- ## 5. Robot handle control

According to different models, just set the purchased model in [.bashrc], X1 (normal four-wheel drive) X3 (Mailun) X3plus (Mailun robotic arm) R2 (Ackerman differential) etc. , this section takes X3 as an example

```
#Raspberry Pi 5 master needs to enter docker first, please perform this step
#If running the script into docker fails, please refer to ROS/07, Docker tutorial
~/run_docker.sh
#Multiple ros commands require multiple terminals to be executed in the same docker container. Please refer to the tutorials in Sections 07/5 and 5.8.
```

Open the [.bashrc] file

```
sudo vim .bashrc
```

Find the [ROBOT_TYPE] parameter and modify the corresponding model

```
export ROBOT_TYPE=X3 # ROBOT_TYPE: X1 X3 X3plus R2 X7
```

5.1. Operating environment

Operating system: Ubuntu 18.04 LTS

ROS version: melodic

Equipment: jetson nano/Raspberry Pi, PC, wireless controller (USB receiver)

Controller function code path: ~/yahboomcar _ws/src/yahboomcar_ctrl/scripts

5.2. Install driver

ROS driver for universal Linux controllers. The Joy package contains Joy_node, a node that connects a generic Linux controller to ROS. This node publishes a "/Joy" message containing the current state of each button and axis of the controller.

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

5.3. Usage steps

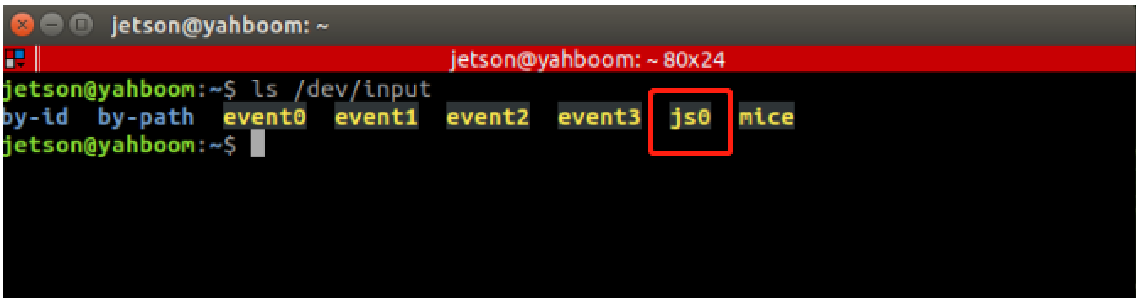
5.3.1. Device connection

First, connect the USB end of the wireless controller to the device (jetson, Raspberry Pi, PC). This lesson takes connecting the USB end of the wireless controller to Jetson as an example. Connect the mouse, keyboard, and monitor; or you can also connect remotely via VNC.

5.3.2. View device

Open the terminal and enter the following command. [js0] is displayed. This is the wireless controller. In special cases, you can also view the changes in the device list through the two states of accessing and not accessing the USB end of the wireless controller. If there is a change, the changed device will be the same; otherwise, the connection will be unsuccessful or unrecognized.

```
ls /dev/input
```



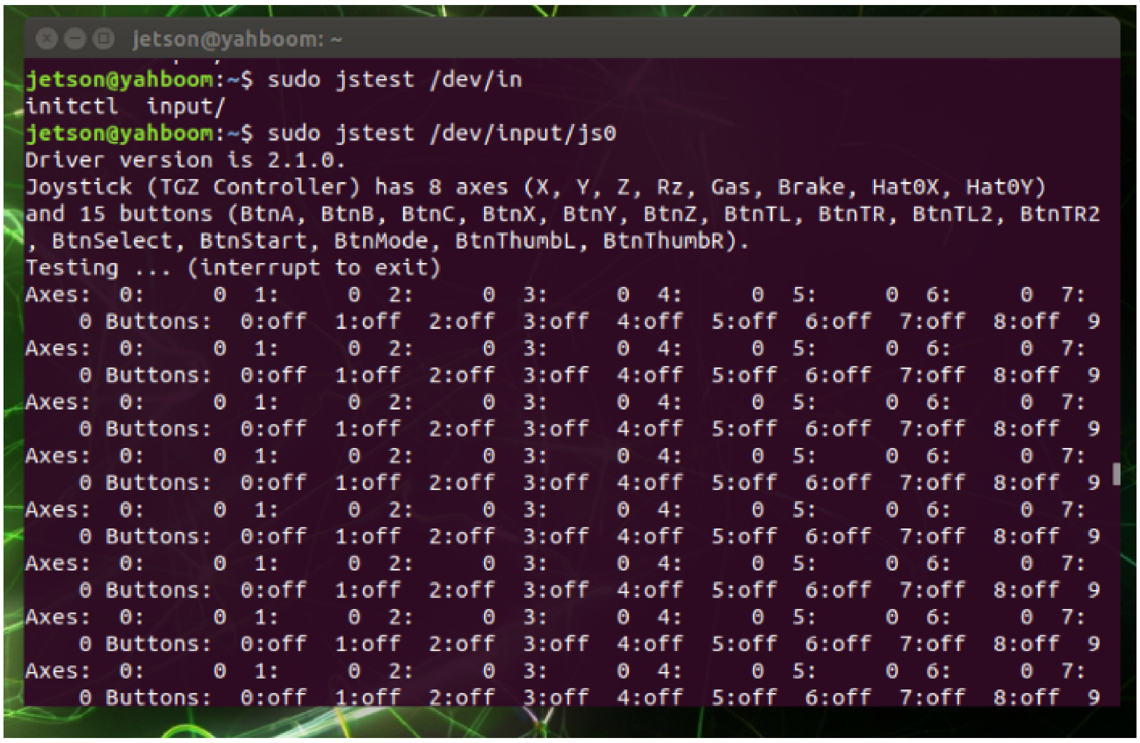
```
jetson@yahboom:~$ ls /dev/input
by-id   by-path  event0  event1  event2  event3  js0  mice
jetson@yahboom:~$ 
```

Note: If a keyboard or mouse or other device is connected to ROSMASTER first, the remote control receiver will be recognized as other devices. Therefore, if you need to connect a keyboard or mouse, you can connect the remote control receiver first and then connect it. into other devices.

5.3.3. Test handle

Open the terminal and enter the following command. As shown in the picture, the wireless handle has 8 axial inputs and 15 key inputs. You can press the keys individually to test the numbers corresponding to the keys.

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



```
jetson@yahboom:~$ sudo jstest /dev/in
initctl  input/
jetson@yahboom:~$ sudo jstest /dev/input/js0
Driver version is 2.1.0.
Joystick (TGZ Controller) has 8 axes (X, Y, Z, Rz, Gas, Brake, Hat0X, Hat0Y)
and 15 buttons (BtnA, BtnB, BtnC, BtnX, BtnY, BtnZ, BtnTL, BtnTR, BtnTL2, BtnTR2
, BtnSelect, BtnStart, BtnMode, BtnThumbL, BtnThumbR).
Testing ... (interrupt to exit)
Axes:  0:     0  1:     0  2:     0  3:     0  4:     0  5:     0  6:     0  7:
    0 Buttons:  0:off  1:off  2:off  3:off  4:off  5:off  6:off  7:off  8:off  9
Axes:  0:     0  1:     0  2:     0  3:     0  4:     0  5:     0  6:     0  7:
    0 Buttons:  0:off  1:off  2:off  3:off  4:off  5:off  6:off  7:off  8:off  9
Axes:  0:     0  1:     0  2:     0  3:     0  4:     0  5:     0  6:     0  7:
    0 Buttons:  0:off  1:off  2:off  3:off  4:off  5:off  6:off  7:off  8:off  9
Axes:  0:     0  1:     0  2:     0  3:     0  4:     0  5:     0  6:     0  7:
    0 Buttons:  0:off  1:off  2:off  3:off  4:off  5:off  6:off  7:off  8:off  9
Axes:  0:     0  1:     0  2:     0  3:     0  4:     0  5:     0  6:     0  7:
    0 Buttons:  0:off  1:off  2:off  3:off  4:off  5:off  6:off  7:off  8:off  9
Axes:  0:     0  1:     0  2:     0  3:     0  4:     0  5:     0  6:     0  7:
    0 Buttons:  0:off  1:off  2:off  3:off  4:off  5:off  6:off  7:off  8:off  9
Axes:  0:     0  1:     0  2:     0  3:     0  4:     0  5:     0  6:     0  7:
    0 Buttons:  0:off  1:off  2:off  3:off  4:off  5:off  6:off  7:off  8:off  9
Axes:  0:     0  1:     0  2:     0  3:     0  4:     0  5:     0  6:     0  7:
    0 Buttons:  0:off  1:off  2:off  3:off  4:off  5:off  6:off  7:off  8:off  9
```

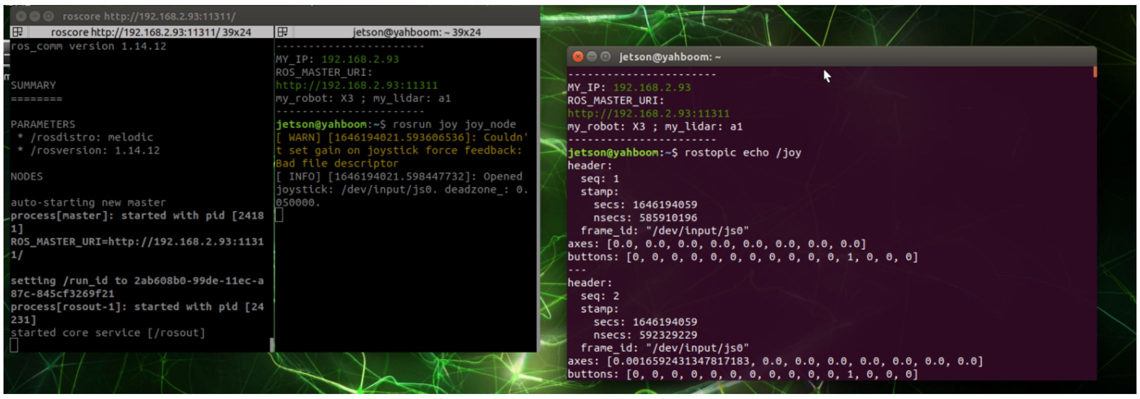
If jstest is not installed, run the following command:

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

5.3.4. Run the handle node

Open three terminals and enter the following commands in order to view detailed information, which is the same as [Test Controller]. Depending on the device (Raspberry Pi, Jetson Nano, PC) and the system, the controller status will be different.

```
roscore
rosrun joy joy_node
rostopic echo joy #Print released information
```



roscore http://192.168.2.93:11311/
roscore http://192.168.2.93:11311/ 39x24
jetson@yahboom: ~ 39x24
jetson@yahboom: ~

```
ros_comm version 1.14.12


SUMMARY
========

PARAMETERS
 * /rosdistro: melodic
 * /rosversion: 1.14.12

NODES

auto-starting new master
process[master]: started with pid [2418
1]
ROS_MASTER_URI=http://192.168.2.93:1131
1/

setting /run_id to 2ab608b0-99de-11ec-a
87c-845cf3269f21
process[rosout-1]: started with pid [24
231]
started core service [/rosout]
```

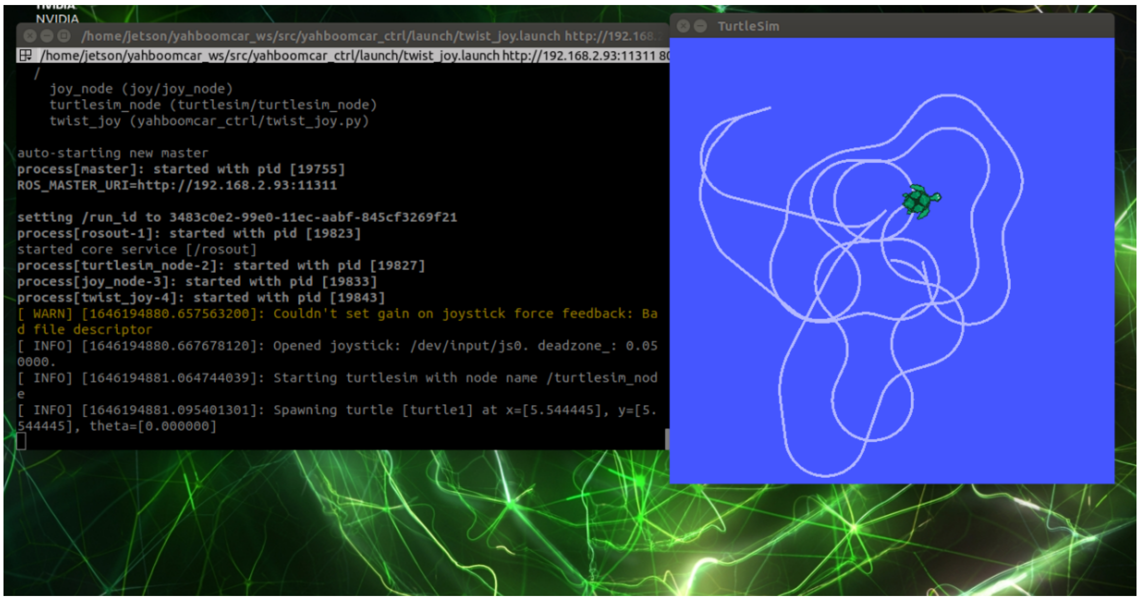
```
-----------------------
MY_IP: 192.168.2.93
ROS_MASTER_URI:
http://192.168.2.93:11311
my_robot: X3 ; my_lidar: a1
-----------------------
jetson@yahboom:~$ rosrun joy joy_node
[ WARN] [1646194021.593606536]: Couldn'
t set gain on joystick force feedback:
Bad file descriptor
[ INFO] [1646194021.598447732]: Opened
joystick: /dev/input/js0. deadzone_: 0.
050000.
```

```
-----------------------
MY_IP: 192.168.2.93
ROS_MASTER_URI:
http://192.168.2.93:11311
my_robot: X3 ; my_lidar: a1
-----------------------
jetson@yahboom:~$ rostopic echo /joy
header:
  seq: 1
  stamp:
    secs: 1646194059
    nsecs: 585910196
  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, 1, 0, 0, 0]
---
header:
  seq: 2
  stamp:
    secs: 1646194059
    nsecs: 592329229
  frame_id: "/dev/input/js0"
axes: [0.0016592431347817183, 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, 1, 0, 0, 0]
```

5.4. Control the little turtle with the handle

5.4.1. Start

```
roslaunch yahboomcar_ctrl twist_joy.launch
```



NVIDIA
/home/jetson/yahboomcar_ws/src/yahboomcar_ctrl/launch/twist_joy.launch http://192.168.
/home/jetson/yahboomcar_ws/src/yahboomcar_ctrl/launch/twist_joy.launch http://192.168.2.93:11311 80
TurtleSim

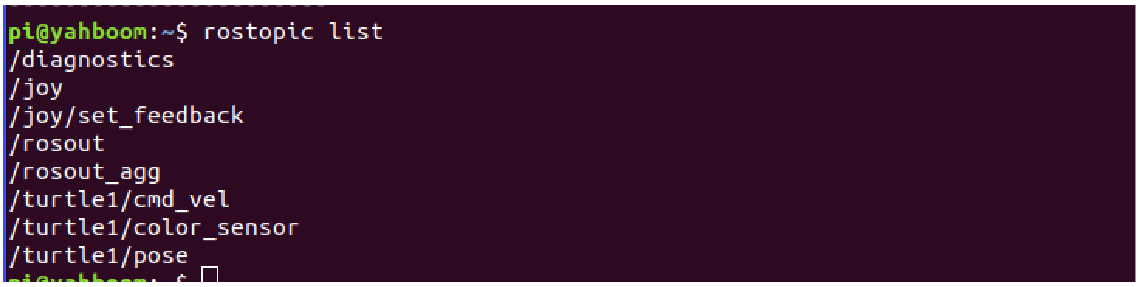
```
  /
    joy_node (joy/joy_node)
    turtlesim_node (turtlesim/turtlesim_node)
    twist_joy (yahboomcar_ctrl/twist_joy.py)

auto-starting new master
process[master]: started with pid [19755]
ROS_MASTER_URI=http://192.168.2.93:11311

setting /run_id to 3483c0e2-99e0-11ec-aabf-845cf3269f21
process[rosout-1]: started with pid [19823]
started core service [/rosout]
process[turtlesim_node-2]: started with pid [19827]
process[joy_node-3]: started with pid [19833]
process[twist_joy-4]: started with pid [19843]
[ WARN] [1646194880.657563200]: Couldn't set gain on joystick force feedback: Ba
d file descriptor
[ INFO] [1646194880.667678120]: Opened joystick: /dev/input/js0. deadzone_: 0.05
0000.
[ INFO] [1646194881.064744039]: Starting turtlesim with node name /turtlesim_nod
e
[ INFO] [1646194881.095401301]: Spawning turtle [turtle1] at x=[5.544445], y=[5.
544445], theta=[0.000000]
```

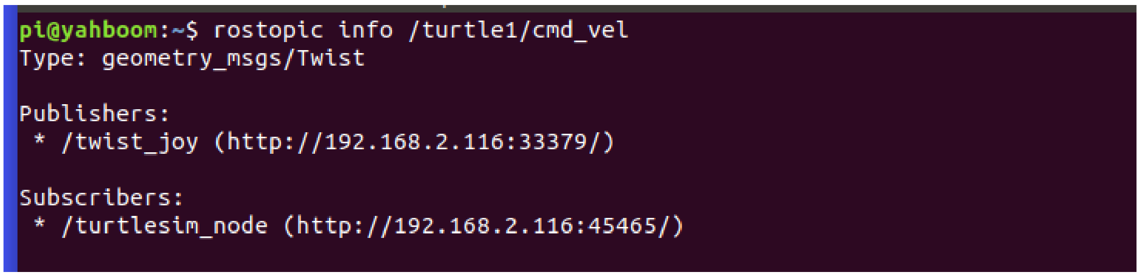
1), view nodes

```
rostopic list
```



```
pi@yahboom:~$ rostopic list
/diagnostics
/joy
/joy/set_feedback
/rosout
/rosout_agg
/turtle1/cmd_vel
/turtle1/color_sensor
/turtle1/pose
```

2. View speed topic information



```
pi@yahboom:~$ rostopic info /turtle1/cmd_vel
Type: geometry_msgs/Twist

Publishers:
 * /twist_joy (http://192.168.2.116:33379/)

Subscribers:
 * /turtlesim_node (http://192.168.2.116:45465/)
```

3. Correspondence between the handle and the operation of the little turtle

handle	little turtle
On the left joystick	Forward
Left joystick down	Backward
Right joystick left	Turn left
Right joystick right	Turn right

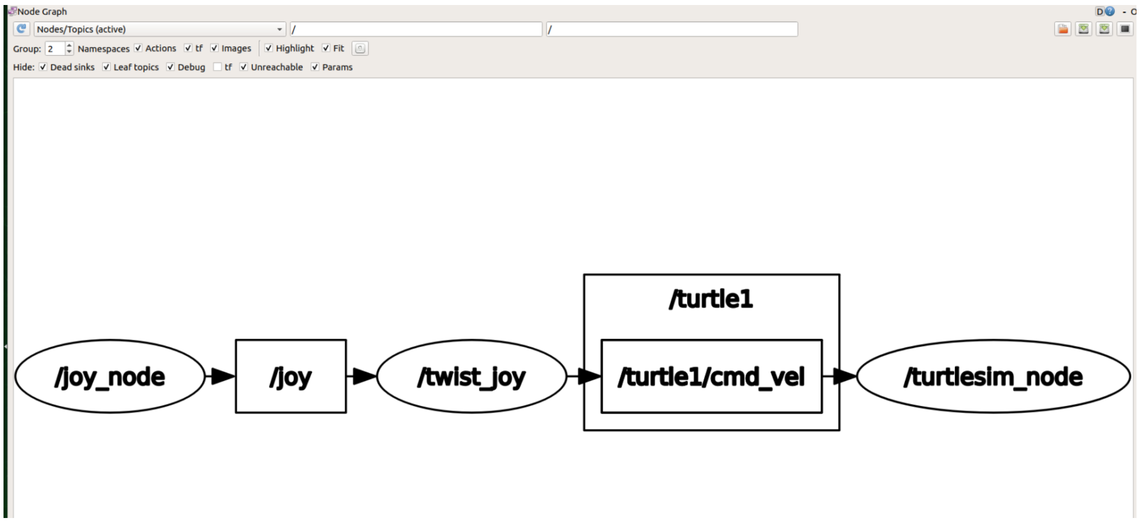
3. View the node graph

【/joy_node】： Node of controller information

【/twist_joy】： Nodes controlled by the handle

【/turtlesim_node】： The node of the little turtle

The node [/joy_node] publishes the topic [/joy] so that the node [/twist_joy] subscribes. After processing, it publishes the topic [/turtle1/cmd_vel] so that the node [/turtlesim_node] subscribes to drive the movement of the little turtle.



Node Graph

Nodes/Topics (active) | / | /

Group: 2 Namespaces ✓ Actions ✓ tf ✓ Images ✓ Highlight ✓ Fit

Hide: ✓ Dead sinks ✓ Leaf topics ✓ Debug ☐ tf ✓ Unreachable ✓ Params

5.5. Handle control ROSMASTER

Controlling ROSMASTER with a handle is similar to controlling a little turtle with a handle; let the handle control node establish contact with the underlying drive node of ROSMASTER, change the current state of the handle, send different information to ROSMASTER, and drive ROSMASTER to make different reactions. **Corresponding to different models of ROSMASTER, what we need to control is also different.**

For the ROSMASTER-X3 (Mecanum wheel), what we can control through the handle are **the buzzer, the light strip, the linear speed of the car's movement (x-axis and y-axis), and the angular speed of the car's movement.**

5.5.1. Start handle control

1. Reference path of handle control yahboom_joy.launch file

```
~/yahboomcar_ws/src/yahboomcar_ctrl/launch/
```

2), start

```
roslaunch yahboomcar_bringup bringup.launch #Start chassis and handle
control, the launch of handle control is yahboom_joy.launch
```

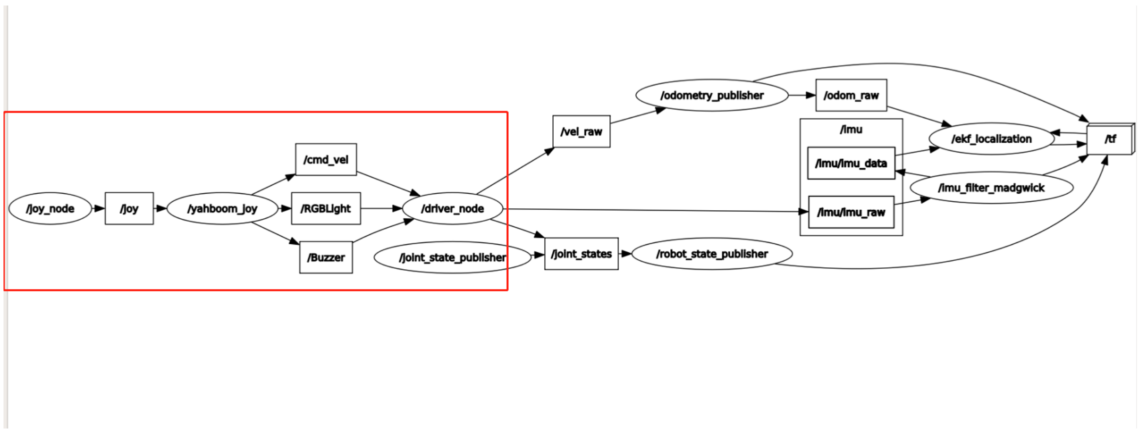
After turning it on, press the "START" button and hear the buzzer sound to start remote control. **The remote control will enter sleep mode after being turned on for a period of time. You need to press the "START" button to end sleep.**

3), remote control effect description

Handle	Effect
Left joystick up/down	Car forward/backward to go straight
Left joystick left/right	The car goes straight left/right
Right joystick left/right	Rotate car left/right
Right "1" key	Control light strip effect
"2" key on the right	End/start other functions
"START" button	Control buzzer/end sleep
Press the left joystick	Adjust the X/Y axis speed
Press the right joystick	Adjust the angular velocity

4. View the node graph

```
rqt_graph
```



The red box part is the topic communication between the handle control node/yahboom_joy and the underlying node/driver_node.

5), program analysis

Underlying control program:

```
Mcnamu_driver.py
```

The code path is:

```
~/yahboomcar_ws/src/yahboomcar_bringup/scripts
```

In Mcnamu_driver.py, the **subscribers and their respective callback functions for the topic information of the buzzer, speed control, and light strip are defined,**

```
self.sub_cmd_vel = rospy.Subscriber('cmd_vel', Twist, self.cmd_vel_callback,
queue_size=100) #Speed control
self.sub_RGBLight = rospy.Subscriber("RGBLight", Int32,
self.RGBLightcallback, queue_size=100) #Light strip control
self.sub_Buzzer = rospy.Subscriber("Buzzer", Bool, self.Buzzercallback,
queue_size=100) #Buzzer control

def cmd_vel_callback(self, msg) #Speed callback function
def RGBLightcallback(self, msg) #Light strip callback function
def Buzzercallback(self, msg) #Buzzer callback function
```

Handle control program:

```
yahboom_joy.py
```

The code path is:

```
~/yahboomcar_ws/src/yahboomcar_ctrl/scripts
```

In yahboom_joy.py, define the **publisher** of the buzzer, speed control, and light strip topic information, and publish these messages

```
self.pub_cmdVel = rospy.Publisher('cmd_vel', Twist, queue_size=10) #Speed
control
self.pub_RGBLight = rospy.Publisher("RGBLight", Int32, queue_size=10) #Light
strip control
self.pub_Buzzer = rospy.Publisher("Buzzer", Bool, queue_size=1) #Buzzer
control

self.pub_cmdVel.publish(twist) #Publish velocity data
self.pub_RGBLight.publish(self.RGBLight_index) #Publish light strip data
self.pub_Buzzer.publish(self.Buzzer_active) #Publish buzzer data
```

6), code analysis

- /joy topic data analysis

  Run the joy_node node and view the /joy topic information,

```
rosrun joy joy_node
rostopic echo joy
```

In the printed information, there are two arrays: axes and buttons. The data they store is the behavior of the joystick and buttons on the remote control. You can press each button on the remote control one by one to correspond to the transformation of the array, and you can know what behavior will cause which variable in the array to change its value.

- Knowing the changes in the /joy topic data corresponding to the keystroke behavior, then in yahboom_joy.py, we only need to make judgments on these values. There are also two categories in yahboom_joy.py. **The first step is to determine the name of the system (the first step is to determine whether the handle receiver is plugged into a jetson or a Raspberry Pi/PC (here it refers to a virtual machine))**,

```
if self.user_name == "jetson": self.user_jetson(joy_data)
         else: self.user_pc(joy_data)
```

- Value judgment: Take the jetson processor to judge the buzzer data as an example. Analysis shows that we use the "START" button to control the buzzer, and it corresponds to buttons[11]. When it is pressed At this time, buttons[11] will become 1. At this time, we can send the buzzer data,

  ```
  if joy_data.buttons[11] == 1:
  self.Buzzer_active=not self.Buzzer_active
     # print "self.Buzzer_active: ", self.Buzzer_active
     self.pub_Buzzer.publish(self.Buzzer_active)
  ```

  Other remote control behaviors are analyzed by analogy.

  Note: When judging the left and right of the left rocker, only the data of X3 (Mecanum wheel) and X3 Plus (Mecanum wheel + robotic arm) are valid, because of the characteristics of their wheels, they can move laterally. So there is speed on the Y axis.

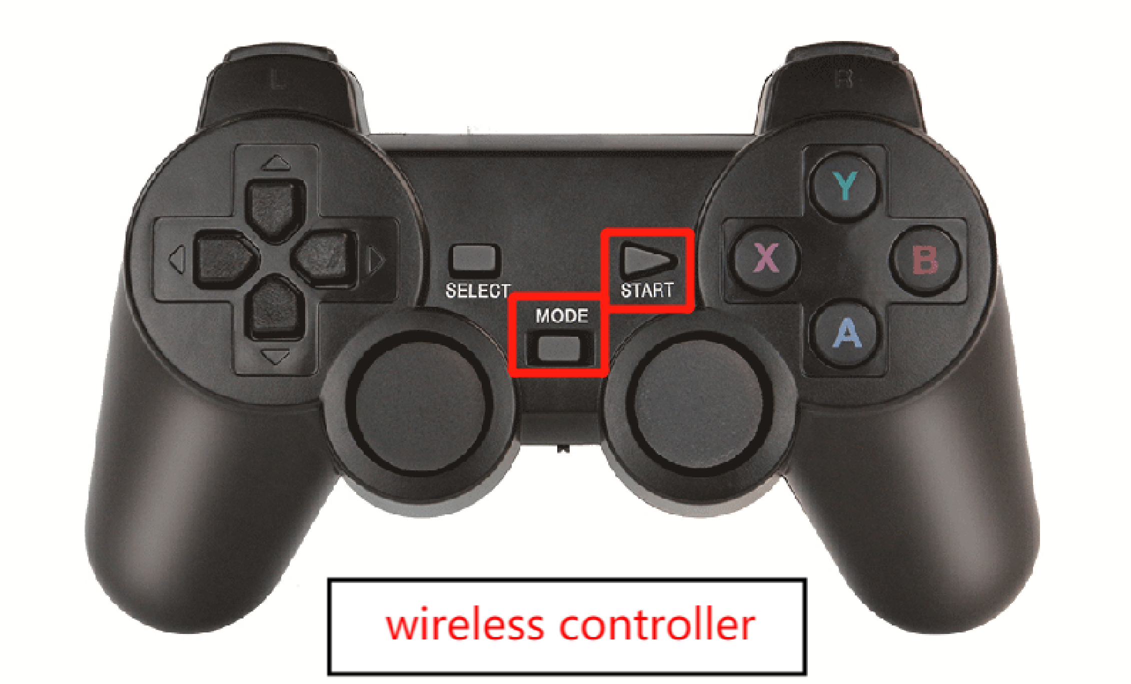
  ```
  ylinear_speed = self.filter_data(joy_data.axes[0]) * self.yspeed_limit
  * self.linear_Gear
  ```

5.6. Precautions when using the handle

- When connecting the USB handle receiver, it is recommended to connect it to the outermost USB-HUB expansion board instead of directly connecting to the motherboard or the middle USB-HUB expansion board (X3plus). If it is directly connected to the motherboard or the middle USB-HUB expansion board (X3plus), due to the aluminum alloy blocks on the top and bottom, it will seriously interfere with the handle signal reception.
- After plugging and unplugging the handle receiver, you need to restart the handle program, otherwise you will not be able to control the car.
- 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, such as If a buzzer sounds, the switch 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

  Raspberry Pi series support mode: X-BOX mode



- After re-plugging or unplugging the handle receiver or restarting the motherboard, the handle will be reset to factory mode. If it cannot be controlled, the mode will need to be switched again every time it is plugged in, unplugged or restarted.