5、KCF object tracking

5.1、Introduction

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

- Transbot Se robot KCF target tracking, can track the target object at any time, and follow the target object to move on the table, transbot se (left and right) and mechanical arm (up and down) follow the target at the same time
- Object Tracking

  Object tracking is to locate an object in consecutive video frames. This definition sounds straightforward, but in computer vision and machine learning, tracking is a very broad term that encompasses concepts that are conceptually similar but technically different. For example, all of the following different but related ideas are commonly studied under object tracking:

  （1）（Dense Optical flow DOF）：These algorithms help to estimate the motion vector of each pixel in a video frame.

  （2）（Sparse optical flow）:An example is the Kanade-Lucas-Tomashi (KLT) feature tracking algorithm, which tracks the position of several feature points in an image.

  （3）（Kalman Filtering）:A very popular signal processing algorithm based on prior motion information is used to predict the position of a moving object. One of the early applications of this algorithm was missile guidance! The onboard computer that guided the Apollo 11 lunar module to the moon had a Kalman filter.

  （4）Meanshift and Camshift：This is the algorithm that locates the maximum of the density function and they are also used for tracking.

  （5）（Single object trackers）:In this class of trackers, the first frame uses a rectangular marker to indicate the location of the object to be tracked. The object is then tracked in subsequent frames using a tracking algorithm. In most real-world applications, these trackers are used together with object detectors.

  （6）（Multiple object track finding algorithms）:When we have a fast object detector, it makes sense to detect multiple objects in each frame and then run a trace finding algorithm to identify which rectangle in one frame corresponds to the rectangle in the next frame.
- OpenCV Tracking API

  OpenCV 4 comes with a tracking API that contains implementations of many single-object tracking algorithms.

OpenCV 4.2 implements these eight trackers -Boosting, MIL, KCF, TLD, MEDIANFLOW, GOTURN, MOSSE, and CSRT.

OpenCV 3.2 implements the six trackers -Boosting, MIL, TLD, MEDIANFLOW, MOSSE, and GOTURN.

OpenCV 3.1 implements these five trackers -Boosting, MIL, KCF, TLD, MEDIANFLOW.

- 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.
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.

5.2. Operation steps

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

5.2.1. Start

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Start the underlying driver control (robot side)

```
roslaunch transbot_track TrackSrv.launch
```

Raspberry Pi 5

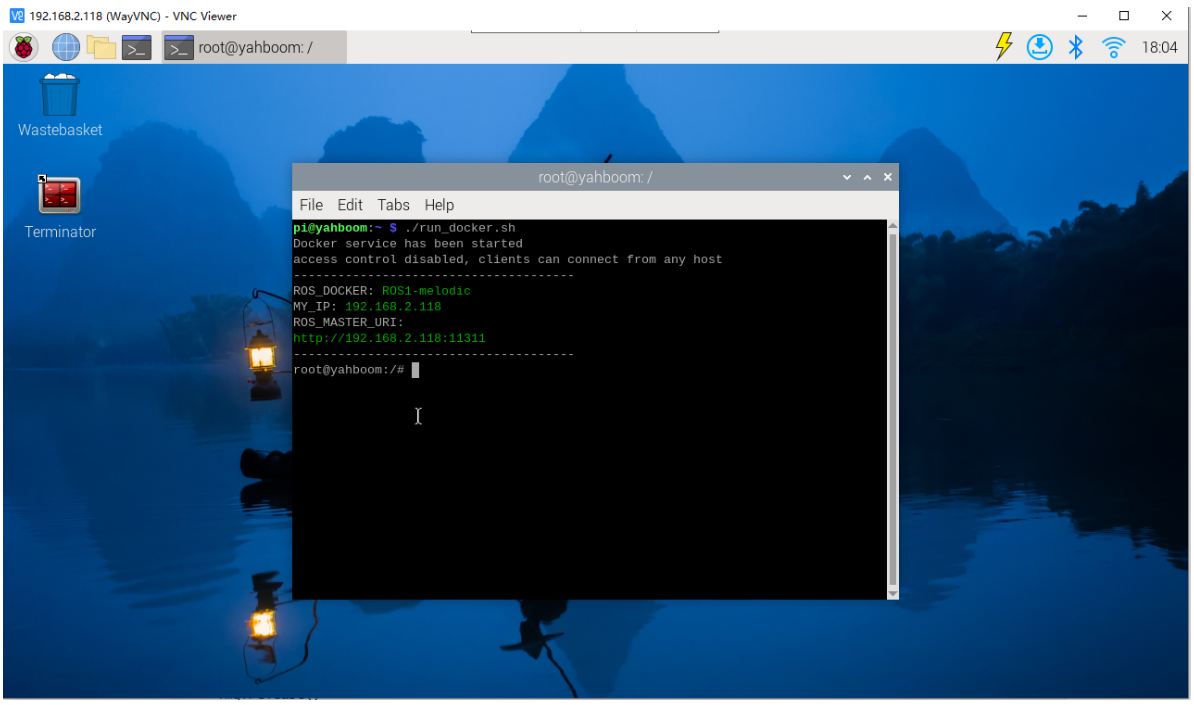
Before running, please confirm that the large program has been permanently closed

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
```



```
pi@yahboom:~ $ ./run_docker.sh
Docker service has been started
access control disabled, clients can connect from any host
------------------------------------
ROS_DOCKER: ROS1-melodic
MY_IP: 192.168.2.118
ROS_MASTER_URI:
http://192.168.2.118:11311
------------------------------------
root@yahboom:/# 
```

Start the underlying driver control (robot side)

```
roslaunch transbot_track TrackSrv.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_track Tracker.launch VideoSwitch:=false tracker_type:=KCF
```

Raspberry Pi 5

Enter the same docker from multiple terminals

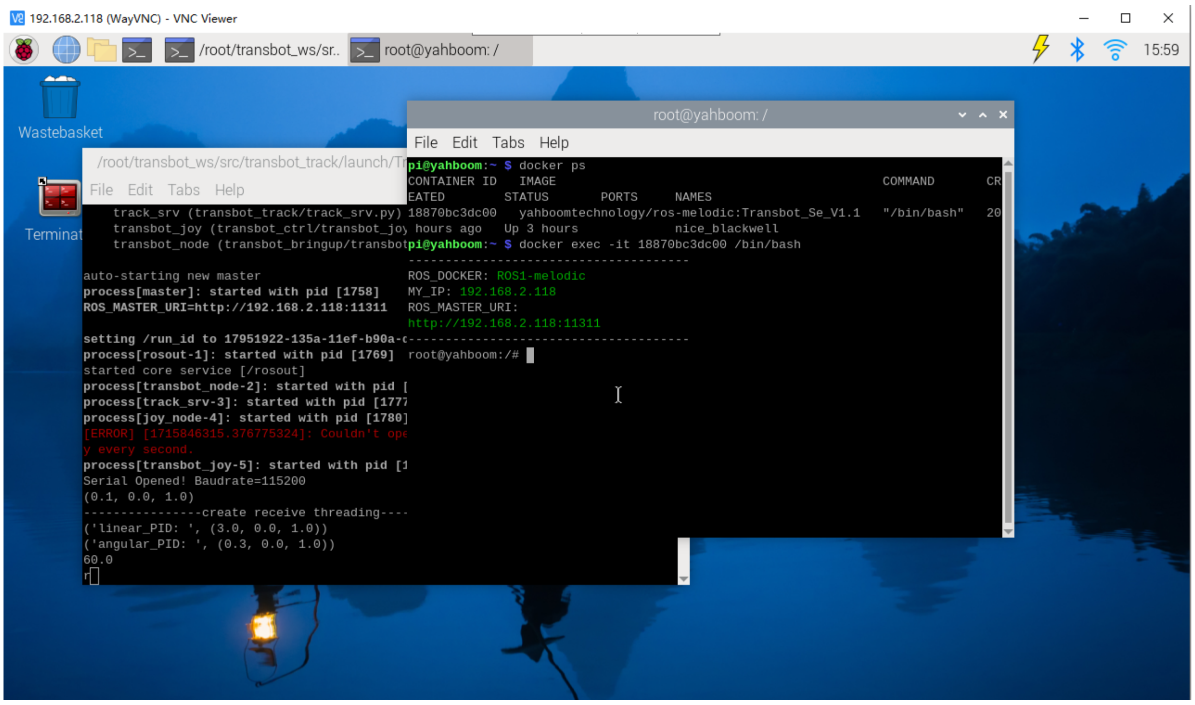
Keep the program of the previous docker terminal running and open a new terminal

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
```



```
    track_srv (transbot_track/track_srv.py)
    transbot_joy (transbot_ctrl/transbot_jo
    transbot_node (transbot_bringup/transbot

auto-starting new master
process[master]: started with pid [1758]
ROS_MASTER_URI=http://192.168.2.118:11311

setting /run_id to 17951922-135a-11ef-b90a-c
process[rosout-1]: started with pid [1769]
started core service [/rosout]
process[transbot_node-2]: started with pid [
process[track_srv-3]: started with pid [1777
process[joy_node-4]: started with pid [1780]
[ERROR] [1715846315.376775324]: Couldn't ope
y every second.
process[transbot_joy-5]: started with pid [1
Serial Opened! Baudrate=115200
(0.1, 0.0, 1.0)
----------------create receive threading----
('linear_PID: ', (3.0, 0.0, 1.0))
('angular_PID: ', (0.3, 0.0, 1.0))
60.0
r
```

```
pi@yahboom:~ $ docker ps
CONTAINER ID   IMAGE                                          COMMAND       CR
EATED          STATUS         PORTS     NAMES
18870bc3dc00   yahboomtechnology/ros-melodic:Transbot_Se_V1.1   "/bin/bash"   20
 hours ago     Up 3 hours               nice_blackwell
pi@yahboom:~ $ docker exec -it 18870bc3dc00 /bin/bash
--------------------------------------
ROS_DOCKER: ROS1-melodic
MY_IP: 192.168.2.118
ROS_MASTER_URI:
http://192.168.2.118:11311
--------------------------------------
root@yahboom:/#
```

Start the monocular camera (robot side)

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

Start monocular target tracking control (virtual machine)

```
roslaunch transbot_track Tracker.launch VideoSwitch:=false tracker_type:=KCF
```

Method 2

Note: [q] key to exit.

jetson motherboard/Raspberry Pi 4B

Start monocular target tracking control (robot side)

```
roslaunch transbot_track Tracker.launch VideoSwitch:=true 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
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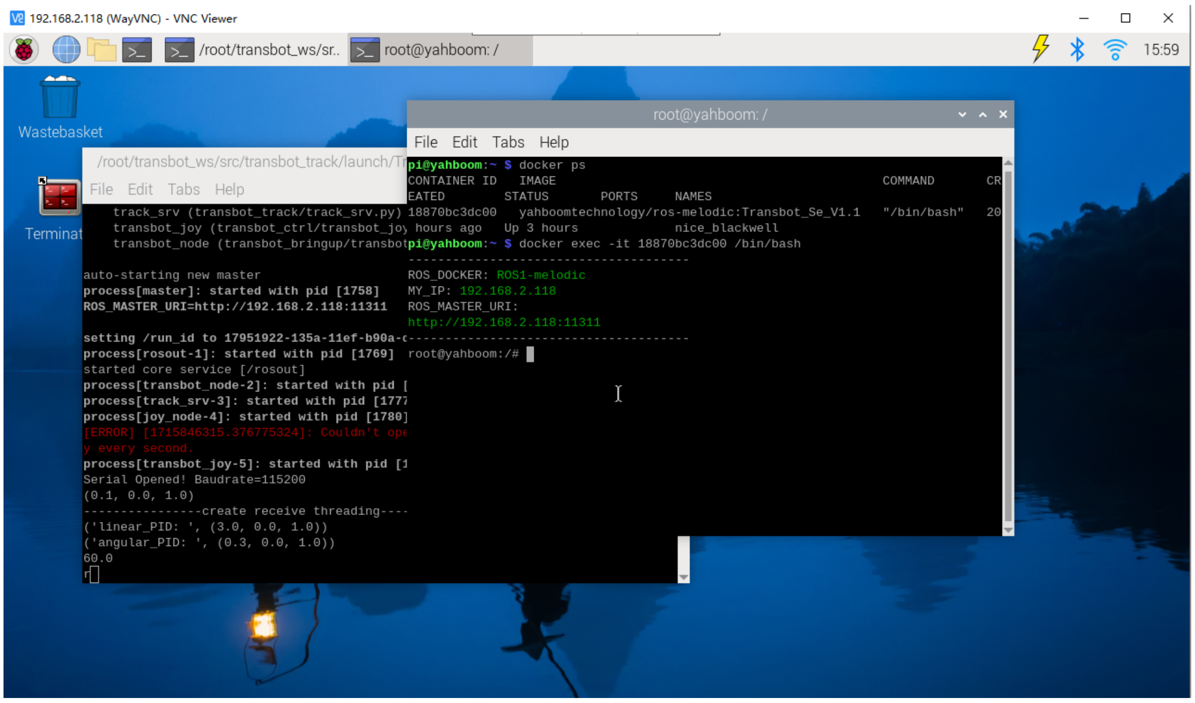
```



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started core service [/rosout]
process[transbot_node-2]: started with pid [
process[track_srv-3]: started with pid [1777
process[joy_node-4]: started with pid [1780]
[ERROR] [1715846315.376775324]: Couldn't ope
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```

```
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CONTAINER ID   IMAGE                                          COMMAND       CR
EATED          STATUS         PORTS      NAMES
18870bc3dc00   yahboomtechnology/ros-melodic:Transbot_Se_V1.1   "/bin/bash"   20
hours ago      Up 3 hours                nice_blackwell
pi@yahboom:~ $ docker exec -it 18870bc3dc00 /bin/bash
-------------------------------------
ROS_DOCKER: ROS1-melodic
MY_IP: 192.168.2.118
ROS_MASTER_URI:
http://192.168.2.118:11311
-------------------------------------
root@yahboom:/#
```

Start monocular target tracking control (robot side)

```
roslaunch transbot_track Tracker.launch VideoSwitch:=true tracker_type:=KCF
```

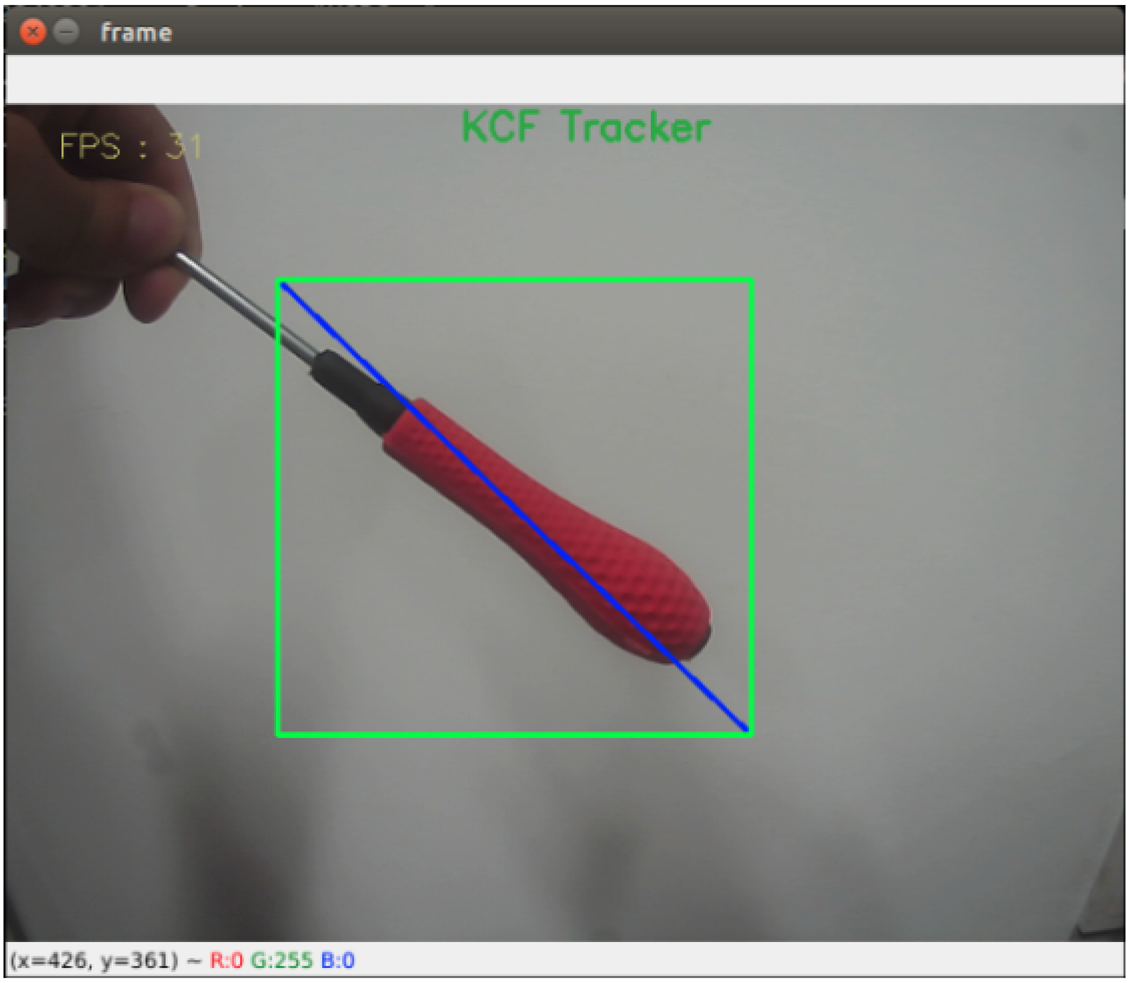
This method can only be started in the main control connected to the camera

- 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.

5.2.2. 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. If the robotic arm blocks the camera, you can press the [r] key to reset the robotic arm.

[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.

5.2.3. Target tracking

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

- Node view

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```
rqt_graph
```

Raspberry Pi 5

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```
docker ps
```

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

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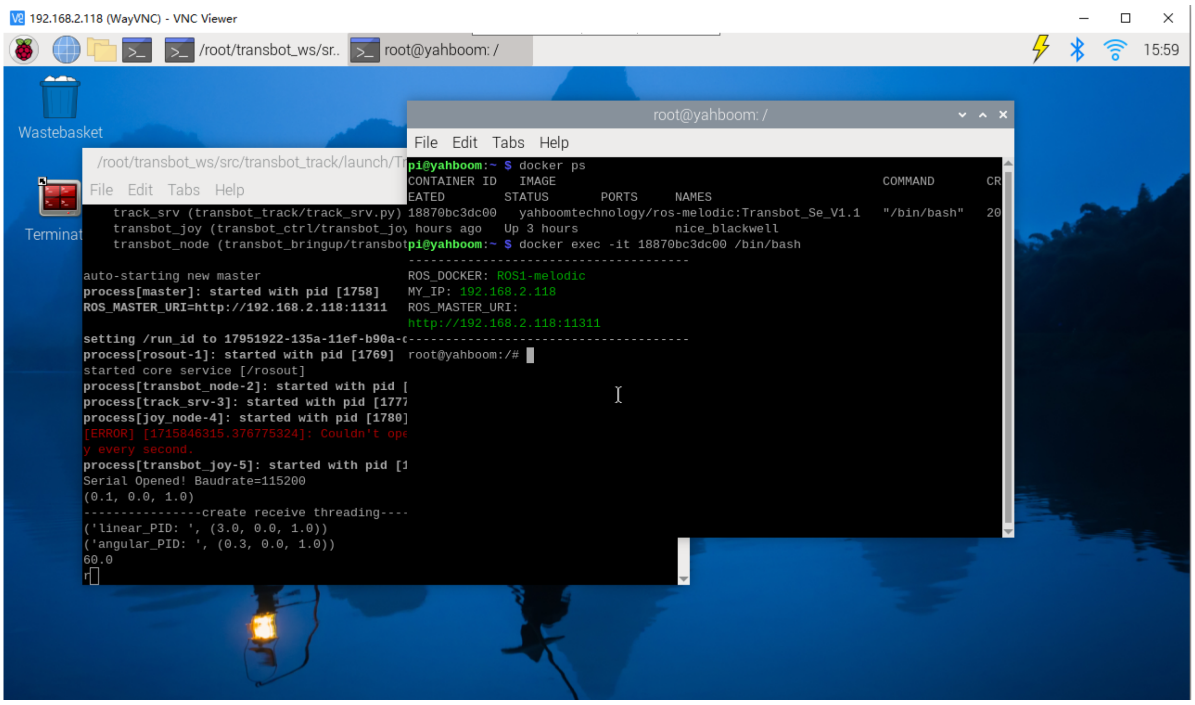
```



```
pi@yahboom:~ $ docker ps
CONTAINER ID   IMAGE                                                 COMMAND       CR
EATED          STATUS        PORTS     NAMES
18870bc3dc00   yahboomtechnology/ros-melodic:Transbot_Se_V1.1   "/bin/bash"   20
 hours ago     Up 3 hours              nice_blackwell
pi@yahboom:~ $ docker exec -it 18870bc3dc00 /bin/bash
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ROS_DOCKER: ROS1-melodic
MY_IP: 192.168.2.118
ROS_MASTER_URI:
http://192.168.2.118:11311
--------------------------------------
root@yahboom:/# 
```

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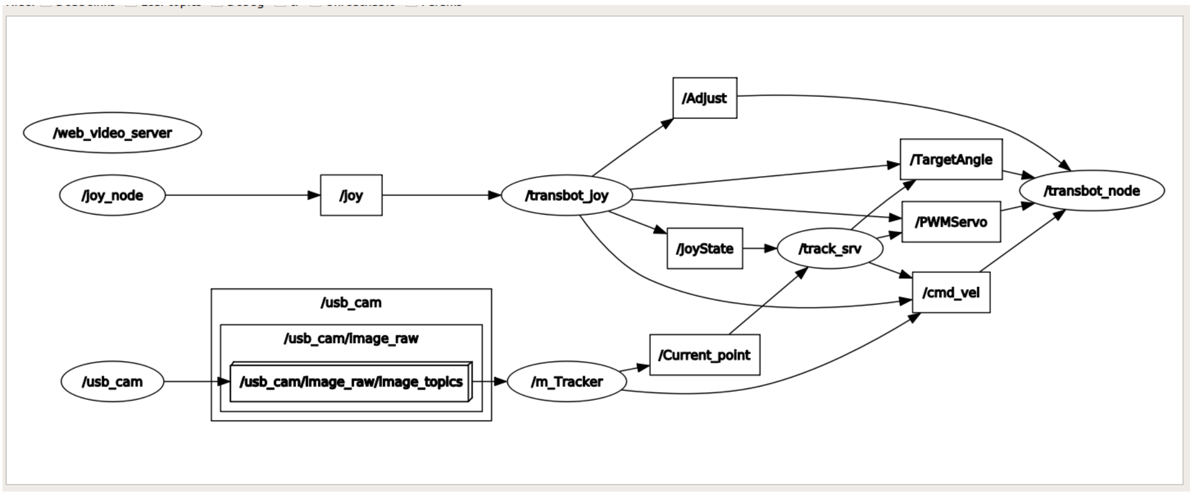
('angular_PID: ', (0.3, 0.0, 1.0))
60.0
r
```

```
rqt_graph
```

- When starting method 1, node [m_Tracker]



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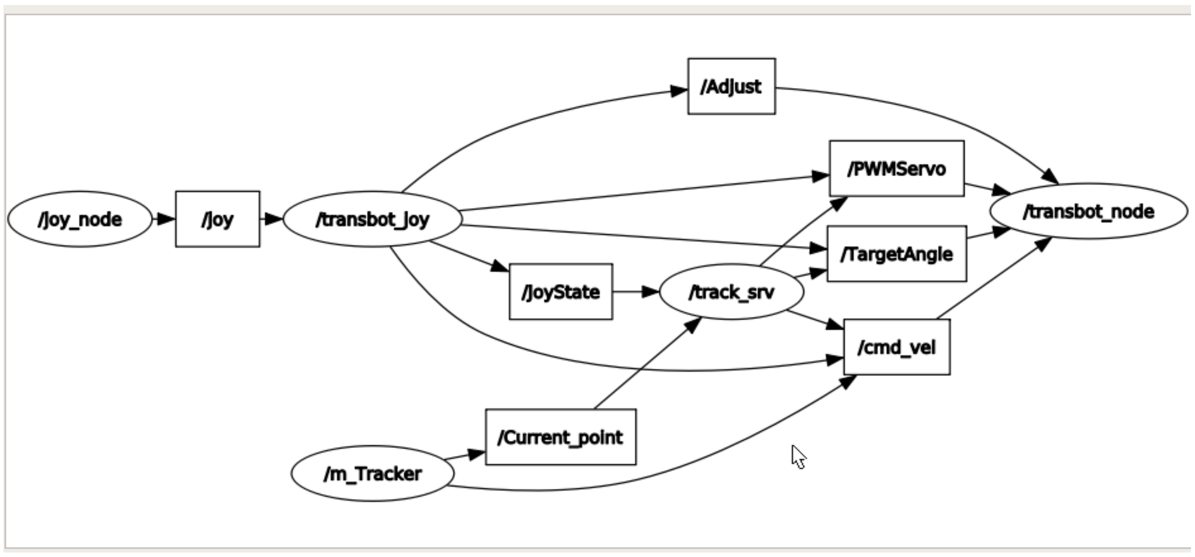
- When starting method 2, node [m_Tracker]



Publish the topic of gimbal servo, publish the topic of chassis driver and robotic arm.