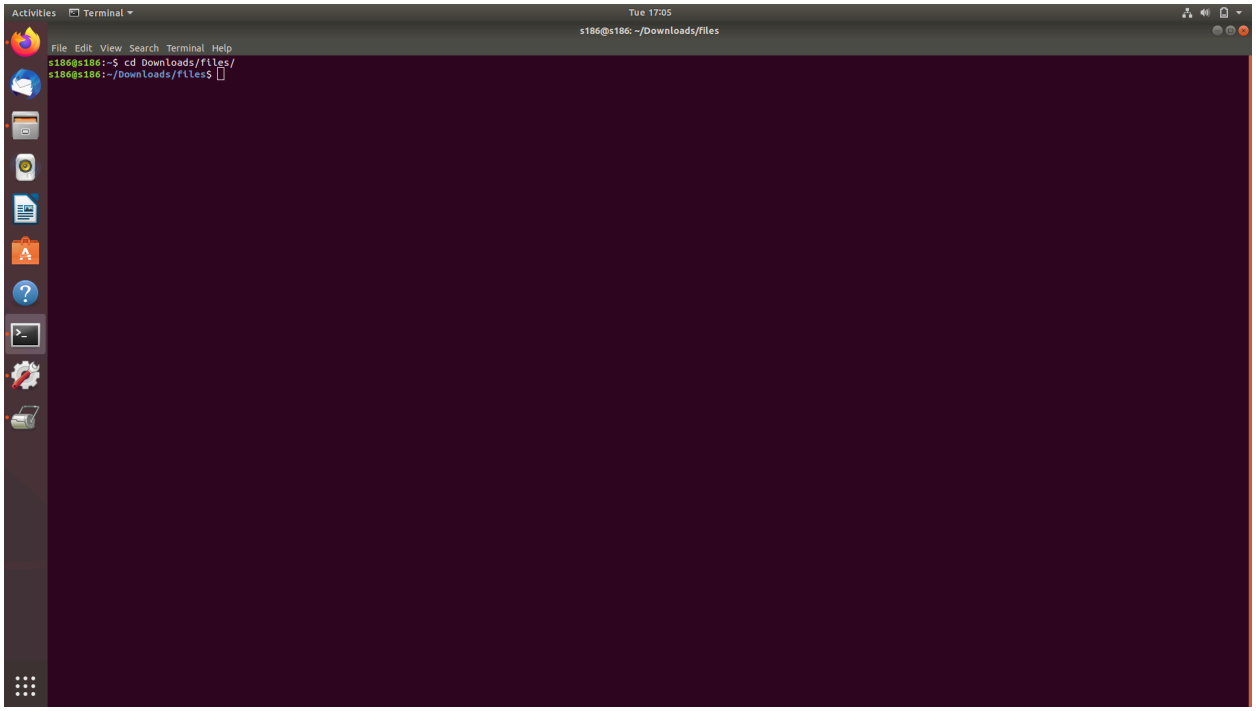
5. It will open a browse window it should contain entire information



6. Find installation commands



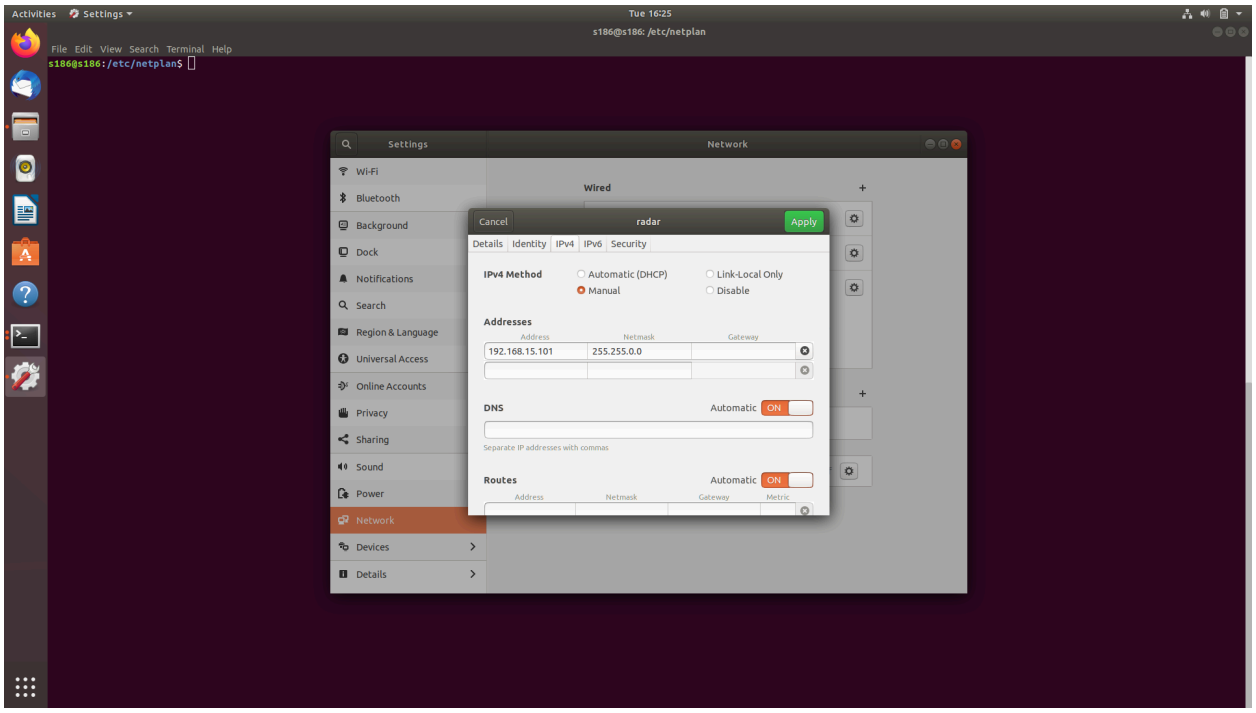
7. Use following commands from file location



8. tar -xavf pdk_base_0.7.5-4773fac-bionic_amd64.tar.gz
9. apt install ./eCAL-5.9.1-Linux.deb
    a. https://eclipse-ecal.github.io/ecal/getting_started/setup.html
    b. Enter below commands to install the required ecal requirements
    c. sudo apt update
    d. sudo apt install libc6 libcurl4 libgcc1 libhdf5-100 libprotobuf10 libqt5core5a libqt5gui5 libqt5widgets5 libqt5svg5 libstdc++6 sysstat ifstat libqwt-qt5-6 libyaml-cpp0.5v5

Note: According to the ubuntu version please select the ecal file.

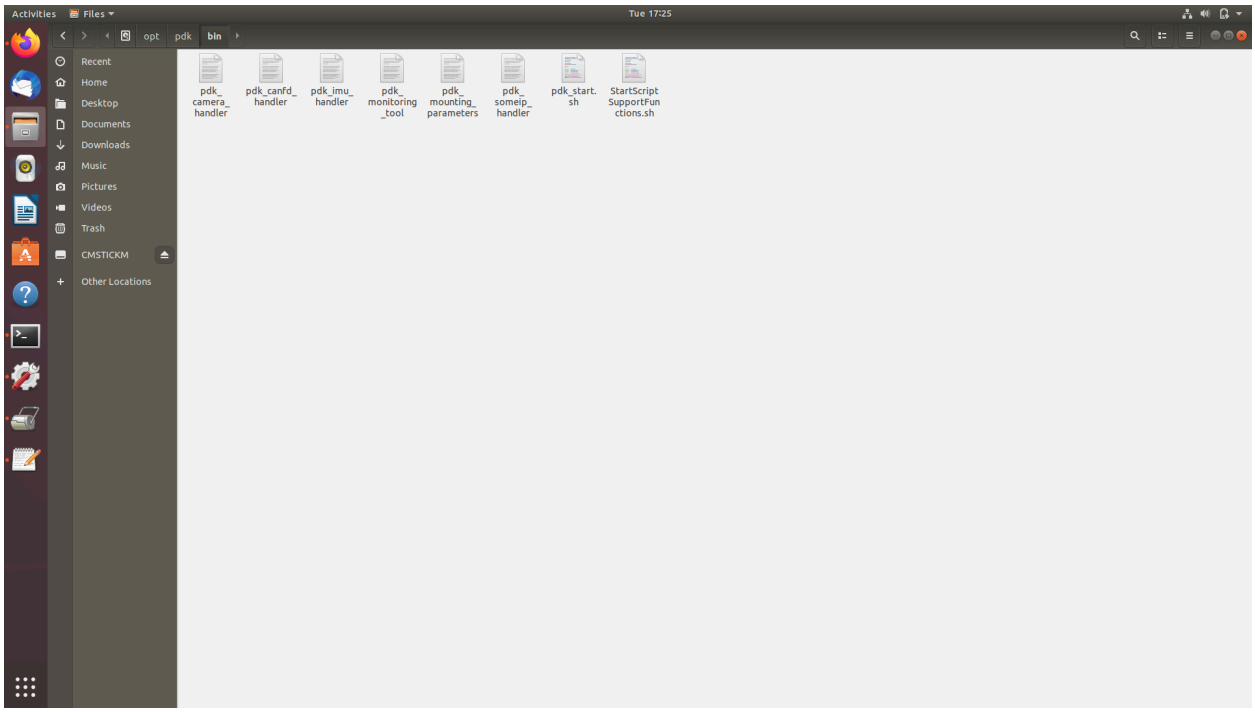
10. apt install ./codemeter-lite_6.90.3691.500_amd64.deb
11. apt install ./pdk_base_0.7.5-4773fac-bionic_amd64.deb
12. After the installation change your system ip to
    a. IP address: 192.168.15.101
    b. Network mask: 255.255.0.0



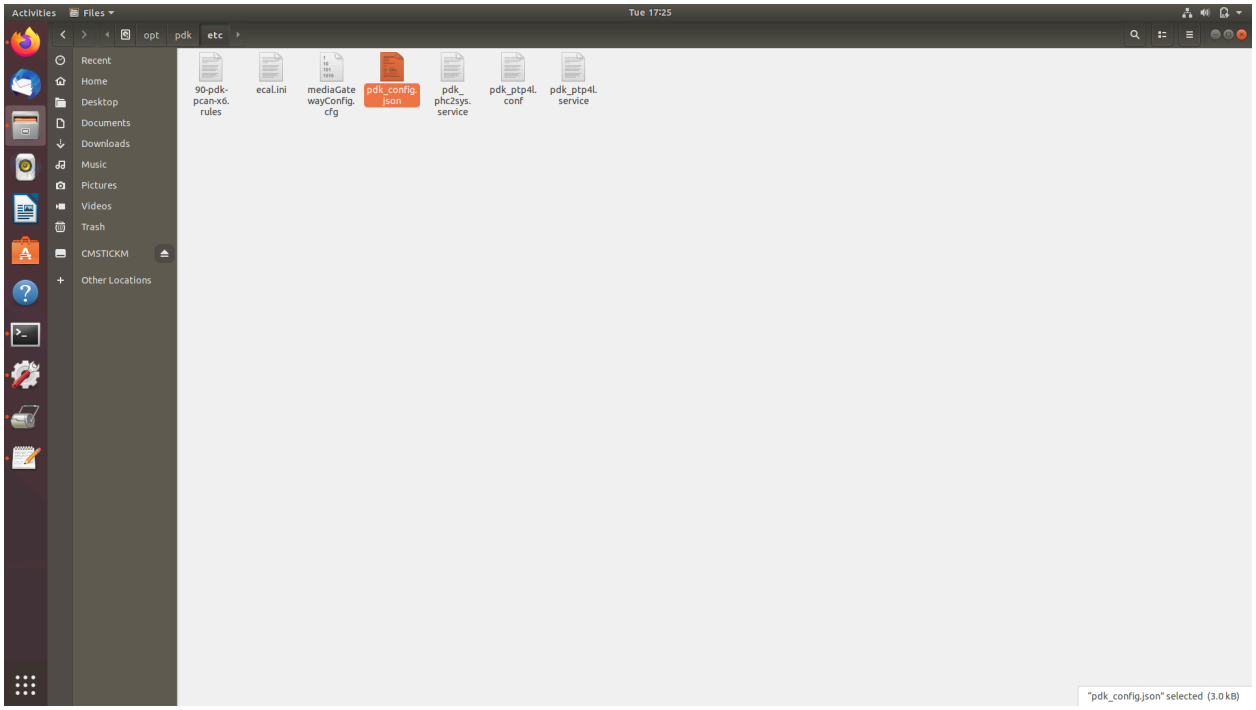
13. Also change the netplan yaml file
    a. Cd /etc/netplan
    b. s186@s186:/etc/netplan$ sudo gedit 01-network-manager-all.yamll
    c. Now your able to edit the file copy the below

```
network:
 version: 2
 renderer: NetworkManager
 ethernets:
        eno1:
        dhcp4: no
        addresses: [192.168.15.101/16]
```

14. Ensure internet connection should be required
15. After the installation completed the pdk file will be created in opt/pdk inside pdk find the bin



16. opt/pdk/etc



a. We need to place the sensor ID in the shown json file for that use below command
   i. Sudo gedit pdk_config,json
   ii. And place the ID like below

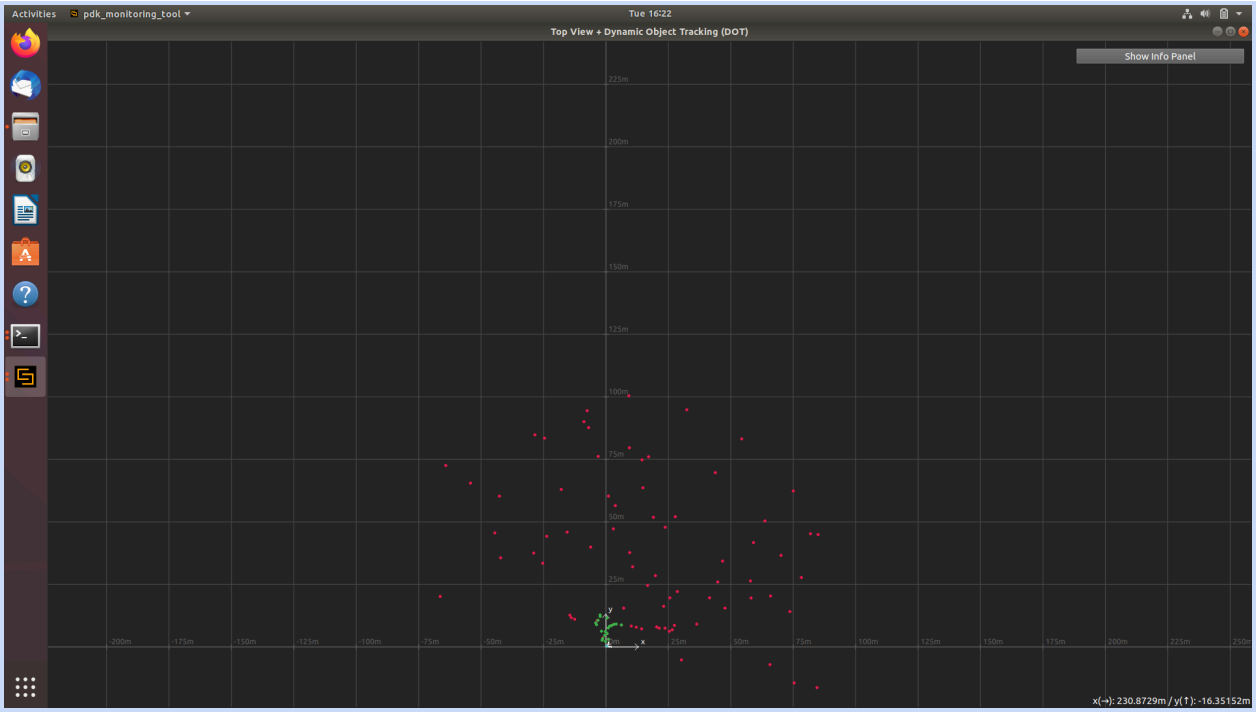
```
// ------------------------------------------------------------------------------
//
// PDK Configuration sample file to be adapted by customer
//
// ------------------------------------------------------------------------------
{
  "radar_sensors": [

        {
        "name": "srr_front_left",
        "type": "srr520di",
        "id": 0,
        "can_channel": "can0",
        "mounting_parameters": {
                "xyz": [0.8, 0.8, 1.2],
                "yaw": 1.37,
                "x_cog": 2.8,
                "orientation": "PLUG_DOWN"
        }
        },
  {
        "name": "srr_front_left",
```

```
        "type": "srr520di",
        "id": 1,
        "can_channel": "can1",
        "mounting_parameters": {
                "xyz": [0.8, 0.8, 1.2],
                "yaw": 1.37,
                "x_cog": 2.8,
                "orientation": "PLUG_DOWN"
        }
        },
{   "name": "srr_front_left",
        "type": "srr520di",
        "id": 2,
        "can_channel": "can2",
        "mounting_parameters": {
                "xyz": [0.8, 0.8, 1.2],
                "yaw": 1.37,
                "x_cog": 2.8,
                "orientation": "PLUG_DOWN"
        }
        },
        {
        "name": "ars_1",
        "type": "ars430di",
        "id": 20,
        "mounting_parameters": {
                "xyz": [1, 0, 0.5],
                "pitch": 0,
                "yaw": 0,
                "orientation": "PLUG_RIGHT"
        }
        },
        {
        "name": "ars_2",
        "type": "ars430di",
        "id": 21,
        "mounting_parameters": {
                "xyz": [1, 0, 0.5],
                "pitch": 0,
                "yaw": 0,
                "orientation": "PLUG_RIGHT"
        }
        },
        {
```

```
        "name": "ars_3",
        "type": "ars430di",
        "id": 22,
        "mounting_parameters": {
                "xyz": [1, 0, 0.5],
                "pitch": 0,
                "yaw": 0,
                "orientation": "PLUG_RIGHT"
        }
        }
        ],
        "camera_sensors": [
        {
        // Optional: sensor description
        "name": "bcam_front",
        // Camera type [bcam, svc215]
        "type": "bcam",
        // Sensor id to be published with camera images
        "id": 0,
        // Stream id for respective camera, given by hardware
        // [bcam]: "192.168.100.1:<port>" where <port> is in range [5000 ..
5003]
        // [svc215]: e.g. "001a371f80011001", "001a371f80021002",
"001a371f80031003",...
        "stream_id": "192.168.100.1:5000",
        "topic_name_id": "svc_front"
        },
        {
        "name": "bcam_rear",
        "type": "bcam",
        "id": 1,
        "stream_id": "192.168.100.1:5001",
        "topic_name_id": "svc_rear"
        }
        ],
        "localization": {
        "map_directory": "/path/to/map"
        }
}
```

17. Open opt/pdk/bin/ in terminal and enter ./pdk_mounting for conforming successful installation
18. For checking the long range radar data
    a. ./pdk_start.sh

19. For short range radar
    a. sudo ip link set can0 up type can bitrate 500000 dbitrate 2000000 fd on
    b. Then run ./pdk_start.sh
    c. The data will be shown like below



Experiment

Radar sensor output data Comparison according to place of radar fixed

Requirements

- For long
  - Technica media gateway
  - Long range radar
  - 12v power
  - Connectors
  - Ethernet cable
  - Pc
- For short
  - Pcan usb
  - Short range radar
  - 12v power for both radar and pcan usb device
  - Connectors

- ➢ Db9 connector
- ➢ Internet connection

Theory

RADAR technology in autonomous vehicles operates with millimeter waves and offers millimeter precision. The utilization of millimeter waves in autonomous vehicular RADAR **ensures high resolution in obstacle detection and centimeter accuracy in position and movement determination.**
For utilizing complete radar data the place of the radar should be the key factor.this experiment will focus on behavior of the radar sensor while placing it in enclosed(inside the bonnet) and free space(outside of the body).

Procedure

1. Sensor placed outside the car

As shown in the image(1),we fixed a long range sensor outside of the car with a double side plaster.and connections are given as per the document provided by the radar manufacturer.

Image : 1

2. Sensor placed inside the car bonnet

As shown in the image (2) we have placed the sensor inside the car bonnet with double side plaster.and connections are given as per the document provided by the radar manufacturer.

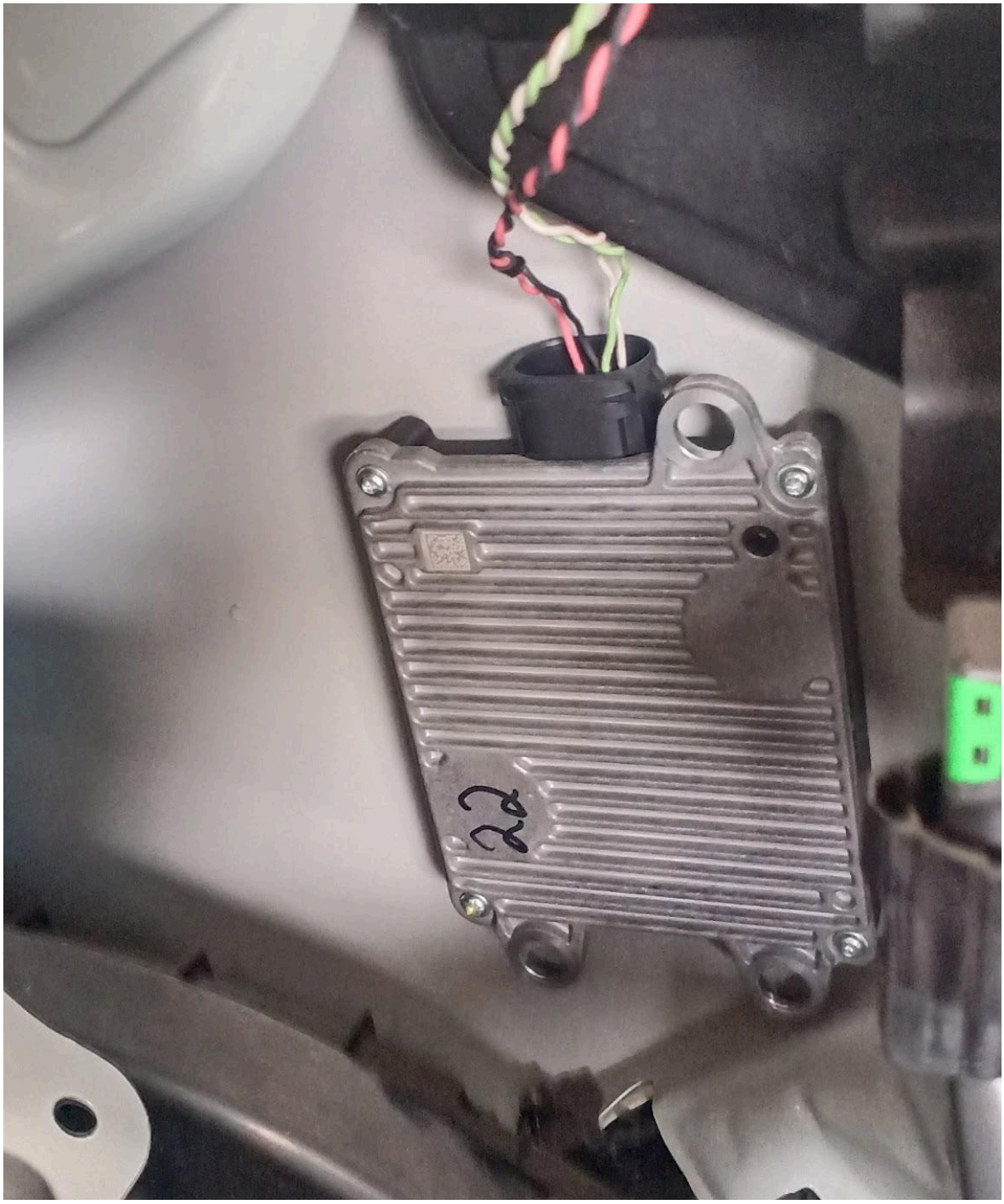


Image : 2

Results

- In the first case we can observe from image(3),radar can able to detect objects up to its mentioned range 200 meters with efficient cloud points

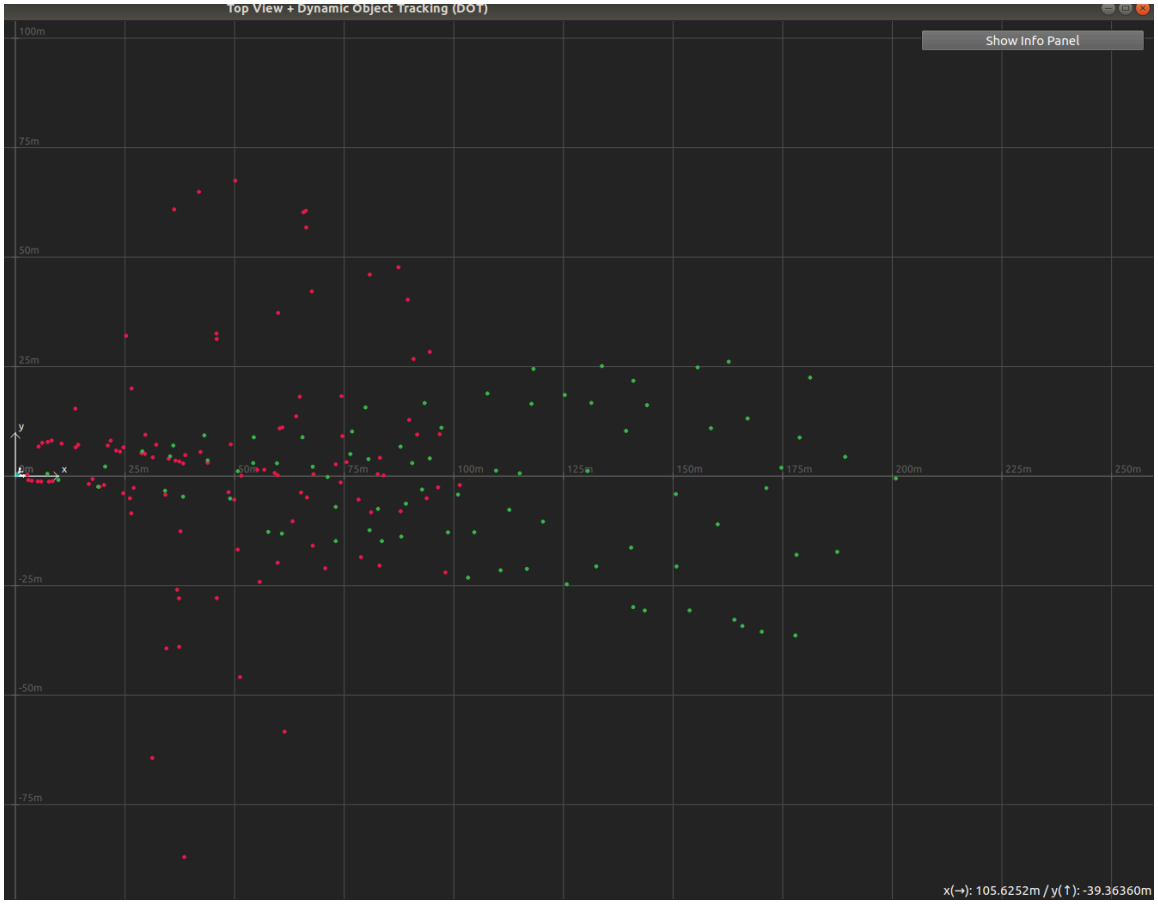


image:3

➢ In the second case from the image (4), we can see that the radar wont detected any objects because of its closed surface area

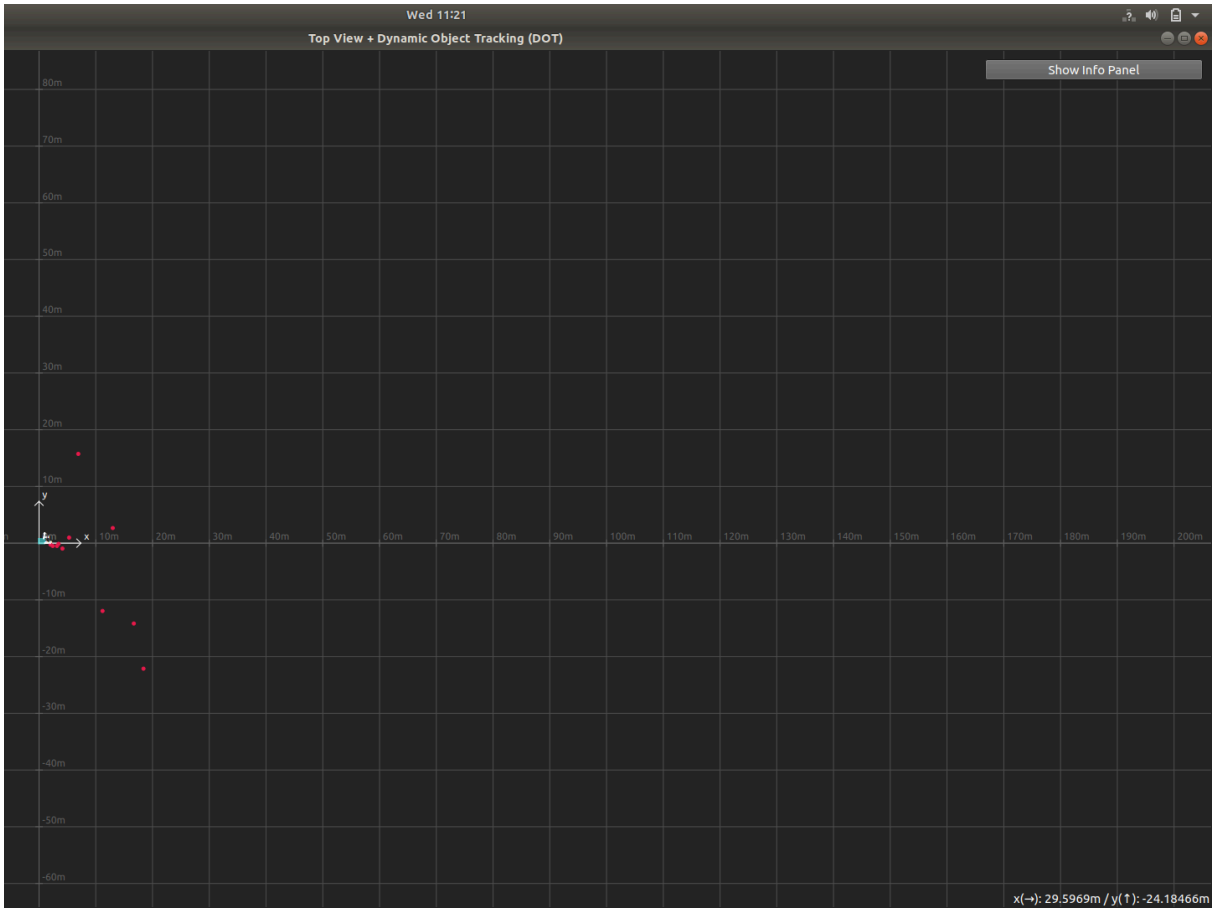


image:4

Precautions

1. Ensure that connections should be proper.avoid loose connections
2. Use proper connectors while connecting the sensor with power and data connections
3. Take the power 12v. If you're using the battery, check the power continuously. Because of power issues you may not get results.
4. Internet connection should be required.

Conclusion

1. The radar sensor surface should be placed in an open place.

2. If we place the sensor inside a closed place (inside car bonnet) sensor considers it like a obstacle.it can't project behind that closed obstacle

Sensor fusion

Environment creation:

1. python3 -m venv fusion
2. source fusion/bin/activate

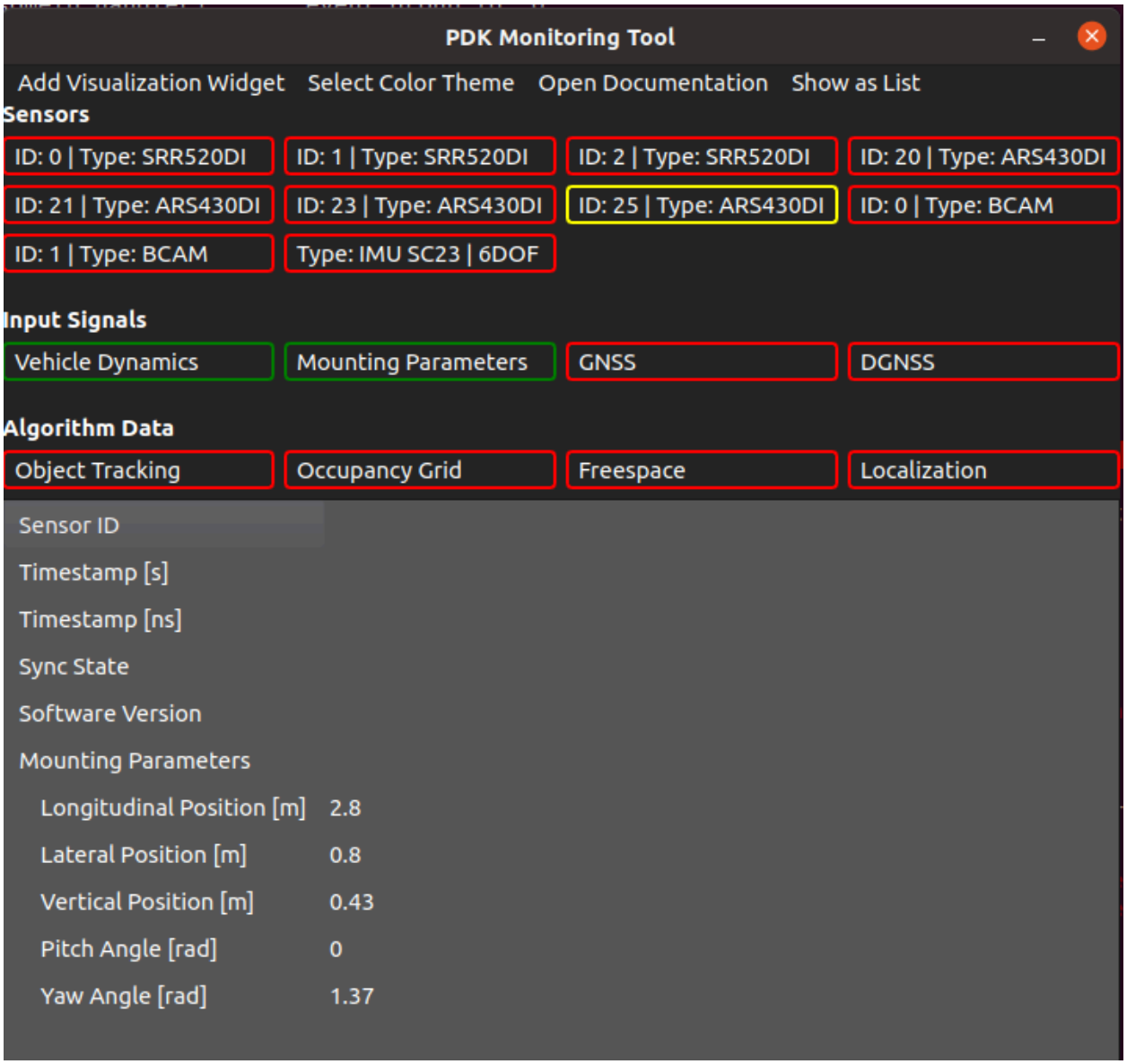
Pypylon library installation:

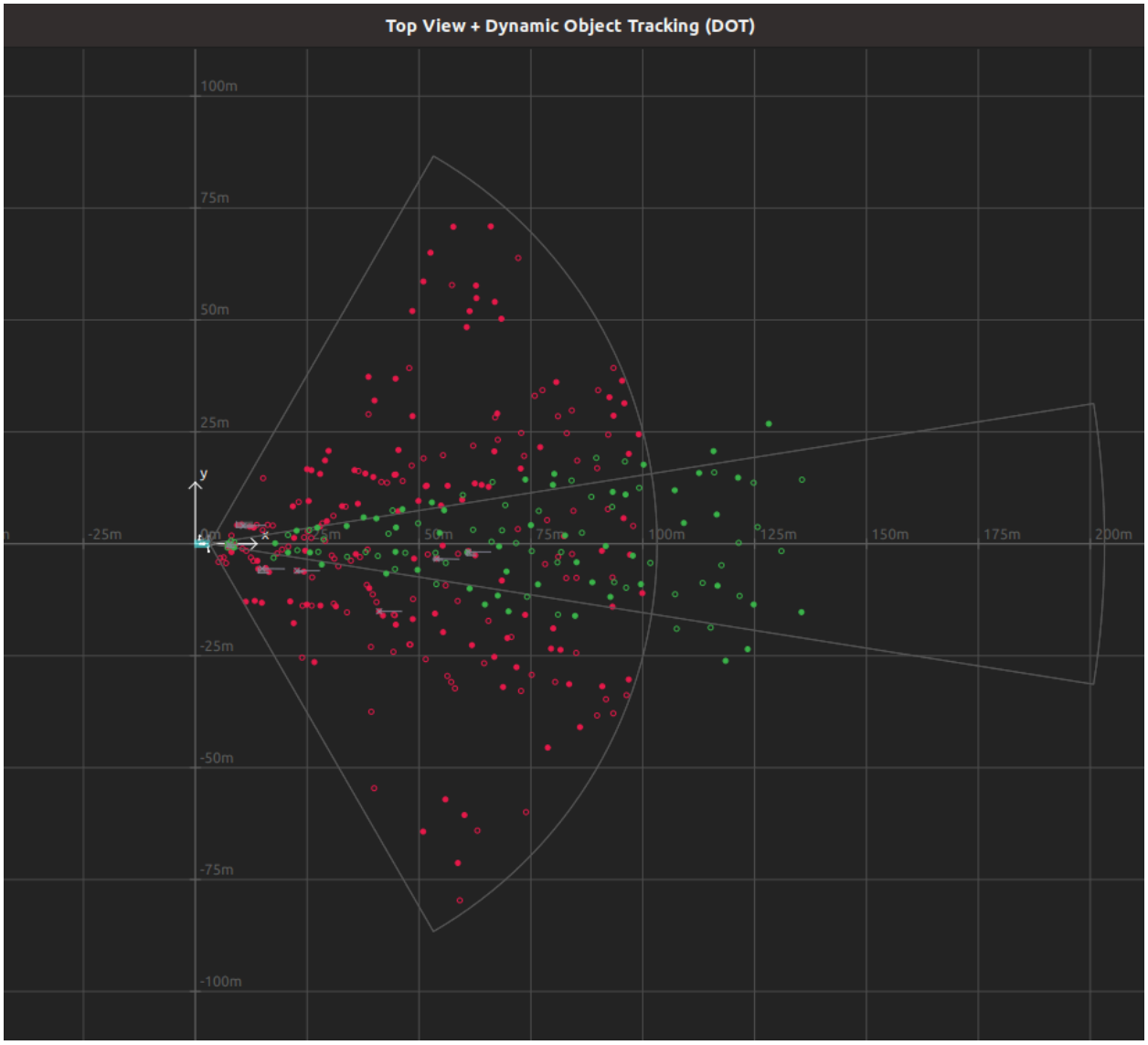
1. git clone https://github.com/basler/pypylon.git
2. cd pypylon
3. pip install .

Yolov8 requirements:

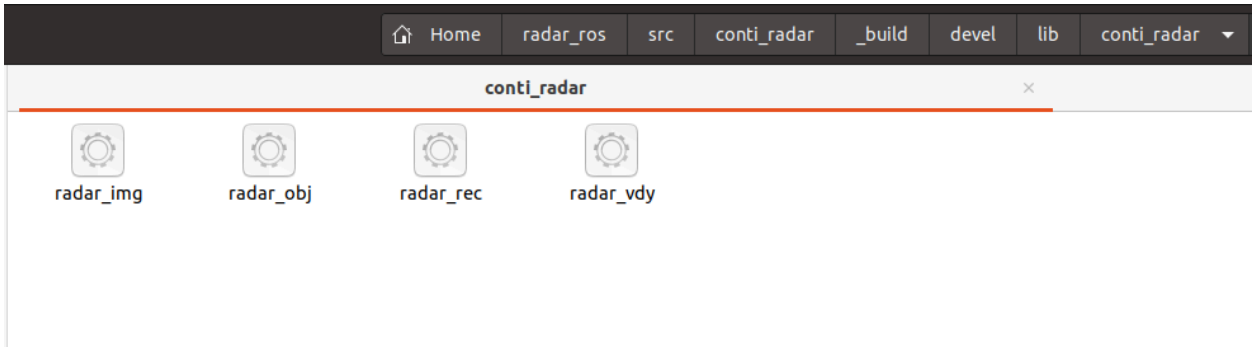
kiwisolver, cycler, pillow, packaging, contourpy, zipp, importlib-resources, fonttools, matplotlib, pytz, tzdata, pandas, seaborn, scipy, filelock, mpmath, sympy, networkx, MarkupSafe, jinja2, typing-extensions, fsspec, torch, thop, idna, urllib3, charset-normalizer, certifi, requests, torchvision, py-cpuinfo, tqdm, psutil, ultralytics
Successfully installed MarkupSafe-2.1.5 certifi-2024.2.2 charset-normalizer-3.3.2 contourpy-1.1.1 cycler-0.12.1 filelock-3.13.3 fonttools-4.51.0 fsspec-2024.3.1 idna-3.6 importlib-resources-6.4.0 jinja2-3.1.3 kiwisolver-1.4.5 matplotlib-3.7.5 mpmath-1.3.0 networkx-3.1 packaging-24.0 pandas-2.0.3 pillow-10.3.0 psutil-5.9.8 py-cpuinfo-9.0.0 pytz-2024.1 requests-2.31.0 scipy-1.10.1 seaborn-0.13.2 sympy-1.12 thop-0.1.1.post2209072238 torch-2.2.2 torchvision-0.17.2 tqdm-4.66.2 typing-extensions-4.11.0 tzdata-2024.1 ultralytics-8.1.43 urllib3-2.2.1 zipp-3.18.1

1.$ roscore
2./opt/pdk/bin$ ./pdk_start.sh





3.~/radar_ros/src/conti_radar/_build/devel/lib/conti_radar$ ./radar_obj



```
orin@ubuntu:~/radar_ros/src/conti_radar/_build/devel/lib/conti_radar$ ./radar_obj
Library version: 0.9.3-321e62e
Received 9 detections
Received 9 detections
Received 9 detections
Received 8 detections
Received 8 detections
Received 8 detections
Received 8 detections
Received 8 detections
Received 8 detections
Received 8 detections
Received 8 detections
Received 9 detections
Received 9 detections
Received 9 detections
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Received 9 detections
Received 9 detections
Received 9 detections
Received 9 detections
Received 9 detections
```
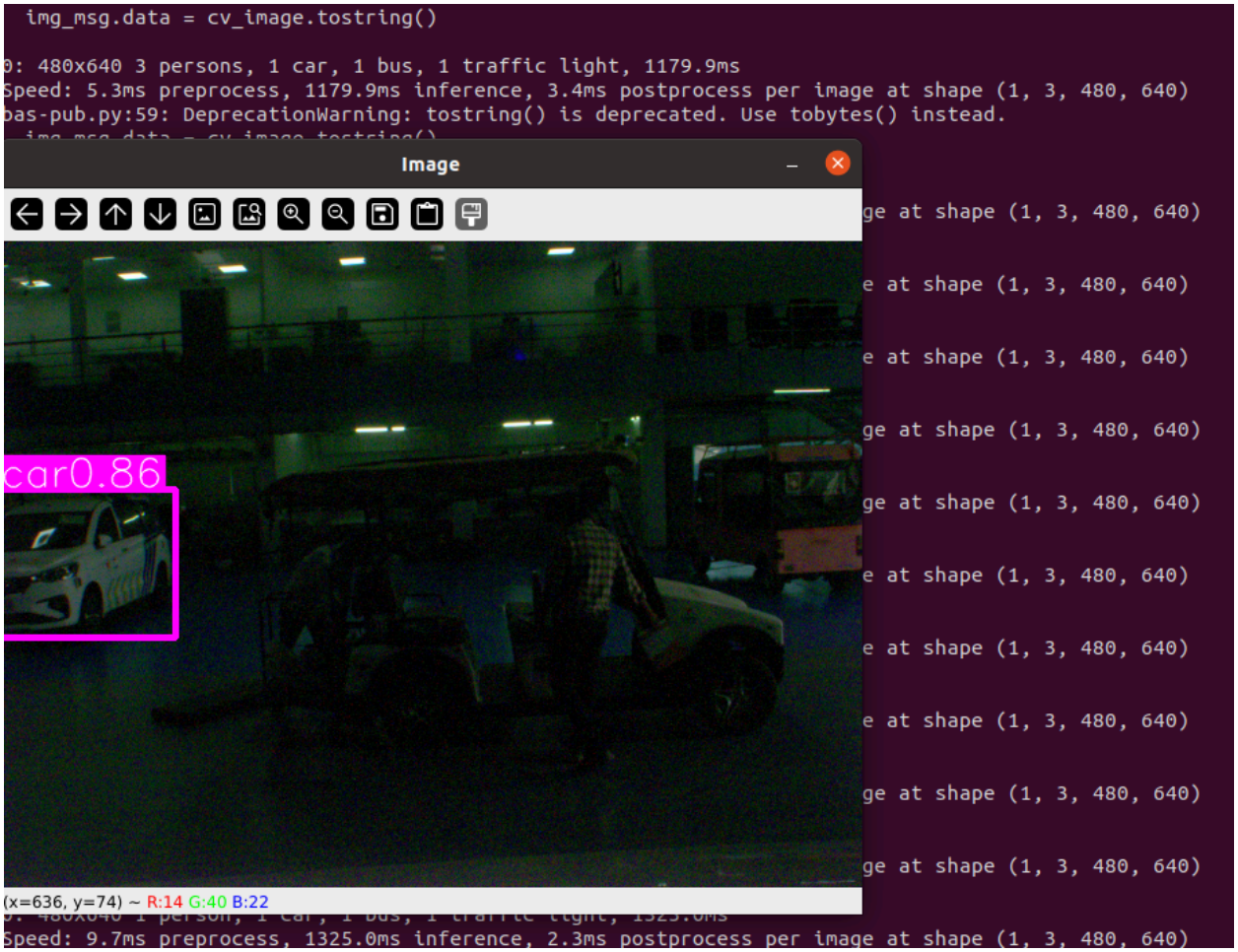

4.~/radar_ros/src/conti_radar/_build/devel/lib/conti_radar$ ./radar_vdy

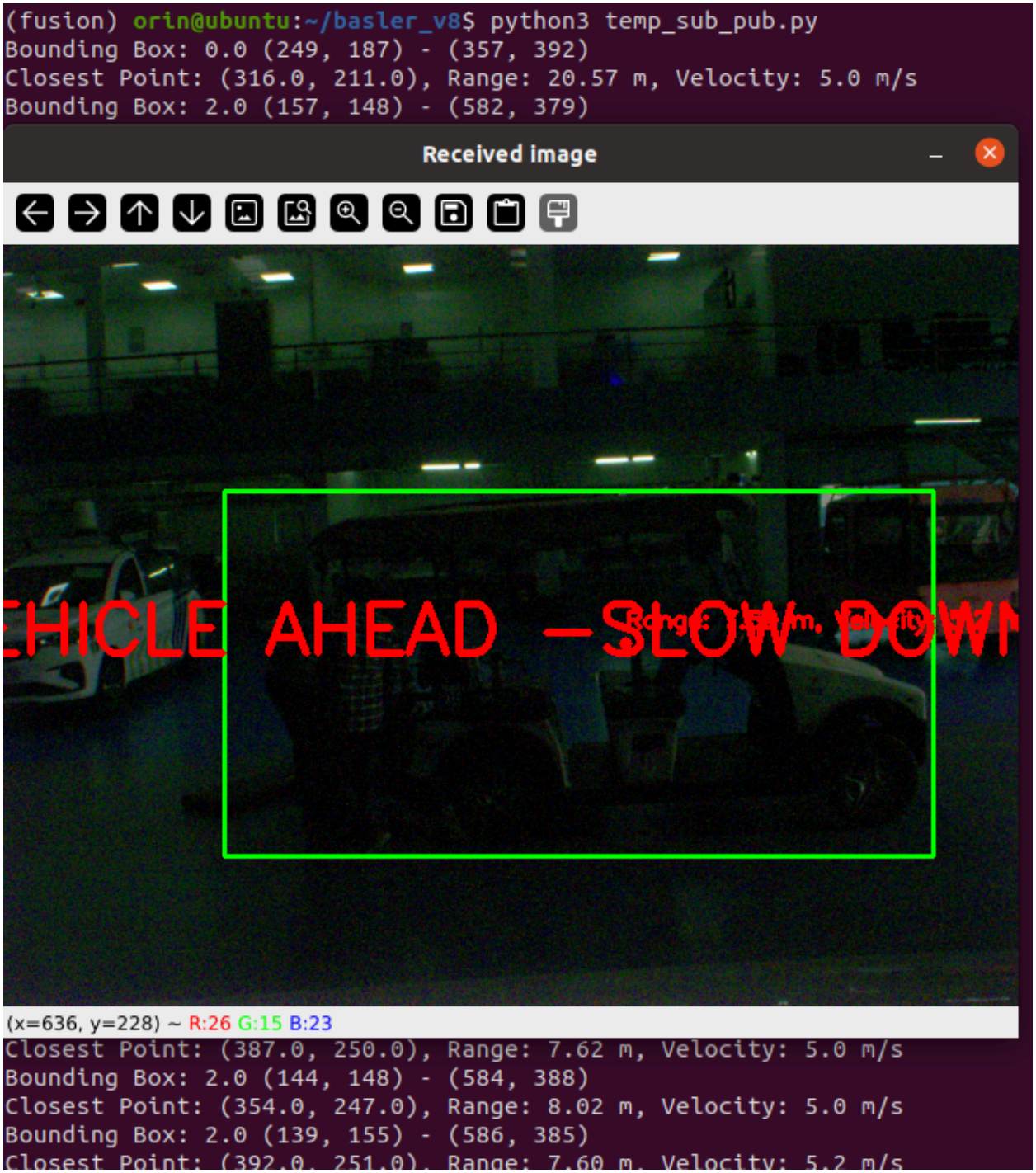
```
orin@ubuntu:~/radar_ros/src/conti_radar/_build/devel/lib/conti_radar$ ./radar_vdy
Library version: 0.9.3-321e62e
not_sent
not_sent
not_sent
not_sent
not_sent
sent
sent
sent
sent
sent
sent
sent
sent
sent
sent
sent
sent
sent
sent
sent
sent
sent
```

5.(fusion) orin@ubuntu:~/basler_v8$ python3 bas-pub.py



6.(fusion) orin@ubuntu:~/basler_v8$ source/home/orin/radar_ros/src/conti_radar/_build/devel/setup.bash

7.(fusion) orin@ubuntu:~/basler_v8$ python3 temp_sub_pub.py



For cuda pytorch and torchvision installations
https://docs.google.com/document/d/1R56QsxFw_WxeJUkjWA_8POHq8MlCPZeUY6IguWTg8io/edit?usp=sharing