4. Docker hardware interaction and data processing

The operating environment and software and hardware reference configuration are as follows:

- Reference model: ROSMASTER X3
- Robot hardware configuration: Arm series main control, Silan A1 lidar, AstraPro Plus depth camera
- Robot system: Ubuntu (no version required) + docker (version 20.10.21 and above)
- PC virtual machine: Ubuntu (18.04) + ROS (Melodic)
- Usage scenario: Use on a relatively clean 2D plane

4.1. Hardware mounting (port binding)

1. Establish udev rules (/etc/udev/rules.d/) in the host machine, see chapter [6. Linux operating system ---- 6. Bind device ID]
2. Then when opening the container, mount the devices with the rules set into the docker container through --device=/dev/myserial --device=/dev/rplidar and other parameters.

```
docker run -it --device=/dev/myserial --device=/dev/rplidar ubuntu:latest
/bin/bash
```

3. The device can be found in the docker container

```
jetson@ubuntu:~$ docker images
REPOSITORY TAG IMAGE ID CREATED SIZE
ubuntu 1.0 78ca7be949b6 About an hour ago 69.2MB
pengan88/ubuntu 1.0 78ca7be949b6 About an hour ago 69.2MB
yahboomtechnology/ros-foxy 3.4.0 49581aa78b6b 6 hours ago 24.3GB
yahboomtechnology/ros-foxy 3.3.9 cefb5ac2ca02 4 days ago 20.5GB
yahboomtechnology/ros-foxy 3.3.8 49996806c64a 4 days ago 20.5GB
yahboomtechnology/ros-foxy 3.3.7 8989b8860d17 5 days ago 17.1GB
yahboomtechnology/ros-foxy 3.3.6 326531363d6e 5 days ago 16.1GB
mysql latest 5371f8c3b63e 6 days ago 592MB
ubuntu latest bab8ce5c00ca 6 weeks ago 69.2MB
hello-world latest 46331d942d63 13 months ago 9.14kB
jetson@ubuntu:~$ ll /dev | grep ttyUSB*
```

```
lrwxrwxrwx 1 root root 7 Apr 23 18:07 myserial -> ttyUSB0
lrwxrwxrwx 1 root root 7 Apr 23 18:07 rplidar -> ttyUSB1
crwxrwxrwx 1 root dialout 188, 0 Apr 23 18:07 ttyUSB0
crwxrwxrwx 1 root dialout 188, 1 Apr 23 18:07 ttyUSB1
jetson@ubuntu:~$ docker run -it --device=/dev/myserial --device=/dev/rplidar
ubuntu:latest /bin/bash
root@03522257ba30:/# ls /dev # There are already myserial and rplidar in docker
console fd full mqueue myserial null ptmx pts random rplidar shm stderr stdin
stdout tty urandom zero
```

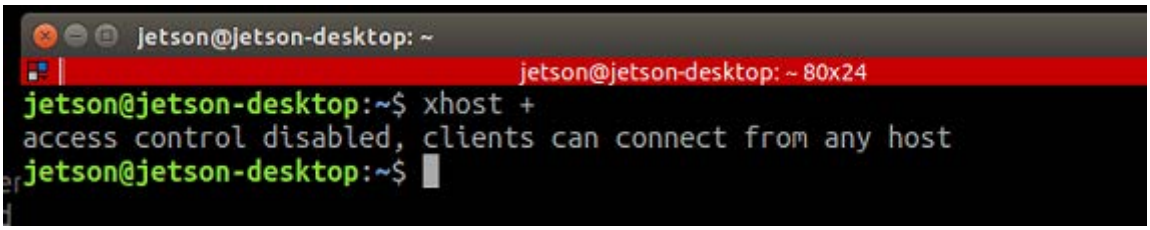
4.2. Display of GUI in docker

1. Install on the host machine:

```
sudo apt-get install tigervnc-standalone-server tigervnc-viewer
sudo apt-get install x11-xserver-utils
```

2. Execute in the host machine: xhost +

After the following picture is displayed normally, perform 3 steps:



3. Execute the command on the host to enter the container:

```
docker run -it \ # Interactively run the docker image
--env="DISPLAY" \ # Turn on the display GUI interface
--env="QT_X11_NO_MITSHM=1" \ # Use X11 port 1 for display
-v /tmp/.X11-unix:/tmp/.X11-unix \ # Map display service node directory
yahboomtechnology/ros-foxy:3.3.9 # The name of the image to be started
/bin/bash # Execute the /bin/bash command within the container
```

4. Test

```
Execute in container: rviz2
```

4.3. Transfer files between docker container and host machine

4.3.1. Use cp naming

4.3.1.1. Copy files from the container to the host

```
# Order
docker cp container id: path within the container destination host path

# test
# Execute within the container and create a file test
jetson@ubuntu:~$ docker ps -a
CONTAINER ID IMAGE COMMAND CREATED STATUS PORTS NAMES
c54bf9efae47 ubuntu:latest "/bin/bash" 2 hours ago Up 9 minutes funny_hugle
3b9c01839579 hello-world "/hello" 3 hours ago Exited (0) 3 hours ago jovial_brown
jetson@ubuntu:~$ docker attach c5
root@c54bf9efae47:/# ls
bin boot dev etc home lib media mnt opt proc root run sbin srv sys tmp usr var
root@c54bf9efae47:/# cd
root@c54bf9efae47:~# ls
root@c54bf9efae47:~# touch test.txt
root@c54bf9efae47:~# ls
test.txt
root@c54bf9efae47:~# pwd
/root
root@c54bf9efae47:/# read escape sequence #Press ctrl+P+Q to exit the container
without stopping.
jetson@ubuntu:~$ docker cp c54bf9efae47:/root/test.txt ~/
jetson@ubuntu:~$ ls # The test.txt file has been copied in
Desktop Documents Downloads fishros Music openvino Pictures Public rootOnNVMe
run_docker.sh sensors snap temp Templates test.txt Videos
```

4.3.1.2. Copy files from the host to the container

```
# Order
docker cp host file path container id: path within the container

#test
jetson@ubuntu:~$ docker ps -a
CONTAINER ID IMAGE COMMAND CREATED STATUS PORTS NAMES
c54bf9efae47 ubuntu:latest "/bin/bash" 2 hours ago Up 5 minutes funny_hugle
3b9c01839579 hello-world "/hello" 3 hours ago Exited (0) 3 hours ago jovial_brown
jetson@ubuntu:~$ ls
Desktop Documents Downloads fishros Music openvino Pictures Public rootOnNVMe
run_docker.sh sensors snap temp Templates test.txt Videos
jetson@ubuntu:~$ touch 11.txt
jetson@ubuntu:~$ ls
11.txt Desktop Documents Downloads fishros Music openvino Pictures Public
rootOnNVMe run_docker.sh sensors snap temp Templates test.txt Videos
jetson@ubuntu:~$ docker cp 11.txt c54bf9efae47:/root/
jetson@ubuntu:~$ docker attach c5
```

```
root@c54bf9e
```