ROS Control

1. Functional Description

This function enables control of the robot's speed, buzzer, and servos through ROS2 topic tools. It also enables access to low-level data, such as radar data, IMU data, and version information.

2. Preparation

2.1. Pre-use Instructions

This lesson uses the Raspberry Pi as an example. For Raspberry Pi and Jetson-Nano boards, you need to open a terminal on the host computer and enter the command to enter the Docker container. Once inside the Docker container, enter the commands mentioned in this lesson in the terminal. For instructions on entering the Docker container from the host computer, refer to **[01. Robot Configuration and Operation Guide] -- [5.Enter Docker (For JETSON Nano and RPi 5)]**. For Orin boards, simply open a terminal and enter the commands mentioned in this lesson.

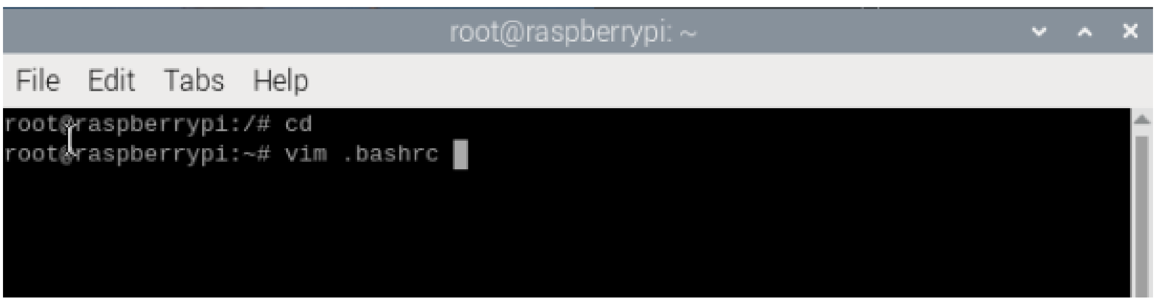
2.2 Pre-use Configuration

This vehicle is equipped with a USB camera, a depth camera, and two different LiDAR models. However, since the device cannot be automatically recognized, the machine type and LiDAR model must be manually configured.

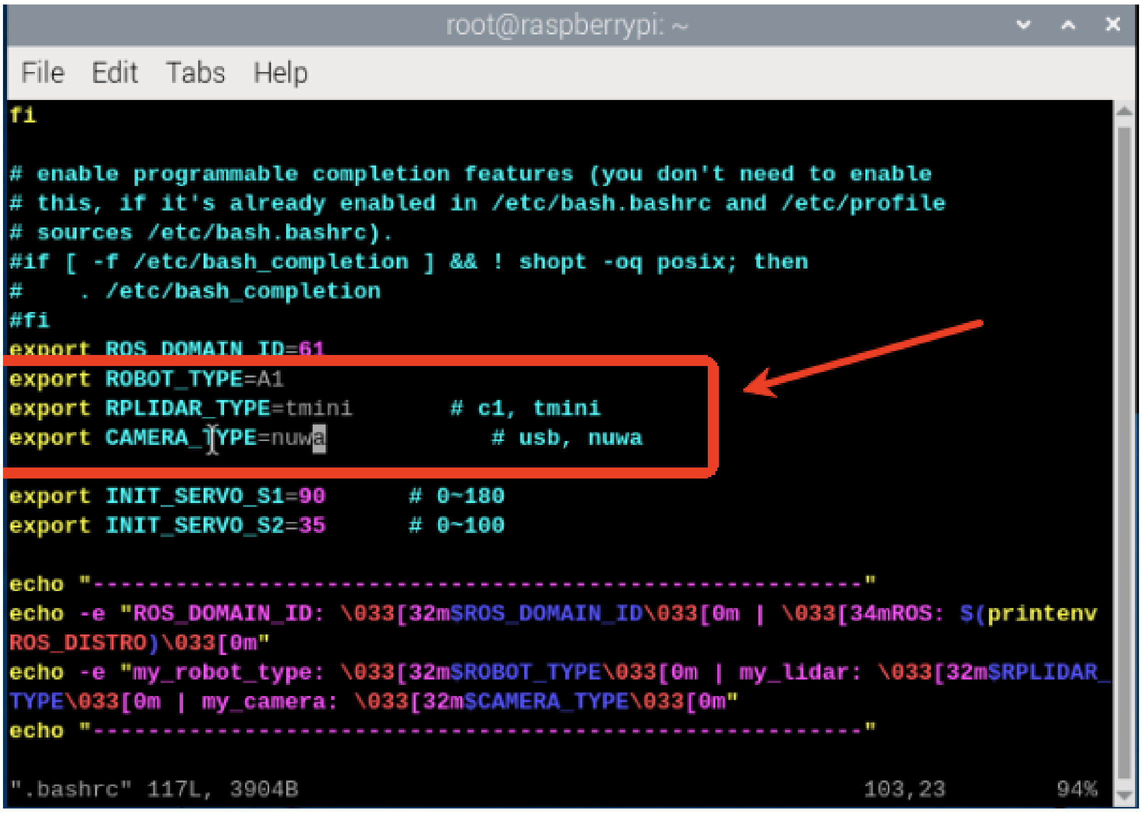
For the Raspberry Pi 5 controller, you must first enter the Docker container. This is not necessary for the Orin .

Change the LiDAR and camera types according to the vehicle model as follows.

```
root@ubuntu:/# cd
root@ubuntu:~# vim .bashrc
```

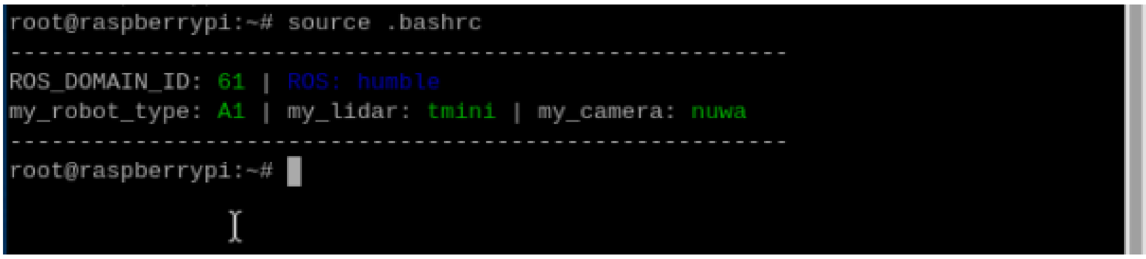


Find this location and press i on your keyboard to change the camera and LiDAR models to the corresponding ones. The default values are Tmini and Nuwa.



After completing the modification, save and exit vim, then execute:

```
root@raspberrypi:~# source .bashrc
--------------------------------------------------------
ROS_DOMAIN_ID: 61 | ROS: humble
my_robot_type: A1 | my_lidar: tmini | my_camera: nuwa
--------------------------------------------------------
root@raspberrypi:~#
```



3. Program Startup

3.1. Startup Command

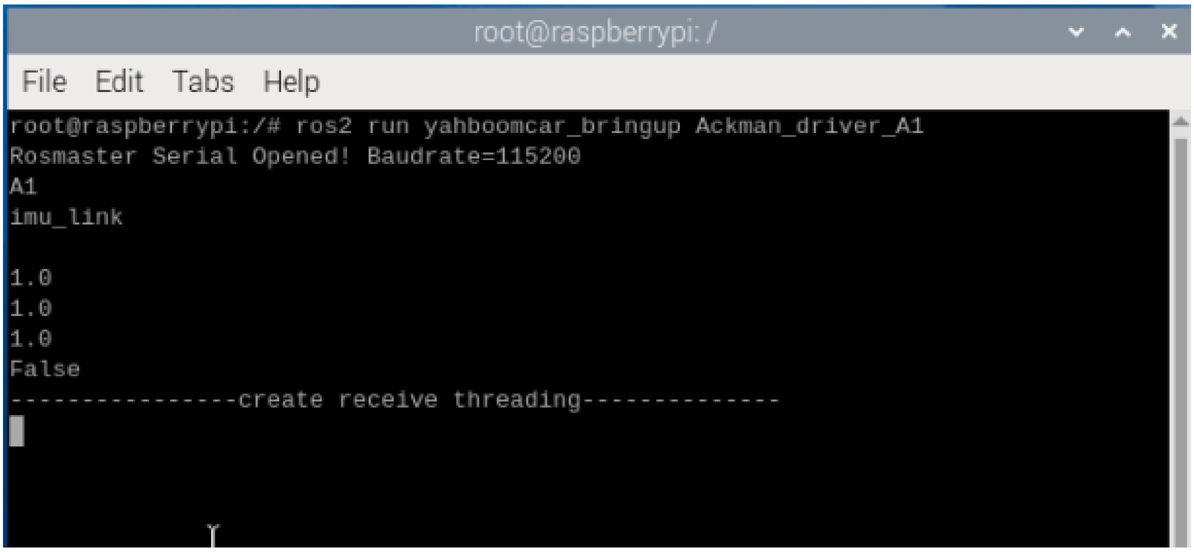
For the Raspberry Pi 5 controller, you must first enter the Docker container. For the Orin controller, this is not necessary.

Enter the Docker container (for steps, see [Docker Course] --- [4. Docker Startup Script]).

All the following commands must be executed from the Docker terminal within the same Docker container.**(For steps, see [Docker Course] --- [3. Docker Submission and Multi-Terminal Access]).**

To start chassis data, enter the following command in the terminal:

```
ros2 run yahboomcar_bringup Ackman_driver_A1
```



You can view the current node name by entering the following command:

```
ros2 node list
```

Enter the following command in the terminal to view the available topics.

```
ros2 topic list
```

Topic Name	Topic Content
/Buzzer	Buzzer
/Servo	Servo s1, s2
/cmd_vel	Speed Control
/edition	Version Information
/imu/data_raw	IMU Sensor Data
/imu/mag	IMU Magnetometer Data
/vel_raw	Vehicle Speed Information
/voltage	Battery voltage information

Then enter the following command to query the topic message data types of the topics published/subscribed by this node.

```
ros2 node info /driver_node
```

```
root@raspberrypi:/# ros2 node info /driver_node
/driver_node
  Subscribers:
    /Buzzer: std_msgs/msg/Bool
    /Servo: yahboomcar_msgs/msg/ServoControl
    /cmd_vel: geometry_msgs/msg/Twist
  Publishers:
    /edition: std_msgs/msg/Float32
    /imu/data_raw: sensor_msgs/msg/Imu
    /imu/mag: sensor_msgs/msg/MagneticField
    /joint_states: sensor_msgs/msg/JointState
    /parameter_events: rcl_interfaces/msg/ParameterEvent
    /rosout: rcl_interfaces/msg/Log
    /vel_raw: geometry_msgs/msg/Twist
    /voltage: std_msgs/msg/Float32
  Service Servers:
    /driver_node/describe_parameters: rcl_interfaces/srv/DescribeParameters
    /driver_node/get_parameter_types: rcl_interfaces/srv/GetParameterTypes
    /driver_node/get_parameters: rcl_interfaces/srv/GetParameters
    /driver_node/list_parameters: rcl_interfaces/srv/ListParameters
    /driver_node/set_parameters: rcl_interfaces/srv/SetParameters
    /driver_node/set_parameters_atomically: rcl_interfaces/srv/SetParametersAtom
ically
  Service Clients:

  Action Servers:

  Action Clients:

root@raspberrypi:/#
```

3.2. Publishing Control Commands

Based on the table of subscribed topics, use the following command format: `ros2 topic pub topic name topic message data type message data --once` to publish a frame of control data.

- Issue Speed Control Commands

For the first test, it's recommended to set up the car and test it without its wheels touching the ground. We'll set the car to move forward at a linear velocity of 0.1 m/s. Enter the following command in the terminal:

```
ros2 topic pub /cmd_vel geometry_msgs/msg/Twist "{linear: {x: 0.1, y: 0.0, z: 0.0}, angular: {x: 0.0, y: 0.0, z: 0.0}}" --once
```

After running, the car will move forward at a speed of 0.1 m/s. Similarly, to control the car to move at an angle of 1.0 rad/s, assign the z value of angular_r to the value of angular_r (note that turning requires not only the angular velocity but also the linear velocity, as Ackerman chassis turning requires forward velocity).** The command is as follows:

```
ros2 topic pub /cmd_vel geometry_msgs/msg/Twist "{linear: {x: 0.1, y: 0.0, z: 0.0}, angular: {x: 0.0, y: 0.0, z: 1.0}}" --once
```

After running, the robot will rotate. To stop the robot, simply publish both the linear velocity and angular velocity to 0. When the velocity reaches 0, the front wheel servo automatically corrects. The command is as follows:

```
ros2 topic pub /cmd_vel geometry_msgs/msg/Twist "{linear: {x: 0.0, y: 0.0, z:
0.0}, angular: {x: 0.0, y: 0.0, z: 0.0}}" --once
```

The "--once" flag indicates that only one frame of message data will be sent. For other parameters of pub, refer to [19. Common ROS2 Command Tools] in [15. ROS2 Basics Course] of this product course.

3.3. Controlling the Buzzer

To turn on the buzzer, enter the following command in the terminal:

```
ros2 topic pub /Buzzer std_msgs/msg/Bool "data: 1" --once
```

To turn off the buzzer, enter the following command in the terminal:

```
ros2 topic pub /Buzzer std_msgs/msg/Bool "data: 0" --once
```

3.4. Controlling the Servo

Note: This command is only required if you purchased the gimbal USB camera version; it is not required for the depth camera version

To control the servo, enter the following command in the terminal:

```
ros2 topic pub -1 /Servo yahboomcar_msgs/msg/ServoControl "{'s1': 90, 's2': 35}"
```

```
root@raspberrypi:/# ros2 topic pub -1 /Servo yahboomcar_msgs/msg/ServoControl "{
's1': 90, 's2': 35}"
publisher: beginning loop
publishing #1: yahboomcar_msgs.msg.ServoControl(s1=90, s2=35)

root@raspberrypi:/# 
```

3.5. Reading Battery Voltage

Terminal Input:

```
ros2 topic echo /voltage
```

```
root@raspberrypi:/# ros2 topic echo /voltage
data: 12.5
---
data: 12.5
---
data: 12.5
---
data: 12.5
---
data: 12.5
---
data: 12.5
---
data: 12.5
---
data: 12.5
---
data: 12.5
---
data: 12.5
---
data: 12.5
---
```

3.6. Reading Firmware Version

Terminal Input:

```
ros2 topic echo /edition
```

```
root@raspberrypi:/# ros2 topic echo /edition
data: 3.5999999046325684
---
data: 3.5999999046325684
---
data: 3.5999999046325684
---
data: 3.5999999046325684
---
data: 3.5999999046325684
---
data: 3.5999999046325684
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data: 3.5999999046325684
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data: 3.5999999046325684
---
data: 3.5999999046325684
---
data: 3.5999999046325684
---
data: 3.5999999046325684
---
```

4. Program Core Source Code Analysis

Using Ackman_driver_A1.py as an example,

```
from Rosmaster_Lib import Rosmaster #Import the driver library

self.car = Rosmaster() #Instantiate the Rosmaster object

#create subscriber
self.sub_cmd_vel =
self.create_subscription(Twist,"cmd_vel",self.cmd_vel_callback,1)
self.sub_BUzzer =
self.create_subscription(Bool,"Buzzer",self.Buzzercallback,100)

#create publisher
self.EdiPublisher = self.create_publisher(Float32,"edition",100)
self.volPublisher = self.create_publisher(Float32,"voltage",100)
self.staPublisher = self.create_publisher(JointState,"joint_states",100)
self.velPublisher = self.create_publisher(Twist,"vel_raw",50)
self.imuPublisher = self.create_publisher(Imu,"/imu/data_raw",100)
self.magPublisher = self.create_publisher(MagneticField,"/imu/mag",100)

#Call the library and read the information of the ros expansion board
edition.data = self.car.get_version()*1.0
battery.data = self.car.get_battery_voltage()*1.0
ax, ay, az = self.car.get_accelerometer_data()
gx, gy, gz = self.car.get_gyroscope_data()
mx, my, mz = self.car.get_magnetometer_data()
vx, vy, angular = self.car.get_motion_data()

#Publish topic data
self.imuPublisher.publish(imu)
self.magPublisher.publish(mag)
self.volPublisher.publish(battery)
self.EdiPublisher.publish(edition)
self.velPublisher.publish(twist)

#Subscriber callback function
def cmd_vel_callback(self, msg)
def Buzzercallback(self, msg):
```