Handle control

1、Operating environment

Operating system：Ubuntu 18.04 LTS

ROS version：melodic

Device：jetson nano 、Raspberry Pi、PC、handle（USB receiver）

Handle control function package path：~/transbot_ws/src/transbot_ctrl

2、Install driver

ROS driver for general Linux handles. The Joy package contains Joy_node, which is a node that connects a general Linux controller to ROS. The node publishes a "/Joy" message, which contains the current state of each button and axis of the handle.

```
sudo apt install ros-melodic-joy ros-melodic-joystick-drivers
```

3、Steps for usage

- Device connection

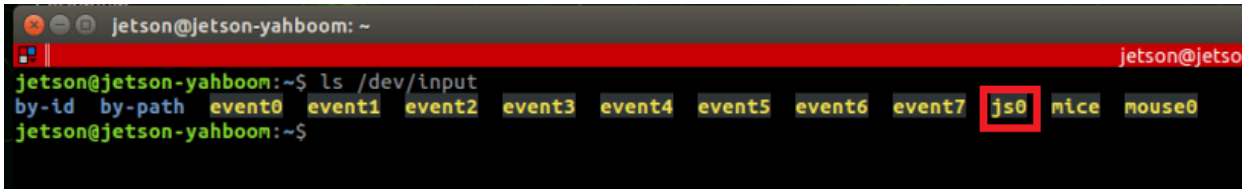
First of all, we need to insert the USB adapter of the wireless controller into Jetson NANO, Raspberry Pi, and PC.

In this lesson, we will insert the USB port of the wireless controller to Jetson NANO board.

- View device

Open the terminal, enter the following command, it shows [js0], this is the wireless controller.

```
ls /dev/input
```

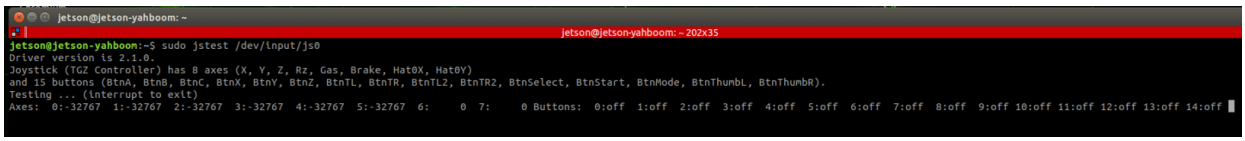


- Test handle

Open the terminal and input the following commands.

As shown in the figure, the wireless handle has 8 axial inputs and 15 key inputs. You can press the keys to test the numbers corresponding to the keys on handle.

```
sudo jstest /dev/input/js0
```



If jstest is not installed, you need run the following command to install it.

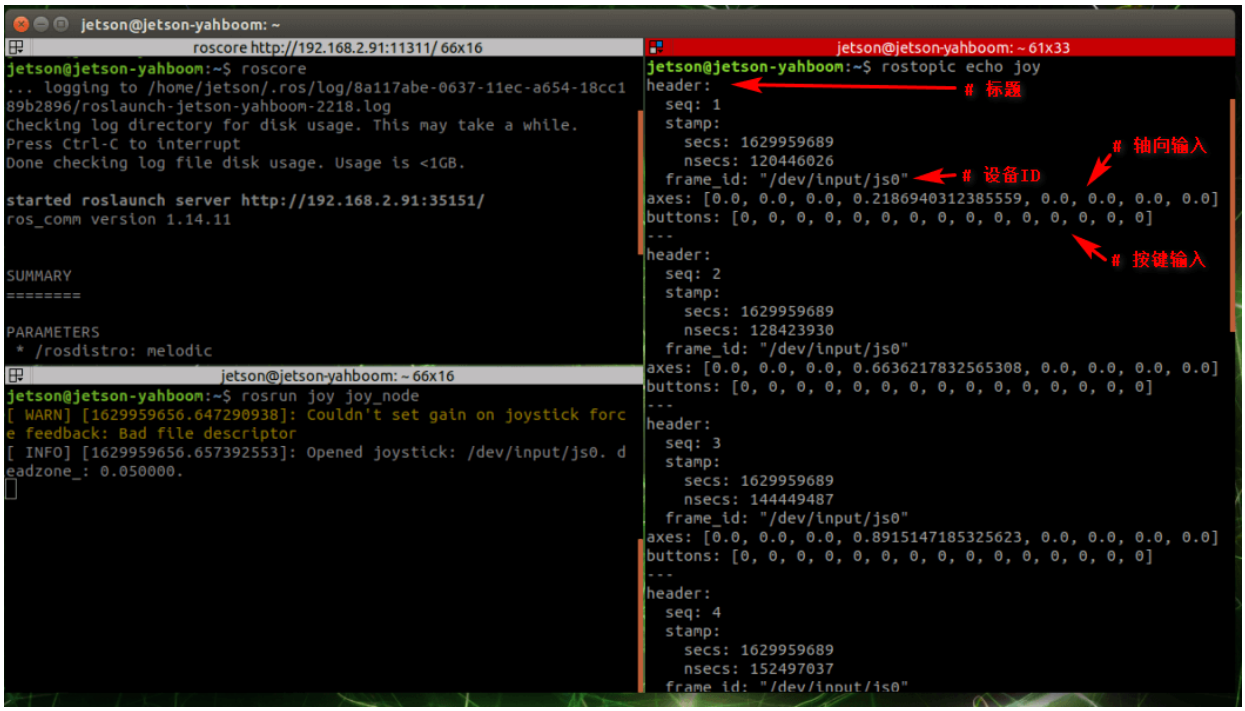
```
sudo apt-get install joystick
```

- Run the controller node

Open three terminals, enter the following commands in sequence to view the detailed information, which is the same as [Test Handle].

Different devices (Raspberry Pi, Jetson NANO, PC) and different systems have different handle states.

```
roscore  Step.1
rosrun joy joy_node  Step.3
rostopic echo joy  Step.3
```

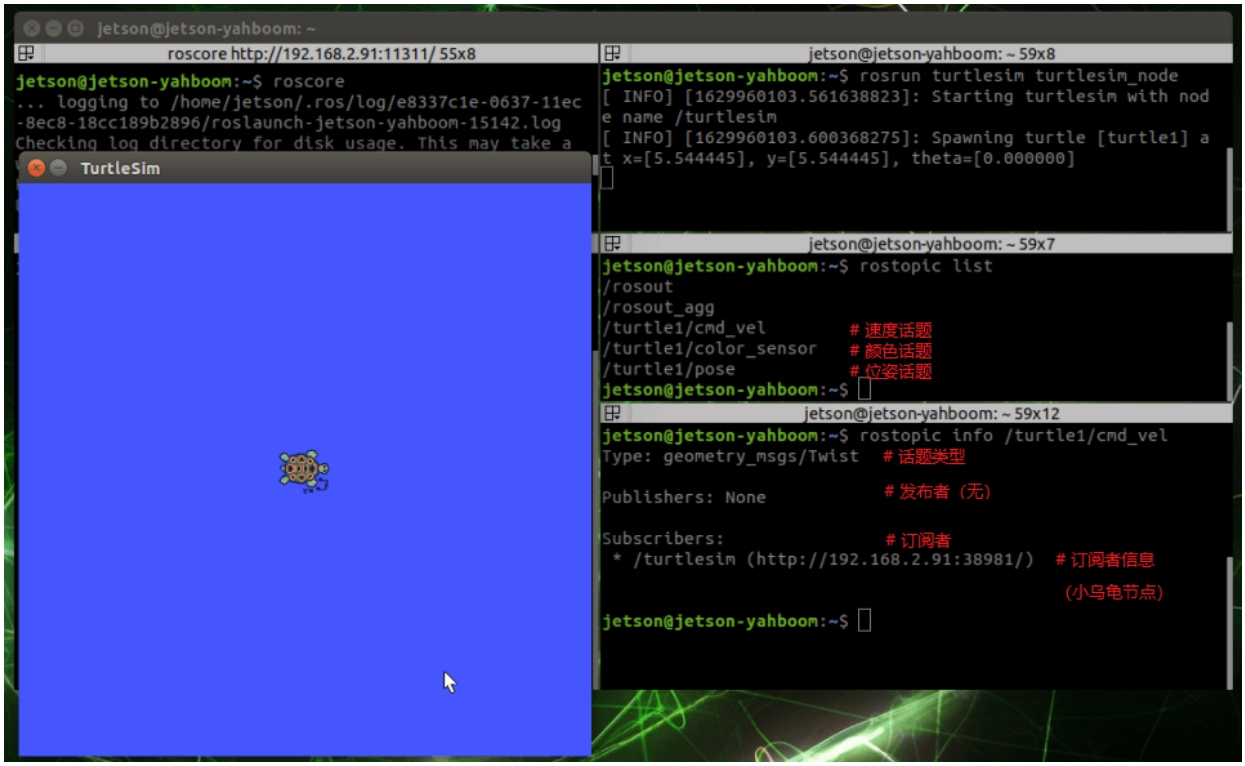


4、Handle control turtle

4.1、Start the turtle

```
roscore
rosrun turtlesim turtlesim_node
```

If you want to drive the little turtle, just give the little turtle a certain speed. Next, check the ROS speed control node.



4.2、View node

```
rostopic list
```

4.3、View the node information

```
rostopic info /turtle1/cmd_vel
```

4.4、Handle control turtle

Receive the current status information of the handle, and send instructions to the little turtle by pressing the button or shaking the joystick to receive different information feedback from the wireless handle.

Copy the wireless controller control function package to the workspace, compile and update the environment.

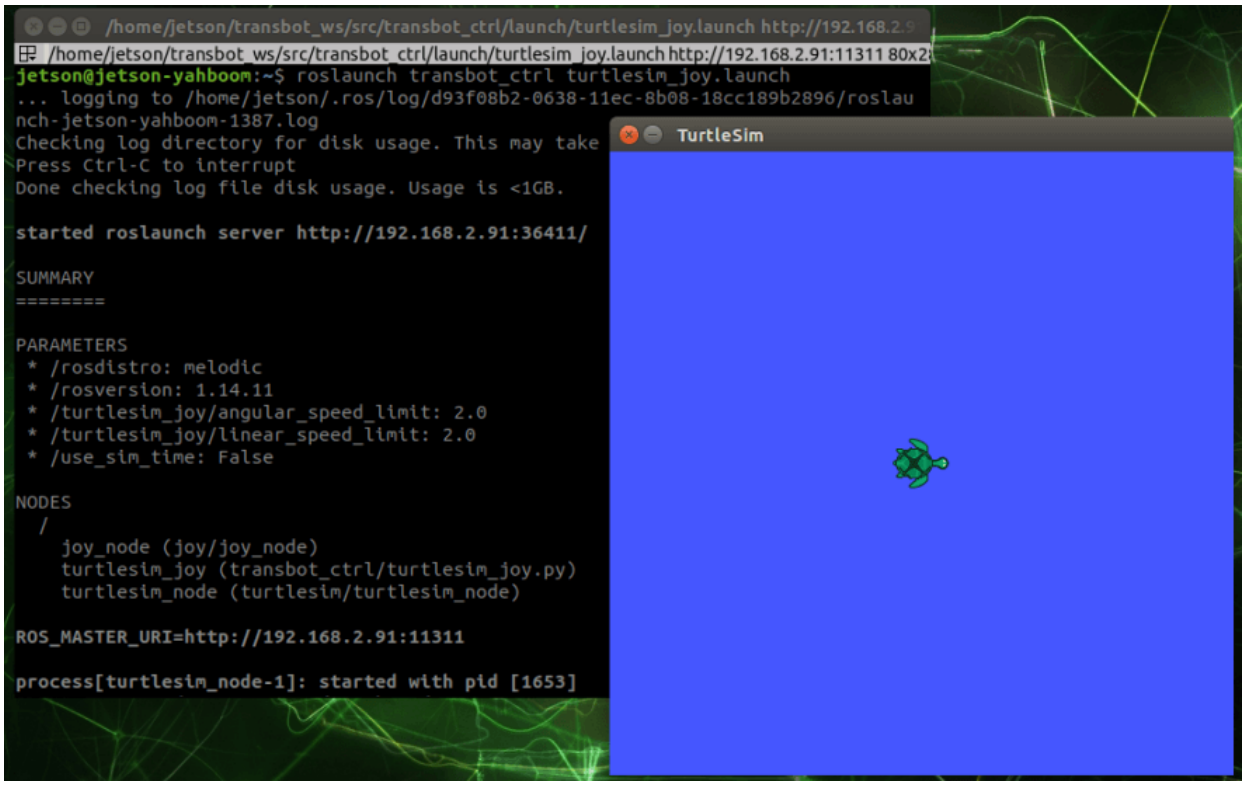
```
catkin_make  # Compile
source devel/setup.bash # Update environment
Note: As long as you modify the C++ code, you must recompile the update to take
effect.
```

Input command to start up python code

```
roslaunch transbot_ctrl turtlesim_joy.launch
```

Input command to start up C++ code

```
roslaunch transbot_ctrl turtlesim_turtle.launch
```



At this point, we can use the handle to control the little turtle to run.

- Correspondence between the handle and the turtle

Handle	Turtle
Left rocker up	advance
Left rocker down	back
Left rocker left	turn left
Left rocker right	turn right

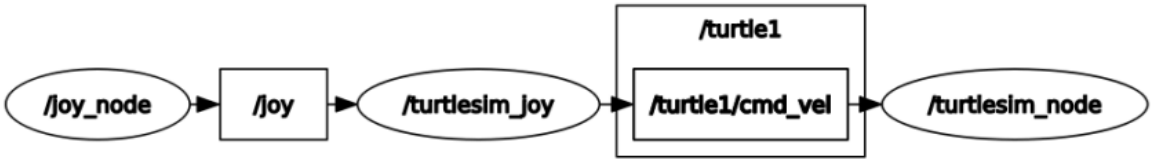
- View node graph

【/joy_node】：Handle information node

【/turtlesim_joy】：Handle control node

【/turtlesim_node】：Turtle node

```
rqt_graph
```



5、Handle control Transbot

Handle controls Transbot, which is similar to the handle control of the turtle; let the handle control node establish a connection with the Transbot bottom driver node, change the current state of the handle, send different information to Transbot, and drive Transbot to make different responses. We need to control the buzzer, searchlight, pan-tilt, light bar, robotic arm, and trolley movement (linear velocity, angular velocity).

5.1、handle control node

- Corresponding to the MCU coprocessorof Transbot
  - Topic

    Publish car movement news 【/cmd_vel】

    Publish robotic arm control message 【/TargetAngle】

    Publish gimbal servo control message 【/PWMServo】
  - Service (client)

    Publish buzzer control message【/Buzzer】

    Publish searchlight control message【/Headlight】

    Publish obtain the current angle of the robotic arm 【/CurrentAngle】

    Publish running water light control message 【/RGBLight】
- Other topic
  - Joy_node corresponds

    Subscribe to the news of the wireless controller【/joy】
  - corresponding to move_base

    Issue the cancel motion planning message【/move_base/cancel】
  - Pause/start of all functions

    Publish the current Joy state (custom) message【/JoyState】
  - Node【DeviceSrv】

    Get the current camera device【/CamDevice】

    -Joy_node corresponds

5.2、Associated node

- Low-level driver
  - Topic

    Subscribe to car sports messages【/cmd_vel】

    Subscribe to robotic arm control messages【/TargetAngle】

    Subscribe to gimbal servo control messages【/PWMServo】
  - Service (client)

    Publish buzzer control message【/Buzzer】

    Publish searchlight control message【/Headlight】

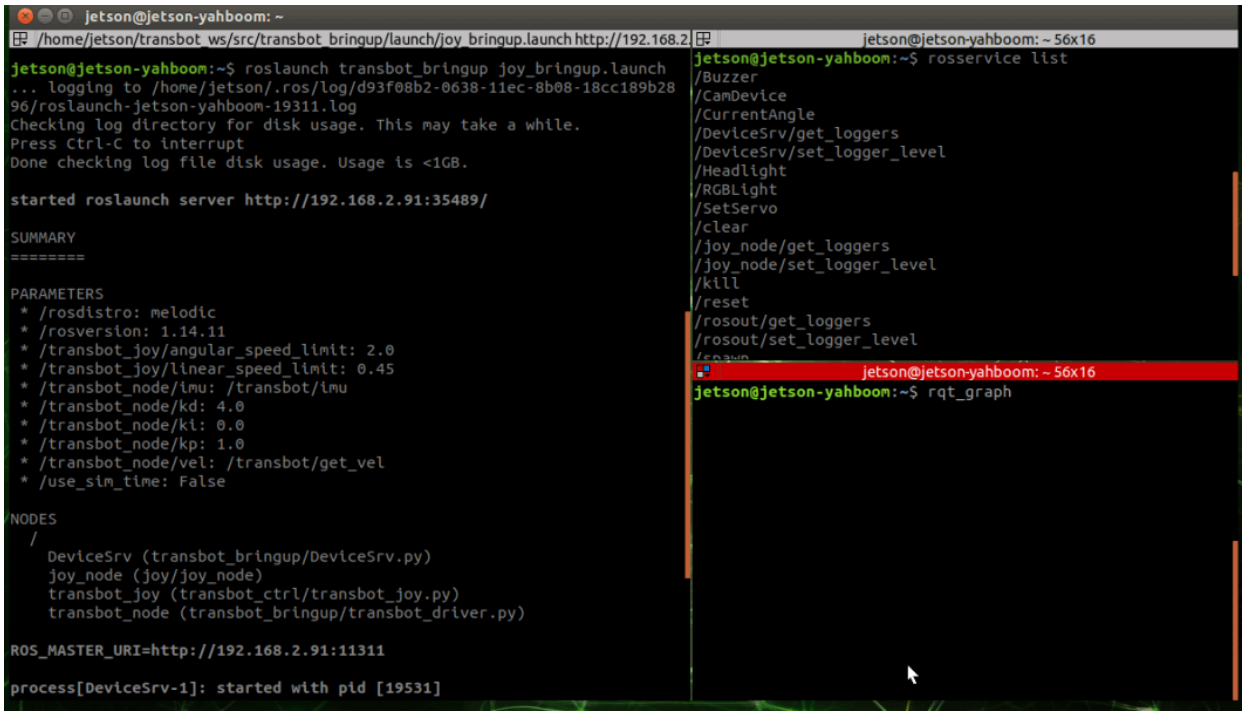
    Publish obtain the current angle of the robotic arm 【/CurrentAngle】

    Publish running water light control message 【/RGBLight】
- Joy_node
  - Topic

    Publish the news of the wireless controller 【/joy】
- DeviceSrv
  - service

    Enable access to the current camera equipment service【/CamDevice】

5.3、Operating procedures



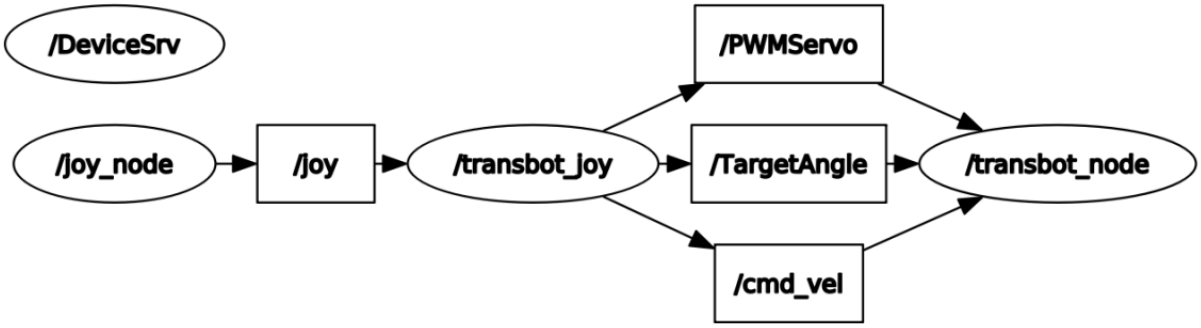
Start up command

```
roslaunch transbot_bringup joy_bringup.launch
```

View node graph

```
rqt_graph
```

Can only see the connections between topics



View service list

```
rosservice list
```

The system will print the following:

```
/Buzzer
/CamDevice
/CurrentAngle
/DeviceSrv/get_loggers
/DeviceSrv/set_logger_level
/Headlight
/RGBLight
/SetServo
/clear
/joy_node/get_loggers
/joy_node/set_logger_level
/kill
/reset
... ...
```

5.4、Source code analysis

- launch file

Code path: ~/transbot_ws/src/transbot_bringup/launch/joy_bringup.launch

```
<launch>
    <!--Start the camera device service-->
    <node pkg="transbot_bringup" type="DeviceSrv.py" name="DeviceSrv"
output="screen"/>
    <!--Start Transbot bottom node-->
```

```
    <node pkg="transbot_bringup" type="transbot_driver.py" name="transbot_node"
required="true" output="screen">
        <param name="imu" value="/transbot/imu"/>
        <param name="vel" value="/transbot/get_vel"/>
        <param name="kp" value="1.0"/>
        <param name="ki" value="0.0"/>
        <param name="kd" value="4.0"/>
    </node>
    <!--Start handle control node-->
    <include file="$(find transbot_ctrl)/launch/transbot_joy.launch"/>
</launch>
```

Node 【DeviceSrv】 starts the camera device service: obtains the current camera device number, and publishes whether it is currently connected to the Astra camera.

- py file

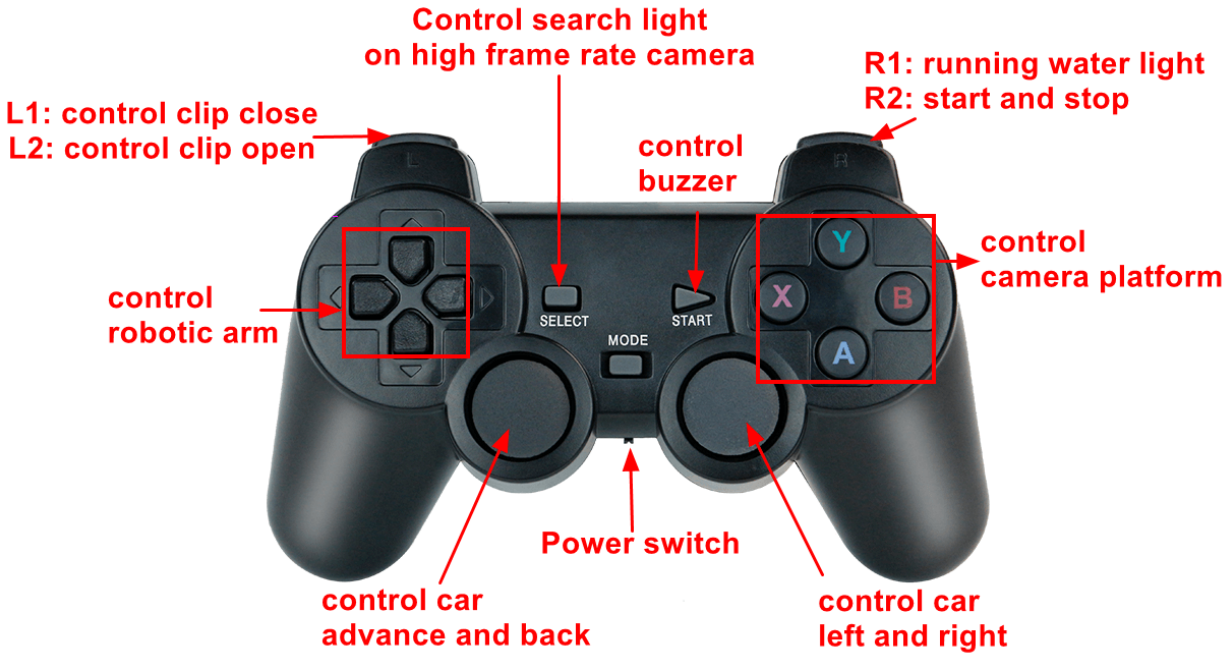
Code path: ~/transbot_ws/src/transbot_ctrl/scripts/transbot_joy.py

```
        arm_thread = threading.Thread(target=self.analyse_PWM())
        arm_thread.setDaemon(True)
        arm_thread.start()
```

Start the thread, get the currently connected camera device in the 【self.analyse_PWM()】function, which is convenient for processing different cameras, and turn on the loop to control the gimbal servo and robotic arm.

```
    def buttonCallback(self, joy_data):
        '''
        Obtain the wireless controller receiving signal
        [1: Clamp, 2: Release, upper left: joint2+, lower left: joint2-, left left:
joint1 upper, left and right joint1: lower]
        '''
        if not isinstance(joy_data, Joy): return
        # rospy.loginfo("joy_data.buttons:", joy_data.buttons)
        # rospy.loginfo("joy_data.axes:", joy_data.axes)
        if self.user_name == "pi": self.user_pi(joy_data)
        else: self.user_jetson(joy_data)
        # rospy.loginfo("linear_Gear: {},angular_Gear:
{}".format(self.linear_Gear,self.angular_Gear))
        #rospy.loginfo("linear_speed: {},angular_speed:
{}".format(linear_speed,angular_speed))
```

5.5、Handle control effect



Appendix

jetson nano

```
joy_data.buttons:
header:
  seq: 335
  stamp:
    secs: 1628324636
    nsecs: 962988952
  frame_id: "/dev/input/js0"
axes: [0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0]
buttons: [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
```

axes (8)

Code analysis	Handle button	Car control
axes[0]	Left rocker	
axes[1]	Left rocker	advance and back
axes[2]	Right rocker	left and right
axes[3]	Right rocker	
axes[4]		
axes[5]		

Code analysis	Handle button	Car control
axes[6]	Left button	Arm-1
axes[7]	Left button	Arm-2

buttons（15）

Code analysis	Handle button	Car control
buttons[0]	A	camera platform move down
buttons[1]	B	camera platform move right
buttons[2]		
buttons[3]	X	camera platform move left
buttons[4]	Y	camera platform move up
buttons[5]		
buttons[6]	L1	Arm-clip close
buttons[7]	R1	running water light
buttons[8]	L2	Arm-clip open
buttons[9]	R2	control switch
buttons[10]	SELECT	search light on high frame rate camera
buttons[11]	START	buzzer
buttons[12]		
buttons[13]	Press left rocker	Linear speed [0.15 , 0.3 , 0.45]
buttons[14]	Press right rocker	Angular speed [0.5 , 1 , 1.5 , 2]

Raspberry Pi

```
joy_data.buttons: header:
  seq: 264
  stamp:
    secs: 1628326479
    nsecs: 848359307
  frame_id: "/dev/input/js0"
axes: [-0.0, -0.0, 0.0, -0.0, -0.0, 0.0, 0.0, 0.0]
buttons: [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
```

axes（8）

Code analysis	Handle button	Car control
axes[0]	Left rocker	
axes[1]	Left rocker	advance and back
axes[2]	L2(press:-1，release:1)	Arm clip
axes[3]	Right rocker	left and right
axes[4]	Right rocker	
axes[5]	R2(press:-1，release:1)	control switch
axes[6]	Left button	Arm-1
axes[7]	Left button	Arm-2

buttons（11）

Code analysis	Handle button	Car control
buttons[0]	A	camera platform move down
buttons[1]	B	camera platform move right
buttons[2]	X	camera platform move left
buttons[3]	Y	camera platform move up
buttons[4]	L1	Arm clip
buttons[5]	R1	running water light
buttons[6]	SELECT	search light on high frame rate camera
buttons[7]	START	buzzer
buttons[8]	MODE	
buttons[9]	Press left rocker	Linear speed [0.15 , 0.3 , 0.45]
buttons[10]	Press right rocker	Angular speed [0.5 , 1 , 1.5 , 2]

Precautions for using the handle

- After plugging and unplugging the handle receiving head, the handle program needs to be restarted, otherwise the car will not be able to be controlled.
- After starting the handle control program, if the handle cannot control the car, it may be caused by the wrong handle control mode. You can press and hold the handle mode button for about 15 seconds to switch modes. After the green indicator light is always on, press the start button again. If the buzzer sounds, it means the switching is successful. If there is no response, you can press and hold the mode button on the handle again for 15 seconds.

Jetson series support mode: PC/PCS mode. In PC mode, the POWER MODE indicator light is red by default. You can connect the handle receiver to the usb port of the computer to connect to the wireless handle. Enter the URL in the browser: https://gamepad-tester.com/. Pressing the button URL will display the change of the button value, as shown in the following figure:

Raspberry Pi series support mode: X-BOX mode.In X-BOX mode, the default POWER MODE indicator light is green. You can connect the handle receiver to the usb port of the computer to connect to the wireless handle. Enter the URL in the browser: https://gamepad-tester.com/. Pressing the button URL will display the change of the button value, as shown in the following figure:

- After re-plugging the handle receiver or restarting the motherboard, the handle will reset to the factory mode. If it cannot be controlled, you need to switch the mode again every time you plug or restart.

- In the case of unsuccessful matching, the POWER MODE indicator light will flash red and green all the time, and will not light up after a few seconds of sleep.