4、HD camera object tracking

4.1、Introduction

Website：https://learnopencv.com/object-tracking-using-opencv-cpp-python/#opencv-tracking-api

Object tracking is to locate an object in consecutive video frames.

- Comparison of OpenCV algorithms

Algorithm	Speed	Accuracy	Description
BOOSTING	Slow	Low	It is the same as the machine learning algorithm behind Haar casades (AdaBoost), but it has been born for more than ten years, a veteran algorithm.
MIL	Slow	Low	It is more accurate than BOOSTING, but the failure rate is higher.
KCF	Fast	High	Faster than BOOSTING and MIL, but it is not effective when there is occlusion
TLD	Middle	Middle	There are a lot of erro
MEDIANFLOW	Middle+	Middle	The model will fail for fast-jumping or fast-moving objects.
GOTURN	Middle	Middle	A deep learning-based object detector requires additional models to run.

Algorithm	Speed	Accuracy	Description
MOSSE	Fastest	High	The speed is really fast, but not as high as the accuracy of CSRT and KCF. If you are looking for speed, you can choose it.
CSRT	Fast -	Higher	Slightly more accurate than KCF, but not as fast as KCF.

4.2. Operation steps

Note: [R2] on the remote control handle has the [pause/start] function for all gameplays.

4.2.1. Start

jetson motherboard/Raspberry Pi 4B

Start the underlying driver control, which can also be placed in other launch files. (robot side)

```
roslaunch transbot_bringup bringup.launch
```

Raspberry Pi 5

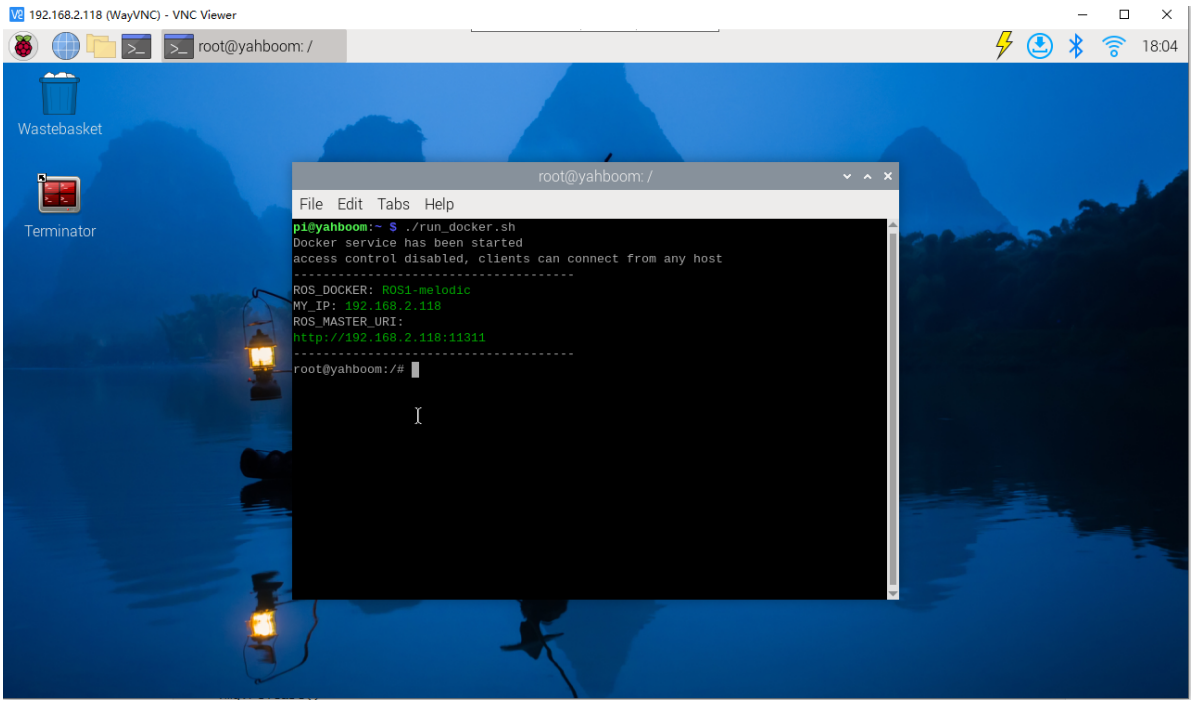
Before running, please confirm that the large program has been permanently closed

Enter docker

Note: If there is a terminal that automatically starts docker, or there is a docker terminal that has been opened, you can directly enter the docker terminal to run the command, and there is no need to manually start docker

Start docker manually

```
./run_docker.sh
```



Start low-level driver control

```
roslaunch transbot_bringup bringup.launch
```

method one

jetson motherboard/Raspberry Pi 4B

Start the monocular camera (robot side)

```
roslaunch usb_cam usb_cam-test.launch
```

Start monocular target tracking control (virtual machine)

```
roslaunch transbot_mono mono_tracker.launch VideoSwitch:=false tracker_type:=KCF
```

Raspberry Pi 5

Enter the same docker from multiple terminals

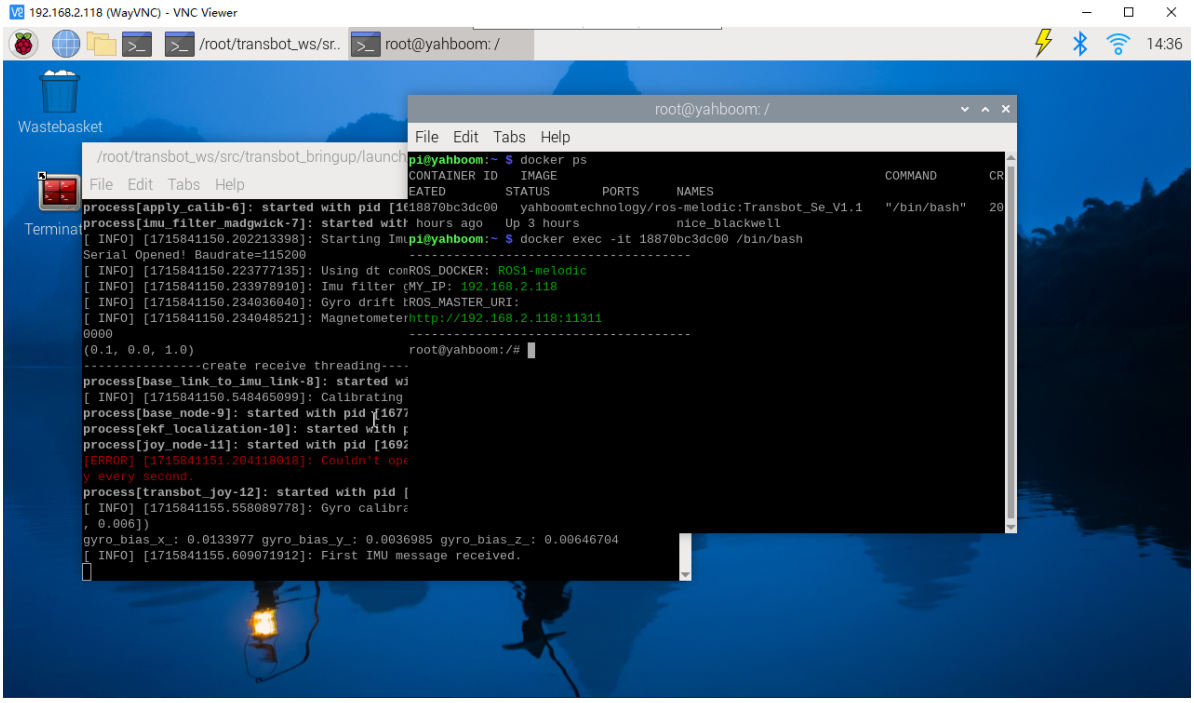
Keep the program of the previous docker terminal running and open a new terminal

Enter the following command

```
docker ps
```

Enter the same docker and use the following 18870bc3dc00 to modify the ID displayed on the actual terminal.

```
docker exec -it 18870bc3dc00 /bin/bash
```



Start the monocular camera (robot side)

```
roslaunch usb_cam usb_cam-test.launch
```

Start monocular target tracking control (virtual machine)

```
roslaunch transbot_mono mono_tracker.launch VideoSwitch:=false tracker_type:=KCF
```

Method 2

Note: [q] key to exit.

jetson motherboard/Raspberry Pi 4B

```
python3 ~/transbot_ws/src/transbot_mono/scripts/mono_Tracker.py
```

Raspberry Pi 5

Enter the same docker from multiple terminals

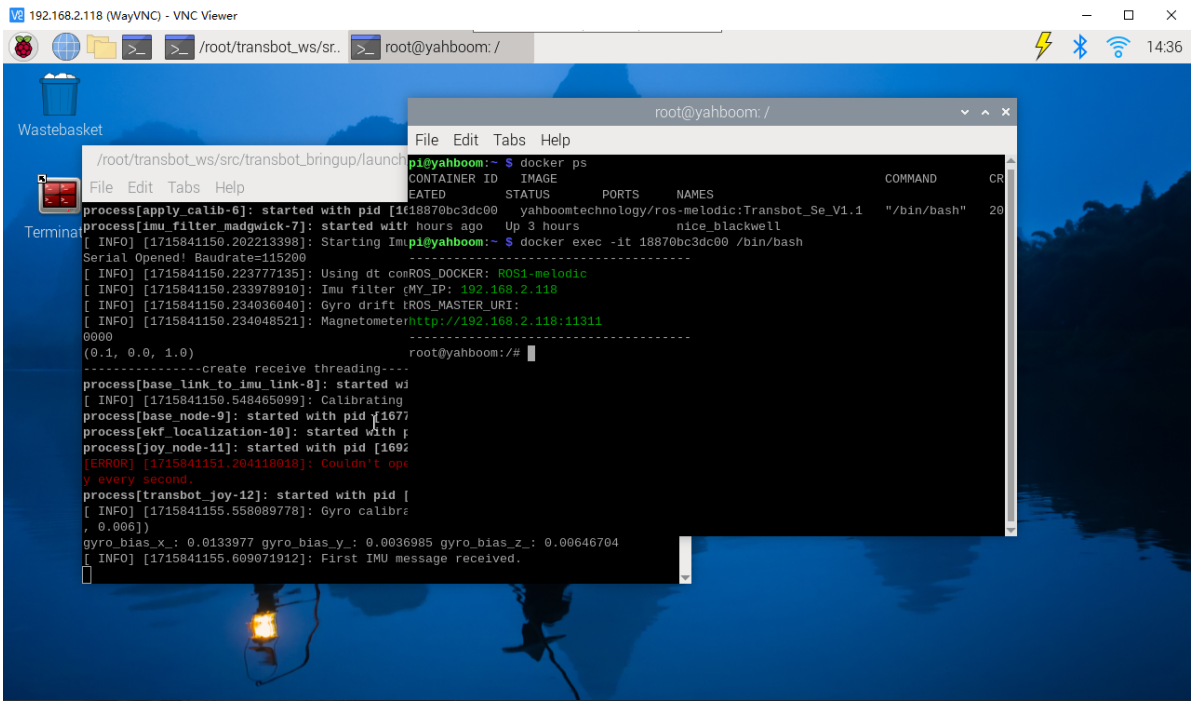
Keep the program of the previous docker terminal running and open a new terminal

Enter the following command

```
docker ps
```

Enter the same docker and use the following 18870bc3dc00 to modify the ID displayed on the actual terminal.

```
docker exec -it 18870bc3dc00 /bin/bash
```




```
python3 ~/transbot_ws/src/transbot_mono/scripts/mono_Tracker.py
```

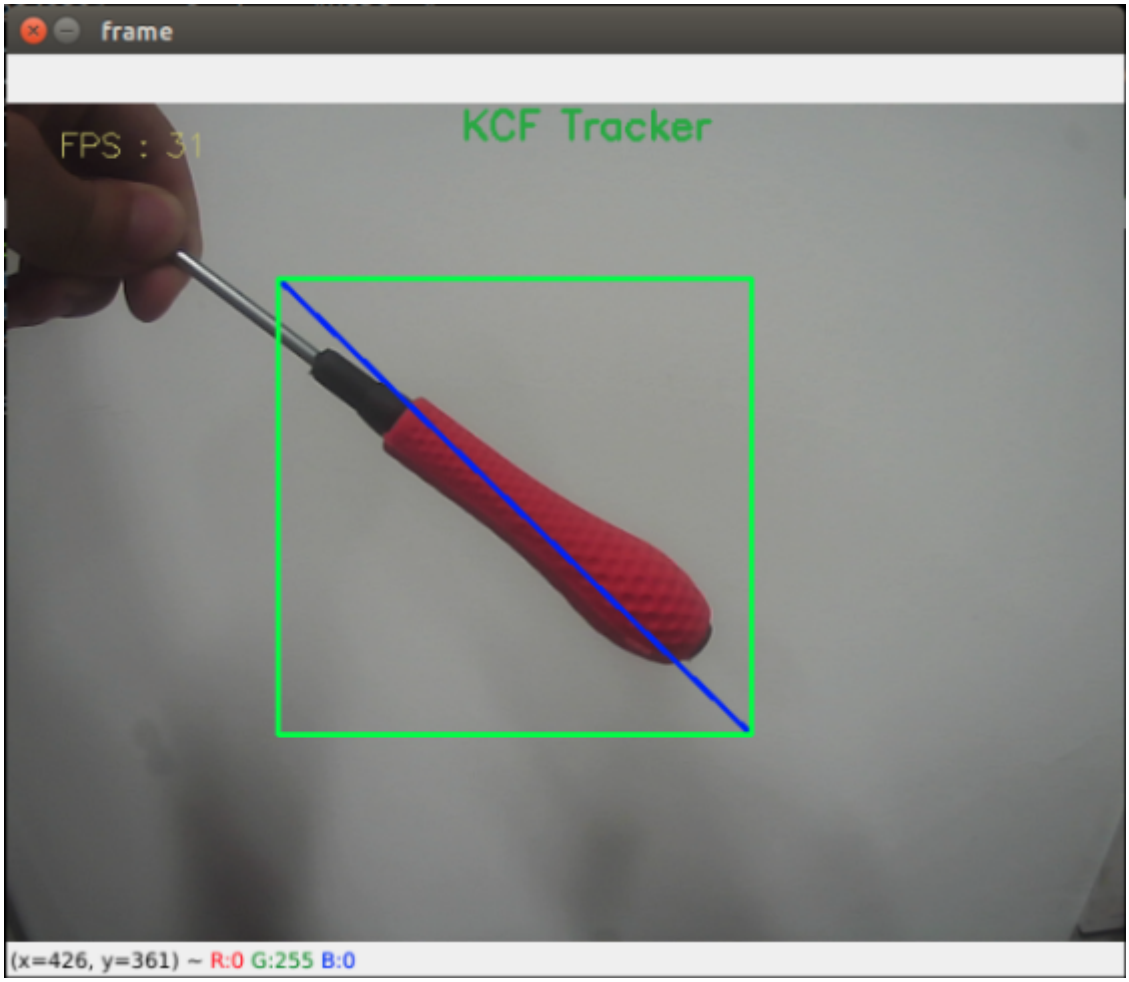
This method can only be started in the main control connected to the camera

- VideoSwitch parameter: whether to use the camera function package to launch; for example: to launch usb_cam-test.launch, this parameter must be set to true; otherwise, it is false.
- tracker_type parameter: OpenCV Tracking API; optional: ['BOOSTING', 'MIL', 'KCF', 'TLD', 'MEDIANFLOW', 'MOSSE', 'CSRT']

Set parameters according to needs, or modify the launch file directly, so there is no need to attach parameters when starting.

4.2.2. Identification

After starting, enter the selection mode, use the mouse to select the target location, as shown in the figure below, release it to start recognition.



Keyboard key control:

[r]: Select mode, you can use the mouse to select the area to identify the target, as shown in the picture above.

[f]: Switching algorithm; ['BOOSTING', 'MIL', 'KCF', 'TLD', 'MEDIANFLOW', 'MOSSE', 'CSRT'].

[q]: Exit the program.

[Spacebar]: Target tracking; just move the target slowly while following. If you move too fast, you will lose the target.

4.2.3. PID adjustment

Dynamic parameter tuning

jetson motherboard/Raspberry Pi 4B

```
rosrun rqt_reconfigure rqt_reconfigure
```

Raspberry Pi 5

Enter the same docker from multiple terminals

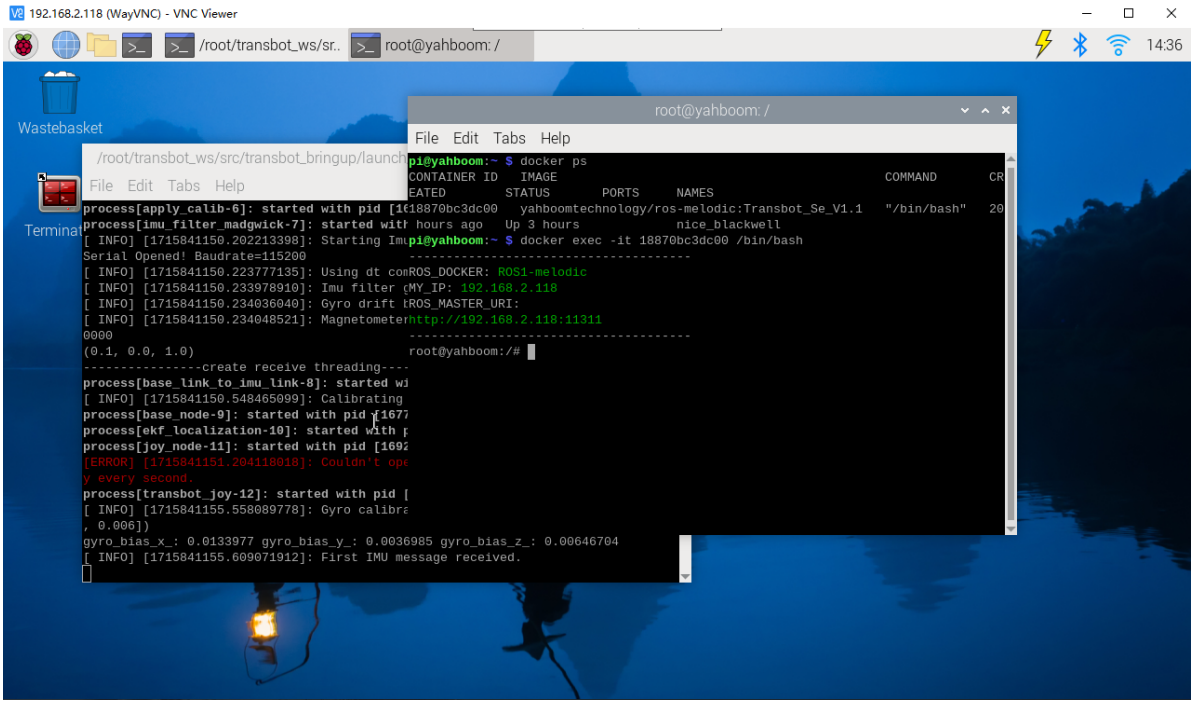
Keep the program of the previous docker terminal running and open a new terminal

Enter the following command

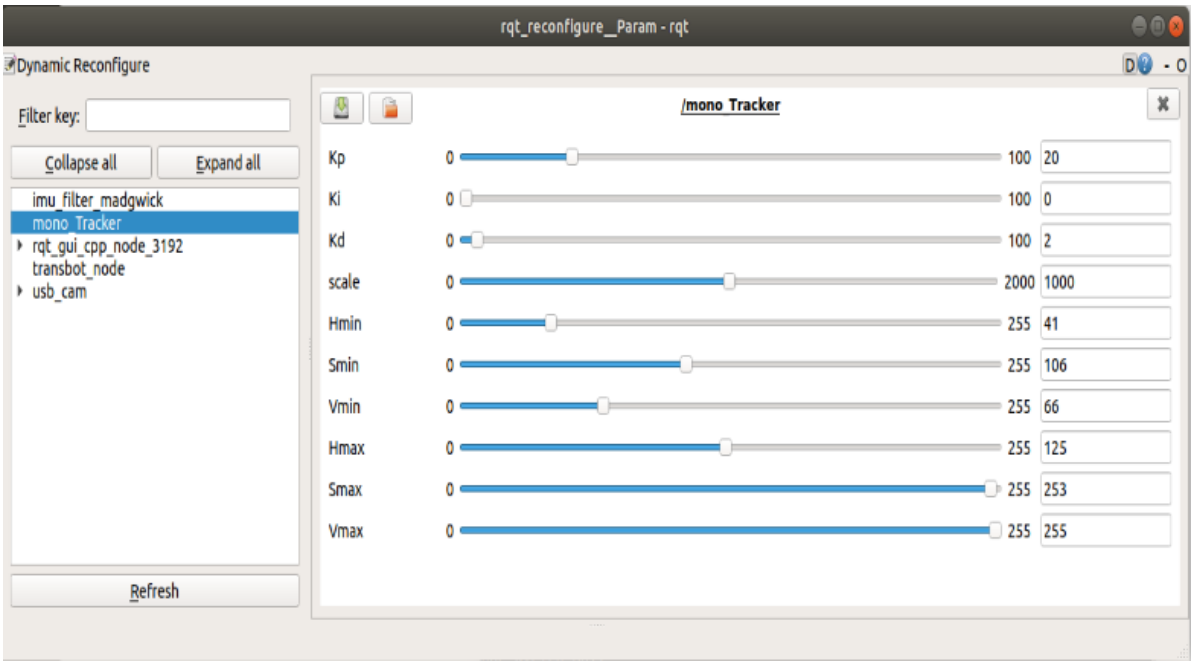
```
docker ps
```

Enter the same docker and use the following 18870bc3dc00 to modify the ID displayed on the actual terminal.

```
docker exec -it 18870bc3dc00 /bin/bash
```




```
rosrun rqt_reconfigure rqt_reconfigure
```



Select the [mono_Tracker] node, and the six parameters [Hmin], [Smin], [Vmin], [Hmax], [Smax], and [Vmax] do not need to be adjusted. The slide bar is always in a dragging state and data will not be transferred to the system until it is released; you can also select a row and then slide the mouse wheel.

Parameter analysis:

[Kp], [Ki], [Kd]: PID control during car driving.

[scale]: PID scaling.

4.2.4. Target tracking

After the recognition is correct, click the [space bar] on the keyboard to execute the object following program.

- Node view

jetson motherboard/Raspberry Pi 4B

```
rqt_graph
```

Raspberry Pi 5

Enter the same docker from multiple terminals

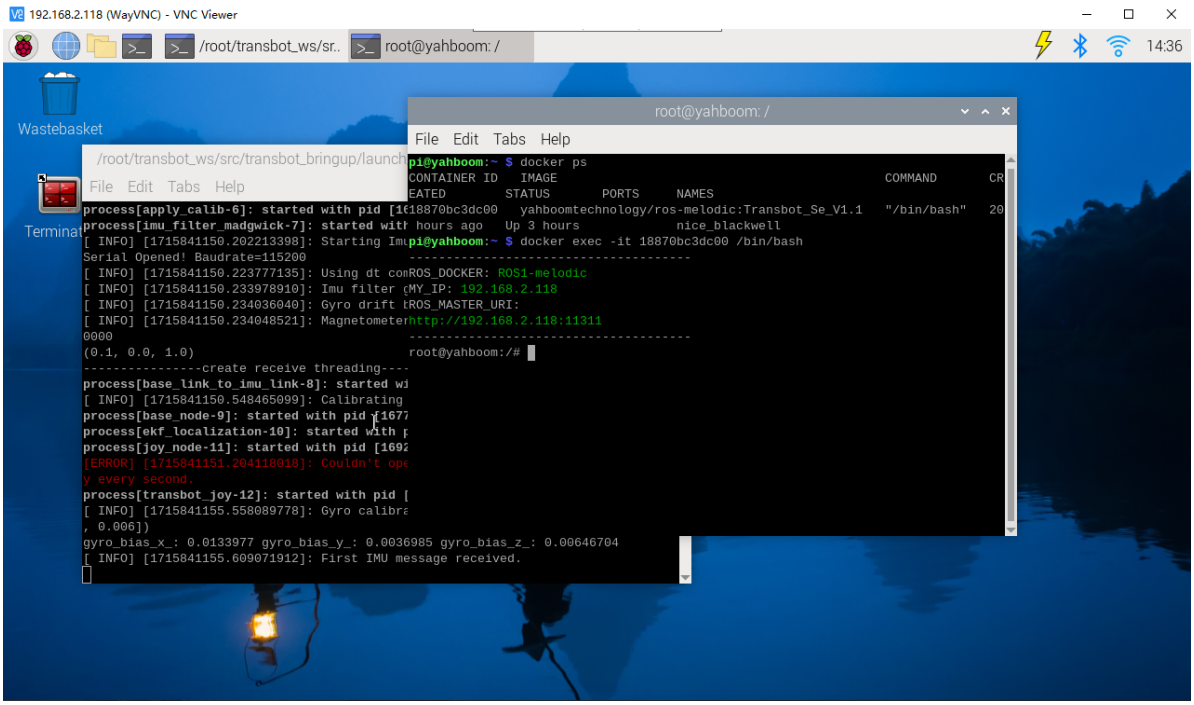
Keep the program of the previous docker terminal running and open a new terminal

Enter the following command

```
docker ps
```

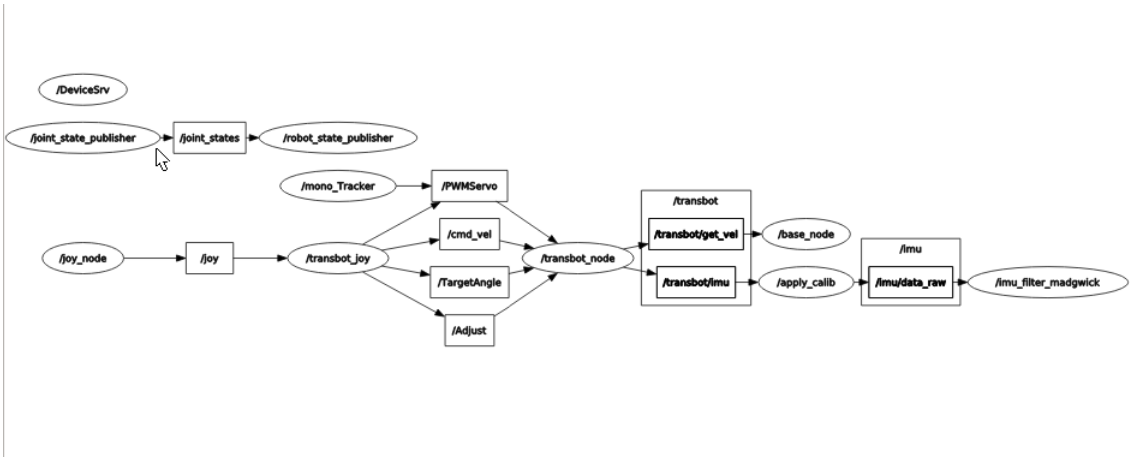
Enter the same docker and use the following 18870bc3dc00 to modify the ID displayed on the actual terminal.

```
docker exec -it 18870bc3dc00 /bin/bash
```



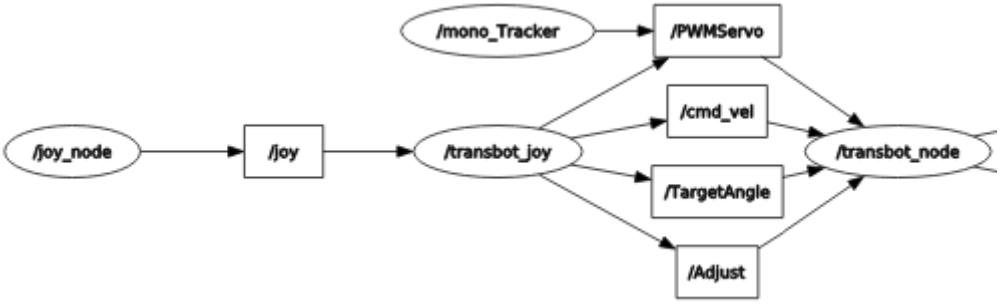
```
rqt_graph
```

- When starting method one, the node [mono_Tracker]



Subscribe to image topics; publish gimbal and servo topics

- When starting method one, the node [mono_Tracker]



Post the gimbal servo topic and control the gimbal to follow.