Controller Control

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1. Course Content

Learn to control robot movement using a PS2 controller.

After running the program, use the PS2 controller to control the robot chassis and the robotic arm.

2. Preparation

2.1 Content Description

This course uses the Jetson Orin NX as an example. For Raspberry Pi and Jetson Nano boards, you need to open a terminal and enter the command to enter the Docker container. Once inside the Docker container, enter the commands mentioned in this course in the terminal. For instructions on entering the Docker container, refer to the product tutorial **[Configuration and Operation Guide] - [Entering the Docker (Jetson Nano and Raspberry Pi 5 users see here)]**. For Orin and NX boards, simply open a terminal and enter the commands mentioned in this course.

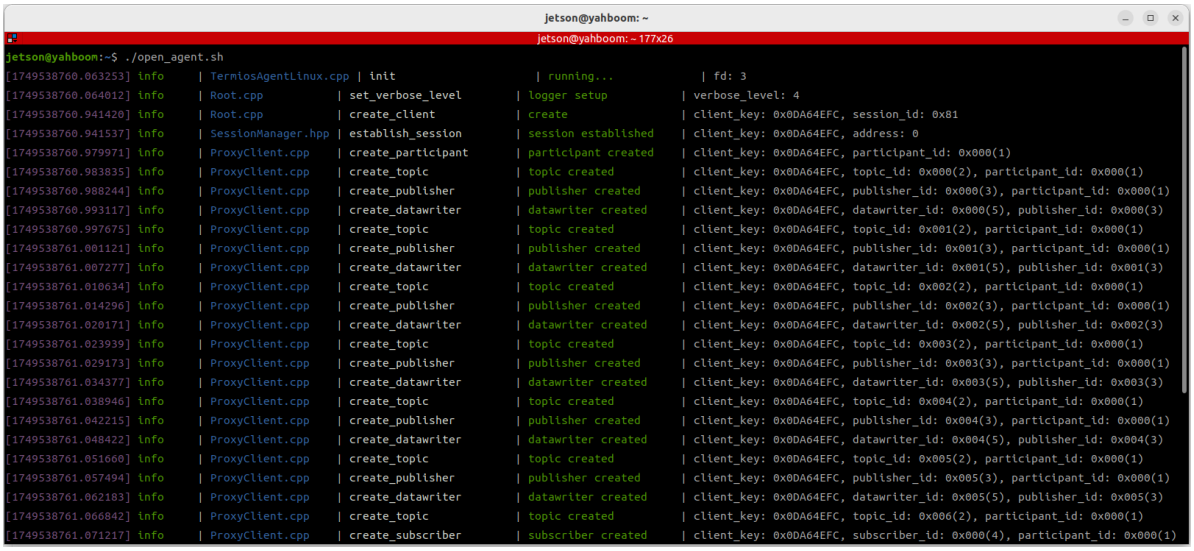
2.2 Start the agent

Note: All test cases must start the docker agent first. If it has already started, there is no need to restart it

Enter the command in the car terminal:

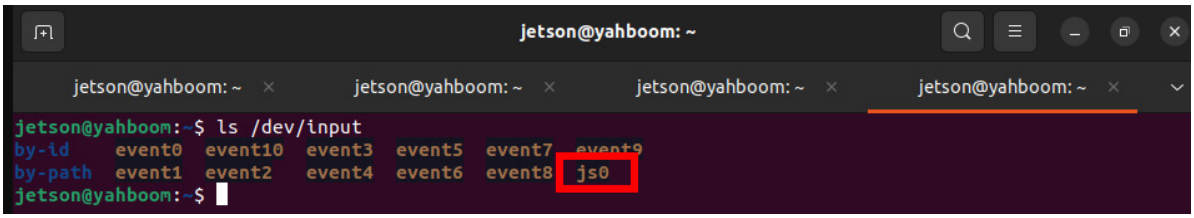
```
sh start_agent.sh
```

The terminal prints the following information, indicating that the connection is successful:



2.3 Check the device

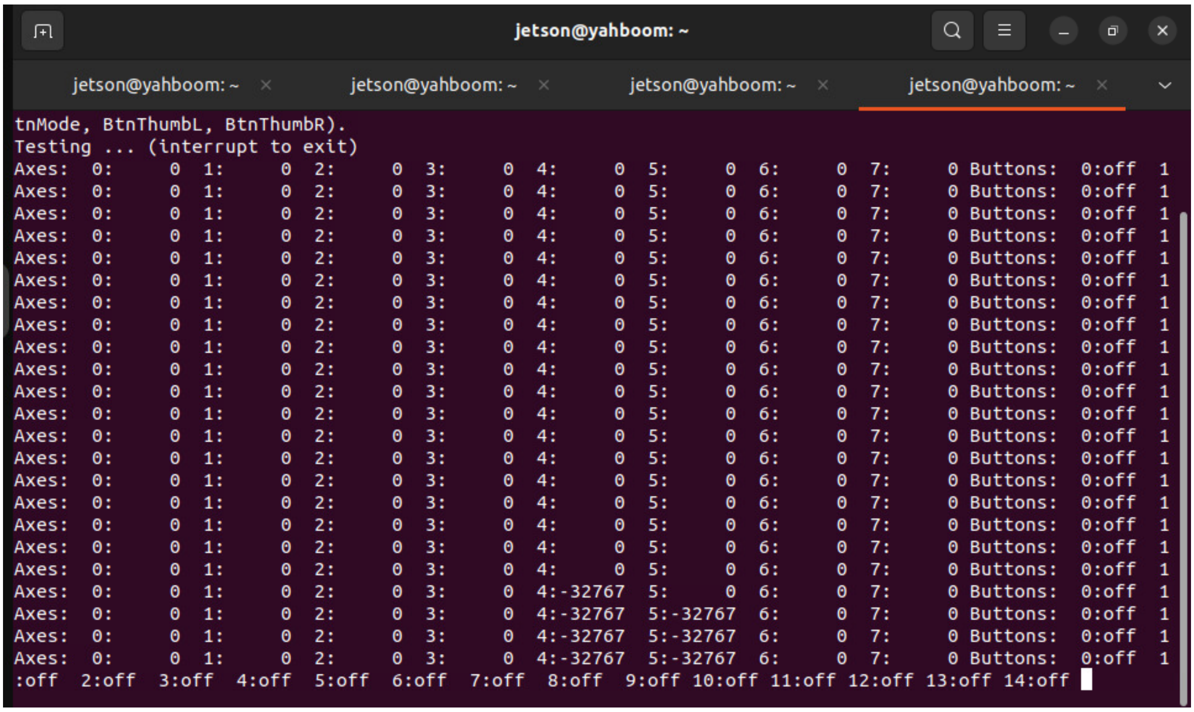
First, insert the wireless handle USB receiver into the main control (jetson, Raspberry Pi, PC), open the terminal, and enter the following command. If [js0] is displayed, it is the wireless handle. In special cases, you can also check the changes in the device list by connecting and disconnecting the wireless handle USB port. If there is a change, the changed device is the device; otherwise, the connection is unsuccessful or cannot be recognized.



2.4 Testing the Controller Input

Open Terminal and enter the following command. As shown in the image, this wireless controller has 8 axis inputs and 15 button inputs. You can test the corresponding numbers by pressing each button individually.

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



If jstest is not installed, run the following command:

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

3. Run the Example

3.1 Start the PS2 Controller Control Node

Note:

- The Jetson Nano and Raspberry Pi series controllers must first enter the Docker container (see the [Docker Course Chapter - Entering the Robot's Docker Container] for steps).

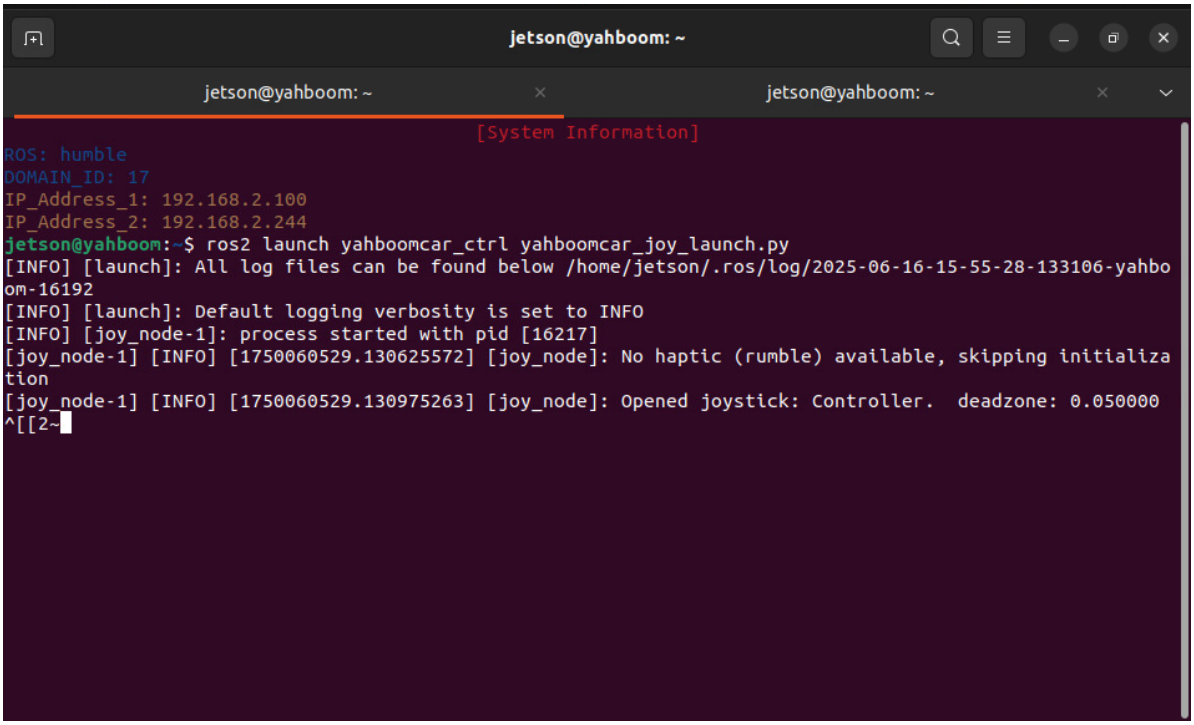
Open two terminals on the car computer and run the following two nodes respectively.

Run the controller receiving node:

```
ros2 launch yahboomcar_ctrl yahboomcar_joy_launch.py
```

Run the robot controller control node:

```
ros2 run yahboomcar_ctrl yahboom_joy_M3Pro
```



3.2 Button Control Instructions

Controller Actions	Functions
Left Joystick Up/Down	Car Moves Forward/Backward
Left Joystick Left/Right	Car Moves Straight Left/Right
Right Joystick Left/Right	Car Rotates Left/Right
"START" Button	End Sleep
Left Joystick Pressed	Adjust X/Y Axis Speed
Right Joystick Pressed	Adjusting Angular Velocity
Up Button	Servo 4 Up
Down Button	Servo 4 Down
Left Button	Servo 3 Down
Right Button	Servo 3 Up
X Button	Servo 1 Left
B Button	Servo 1 Right
Y Button	Servo 2 Up
A Button	Servo 2 Down
Left "1" Button	Servo 6 Clamp (Tighten) / Servo 5 Turn Right
Left "2" Button	Servo 6 Clamp (Loose) / Servo 5 Turn Left
SELECT Button	Switching Control Between Servo 6 and Servo 5

4. Source Code Analysis

Source Code Path:

Jetson Orin Nano, Jetson Orin NX:

```
/home/jetson/yahboomcar_ws/src/yahboomcar_ctrl/yahboomcar_ctrl/yahboom_joy_M3Pro
.py
```

Jetson Orin Nano, Raspberry Pi:

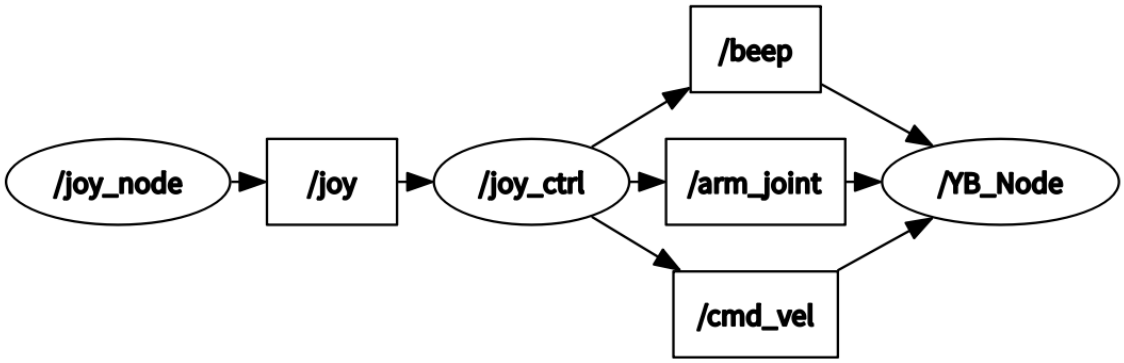
You need to enter Docker first.

```
root/yahboomcar_ws/src/yahboomcar_ctrl/yahboomcar_ctrl/yahboom_joy_M3Pro.py
```

4.1 View the Node Relationship Graph

Open a terminal and enter the command:

```
ros2 run rqt_graph rqt_graph
```



In the above node relationship graph:

- **joy_node**: Receives data from the controller receiver and publishes it to the **/joy** topic.

joy_ctrl: Subscribes to data from the **/joy** topic and parses keystrokes and corresponding operations. Publishes to the **/cmd_vel** and /arm_joint** topics to control the robot chassis and robotic arms.

4.2 Viewing Topic Messages and Message Types

Open a terminal on the vehicle or virtual machine and enter the following command:

```
ros2 interface show sensor_msgs/msg/Joy
```

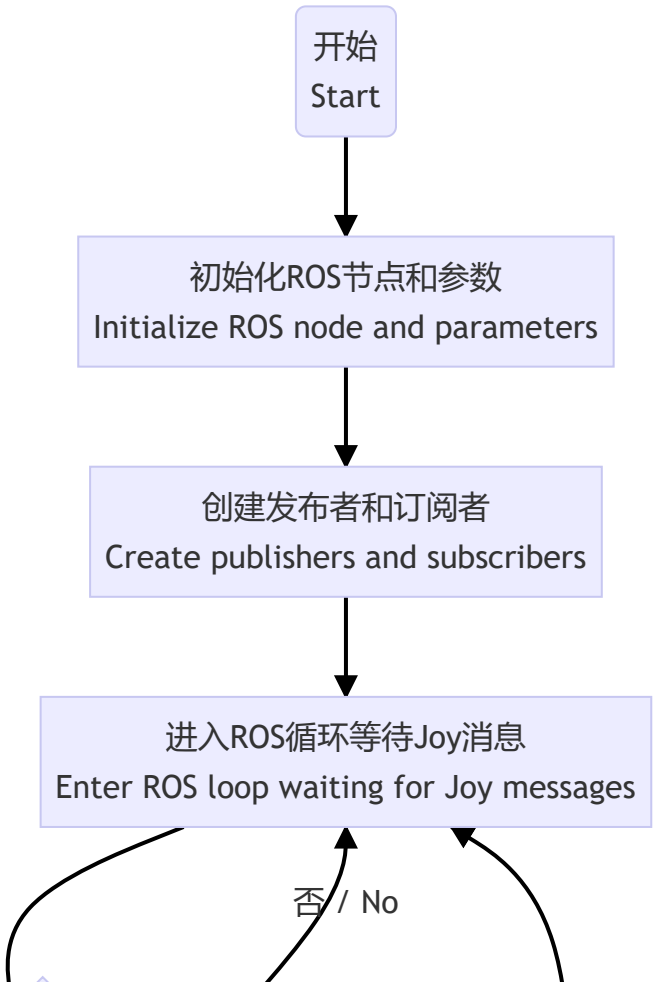
```
jetson@yahboom: ~
jetson@yahboom: ~   jetson@yahboom: ~   jetson@yahboom: ~
jetson@yahboom:~$ ros2 topic info /joy
Type: sensor_msgs/msg/Joy
Publisher count: 1
Subscription count: 1
jetson@yahboom:~$ ros2 interface show sensor_msgs/msg/Joy
# Reports the state of a joystick's axes and buttons.

# The timestamp is the time at which data is received from the joystick.
std_msgs/Header header
        builtin_interfaces/Time stamp
                int32 sec
                uint32 nanosec
        string frame_id

# The axes measurements from a joystick.
float32[] axes

# The buttons measurements from a joystick.
int32[] buttons
jetson@yahboom:~$
```

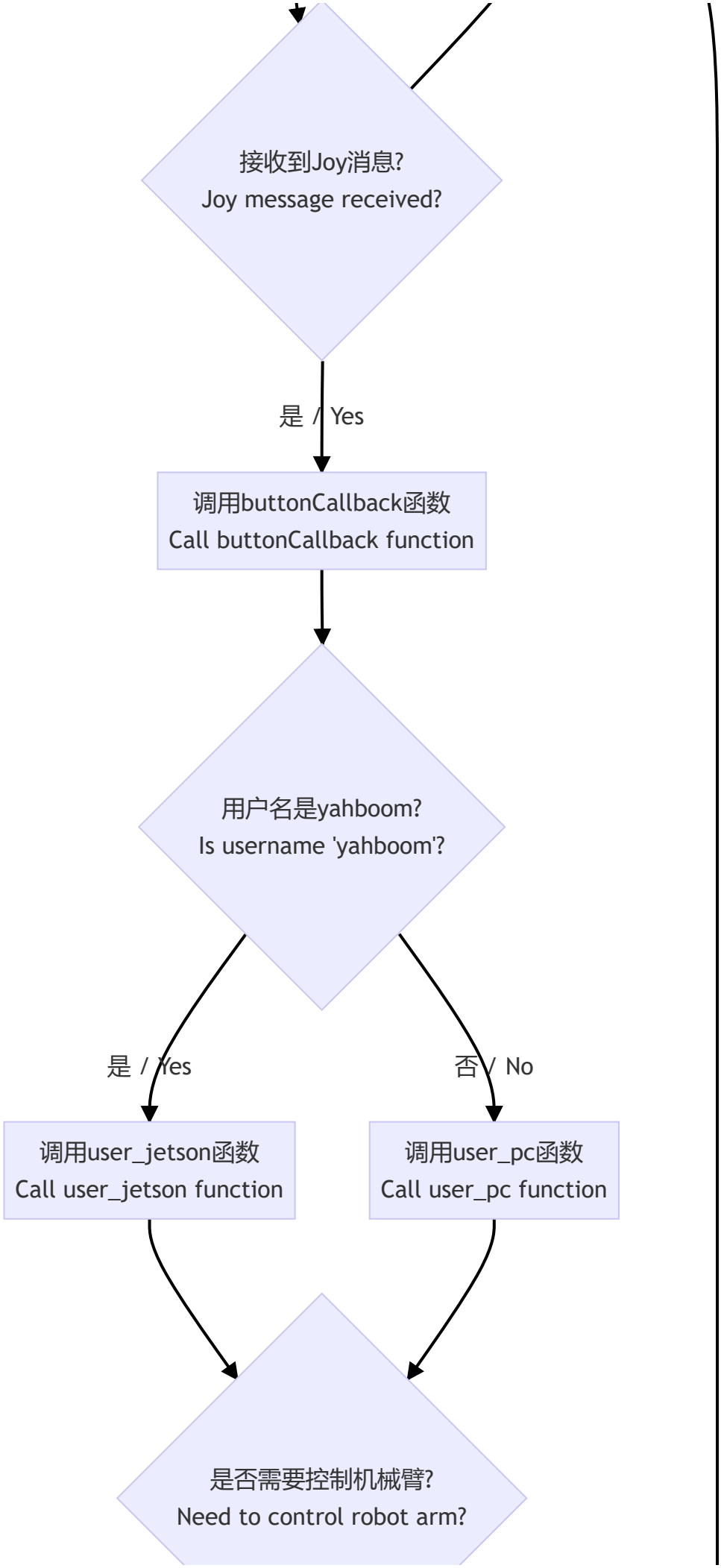
The data in the /joy topic is a float32 array containing timestamps.

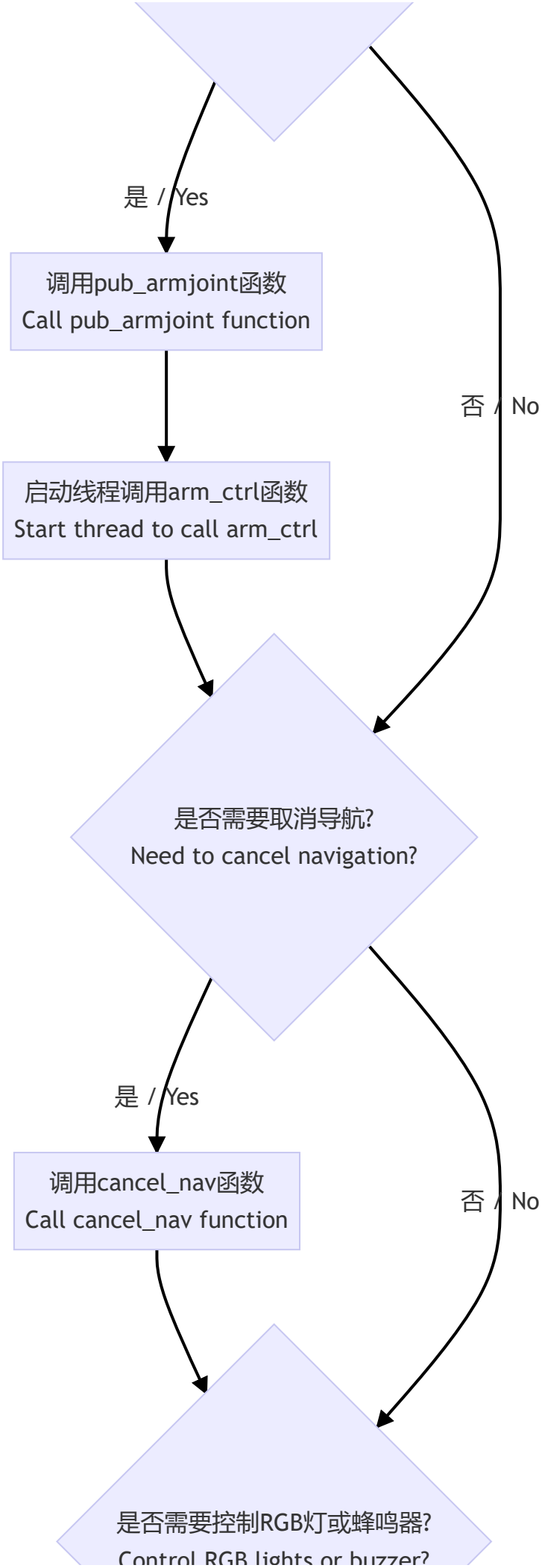
- float32[] axes: Input data for 8 axes
- int32[] buttons: Input data for 15 buttons

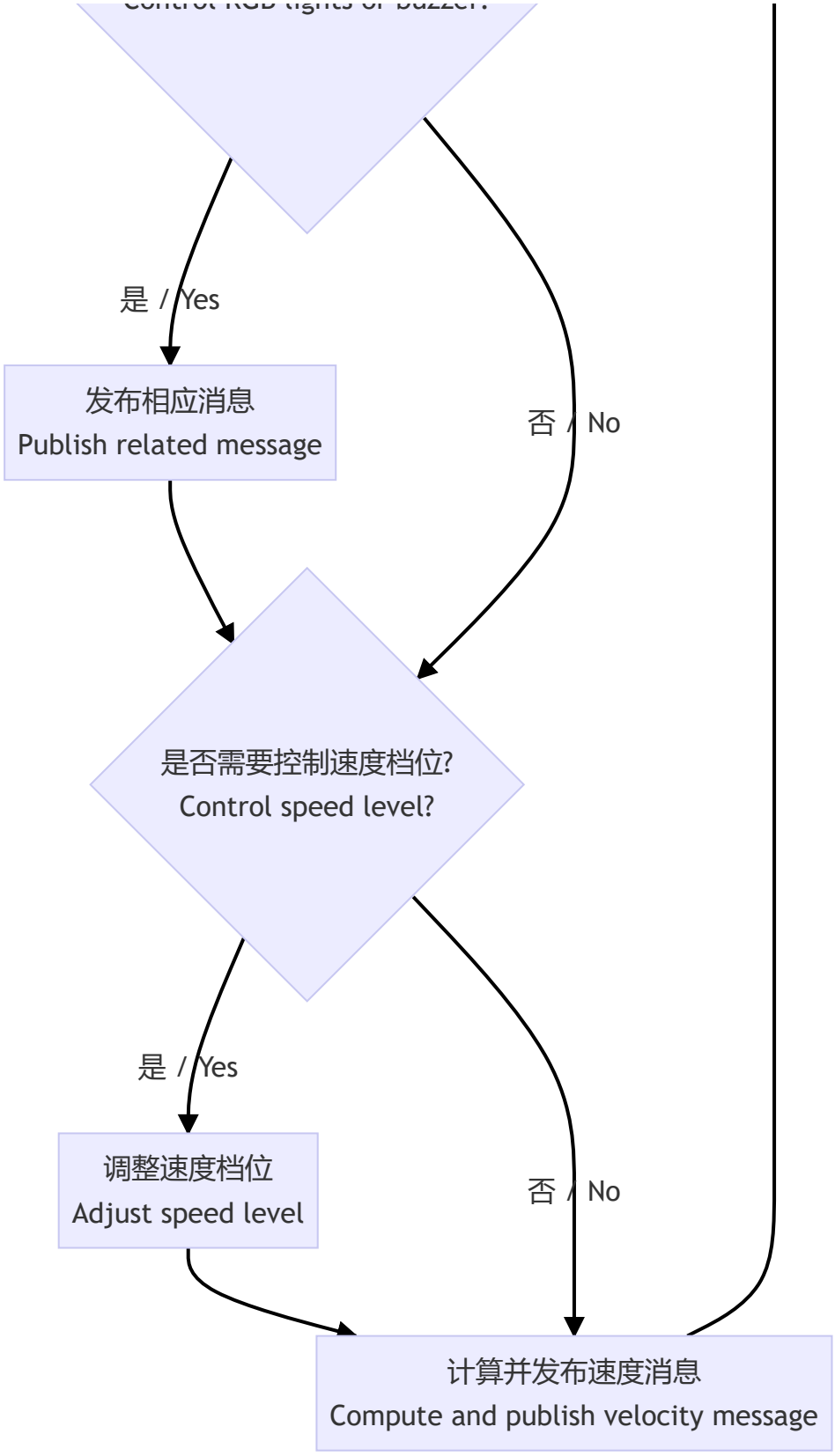
4.3 Program Flowchart

Image size is too large. The original image can be viewed in this lesson's folder.




接收到Joy消息?
Joy message received?
是 / Yes
调用buttonCallback函数
Call buttonCallback function
用户名是yahboom?
Is username 'yahboom'?
是 / Yes
否 / No
调用user_jetson函数
Call user_jetson function
调用user_pc函数
Call user_pc function
是否需要控制机械臂?
Need to control robot arm?


是 / Yes
调用pub_armjoint函数
Call pub_armjoint function
否 / No
启动线程调用arm_ctrl函数
Start thread to call arm_ctrl
是否需要取消导航?
Need to cancel navigation?
是 / Yes
调用cancel_nav函数
Call cancel_nav function
否 / No
是否需要控制RGB灯或蜂鸣器?
Control RGB lights or buzzer?



4.4 Source Code Analysis

Jetson Orin Nano and Jetson Orin NX series motherboards, source code is located here:

```
/home/jetson/yahboomcar_ws/src/yahboomcar_ctrl/yahboomcar_ctrl/yahboom_joy_M3Pro
.py
```

jetson Nano, Raspberry Pi series controller:

You need to first enter the Docker container. The source code is located here:

```
/root/yahboomcar_ws/src/yahboomcar_ctrl/yahboomcar_ctrl/yahboom_joy_M3Pro.py
```

4.4.1 Topic Communication

```
self.pub_cmdVel = self.create_publisher(Twist,'cmd_vel',  1)
self.pub_SingleTargetAngle = self.create_publisher(ArmJoint, "arm_joint", 1)
self.sub_Joy = self.create_subscription(Joy,'joy', self.buttonCallback,10)
```

The chassis and robotic arm movements are controlled by publishing topics **/cmd_vel** and /arm_joint**, and the** /joy** topic is subscribed to obtain the button status of the PS2 controller.

The essential principle of controlling the robot with a controller is to first parse the controller data, convert it into corresponding control state variables, and send it to the chassis control board via topic communication. The chassis control board subscribes to the topic data and converts it into values for directly controlling the hardware.

4.4.2 Robotic Arm Control

The function of controlling the robotic arm with a PS2 controller is implemented through the arm_ctrl method in the JoyTeleop class:

```
def arm_ctrl(self, id, direction):
    while 1:
        if self.loop_active:
            self.arm_joints[id - 1] += direction
            if id == 5:
                if self.arm_joints[id - 1] > 270: self.arm_joints[id - 1] = 270
                elif self.arm_joints[id - 1] < 0: self.arm_joints[id - 1] = 0
            elif id == 6:
                if self.arm_joints[id - 1] >= 180: self.arm_joints[id - 1] = 180
                elif self.arm_joints[id - 1] <= 30: self.arm_joints[id - 1] = 30
            else:
                if self.arm_joints[id - 1] > 180: self.arm_joints[id - 1] = 180
                elif self.arm_joints[id - 1] < 0: self.arm_joints[id - 1] = 0
            self.arm_joint.id = id
            self.arm_joint.joint = int(self.arm_joints[id - 1])
            self.arm_joint.time = 500
            self.pub_SingleTargetAngle.publish(self.arm_joint)
        else: break
        sleep(0.03)
```

4.4.3 Chassis Movement Control

Chassis movement control with the PS2 controller is implemented using the user_jetson method in the JoyTeleop class:

```
def user_jetson(self, joy_data):

    #arm_ctrl_start
    if joy_data.buttons[10] == 1: self.gripper_active = not self.gripper_active
    if joy_data.buttons[0] == joy_data.buttons[1] == joy_data.buttons[
```

```
        6] == joy_data.buttons[3] == joy_data.buttons[4] == 0 and joy_data.axes[
        7] == joy_data.axes[6] == 0 and joy_data.axes[5] != -1: self.loop_active
= False
    else:
        if joy_data.buttons[3] == 1:
            print("1,-")
            self.pub_armjoint(1, -1) # X
        if joy_data.buttons[1] == 1:
            self.pub_armjoint(1, 1)  # B
            print("1,+")
        if joy_data.buttons[0] == 1:
            self.pub_armjoint(2, -1) # A
            print("2,-")
        if joy_data.buttons[4] == 1:
            self.pub_armjoint(2, 1)  # Y
            print("2,+")
        if joy_data.axes[6] != 0:
            self.pub_armjoint(3, -joy_data.axes[6]) # 左按键左正右负 Left button
left positive right negative
            print("3,-/+")
        if joy_data.axes[7] != 0:
            self.pub_armjoint(4, joy_data.axes[7]) # 左按键上正下负 Left button up
positive down negative
            print("4,-/+")
        if self.gripper_active:
            if joy_data.axes[5] == -1:
                self.pub_armjoint(6, -1)  # L2
                print("6,-")
            if joy_data.buttons[6] == 1:
                self.pub_armjoint(6, 1) # L1
                print("6,+")
        else:
            if joy_data.axes[5] == -1:
                self.pub_armjoint(5, -1)  # L2
                print("5,-")
            if joy_data.buttons[6] == 1:
                self.pub_armjoint(5, 1) # L1
                print("5,+")
    #arm_ctrl_end

    #cancel nav
    if joy_data.buttons[9] == 1:
        #print("--------------------")
        self.cancel_nav()
    #RGBLight
    if joy_data.buttons[7] == 1:
        return
    #Buzzer
    if joy_data.buttons[11] == 1:
        Buzzer_ctrl = UInt16()
        if  self.Buzzer_active == 0:
            self.Buzzer_active = self.Buzzer_active + 1
        else:
            self.Buzzer_active = self.Buzzer_active - 1
        Buzzer_ctrl.data =self.Buzzer_active
        for i in range(3): self.pub_Buzzer.publish(Buzzer_ctrl)
    #linear Gear control
    if joy_data.buttons[13] == 1:
```

```
        if self.linear_Gear == 1.0: self.linear_Gear = 1.0 / 3
        elif self.linear_Gear == 1.0 / 3: self.linear_Gear = 2.0 / 3
        elif self.linear_Gear == 2.0 / 3: self.linear_Gear = 1
    # angular Gear control
    if joy_data.buttons[14] == 1:
        if self.angular_Gear == 1.0: self.angular_Gear = 1.0 / 4
        elif self.angular_Gear == 1.0 / 4: self.angular_Gear = 1.0 / 2
        elif self.angular_Gear == 1.0 / 2: self.angular_Gear = 3.0 / 4
        elif self.angular_Gear == 3.0 / 4: self.angular_Gear = 1.0
    xlinear_speed = self.filter_data(joy_data.axes[1]) * self.xspeed_limit *
self.linear_Gear
    #ylinear_speed = self.filter_data(joy_data.axes[2]) * self.yspeed_limit *
self.linear_Gear
    ylinear_speed = self.filter_data(joy_data.axes[0]) * self.yspeed_limit *
self.linear_Gear
    angular_speed = self.filter_data(joy_data.axes[2]) *
self.angular_speed_limit * self.angular_Gear
    if xlinear_speed > self.xspeed_limit: xlinear_speed = self.xspeed_limit
    elif xlinear_speed < -self.xspeed_limit: xlinear_speed = -self.xspeed_limit
    if ylinear_speed > self.yspeed_limit: ylinear_speed = self.yspeed_limit
    elif ylinear_speed < -self.yspeed_limit: ylinear_speed = -self.yspeed_limit
    if angular_speed > self.angular_speed_limit: angular_speed =
self.angular_speed_limit
    elif angular_speed < -self.angular_speed_limit: angular_speed = -
self.angular_speed_limit
    twist = Twist()
    twist.linear.x = xlinear_speed
    twist.linear.y = ylinear_speed
    twist.angular.z = angular_speed
    if self.Joy_active == True:
        print("joy control now")
        for i in range(3): self.pub_cmdVel.publish(twist)
```