Lidar patrol

Note: The ROS_DOMAIN_ID of the Raspberry Pi and the microROS control board need to be consistent. You can check **[MicroROS Control Board Parameter Configuration]** to set the microROS control board ROS_DOMAIN_ID. Check the tutorial **[Connect MicroROS Agent]** to determine whether the IDs are consistent.

1、Program function description

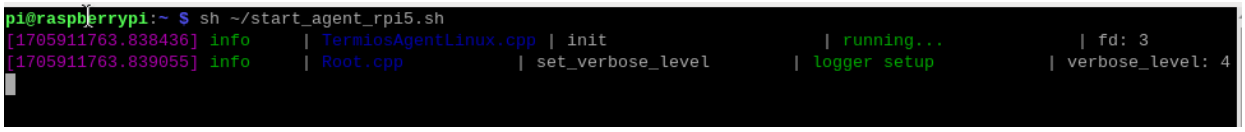
The car connects to the agent, runs the program, sets the route to be patrolled in the dynamic parameter adjuster, and then clicks start. The car will move according to the set patrol route. At the same time, the radar on the car will scan the set radar angle and whether there are obstacles within the set obstacle detection distance. If there are obstacles, it will stop and the buzzer will sound. If there are no obstacles, it will stop and the buzzer will sound. Barriers continue to patrol.

2、Query car information

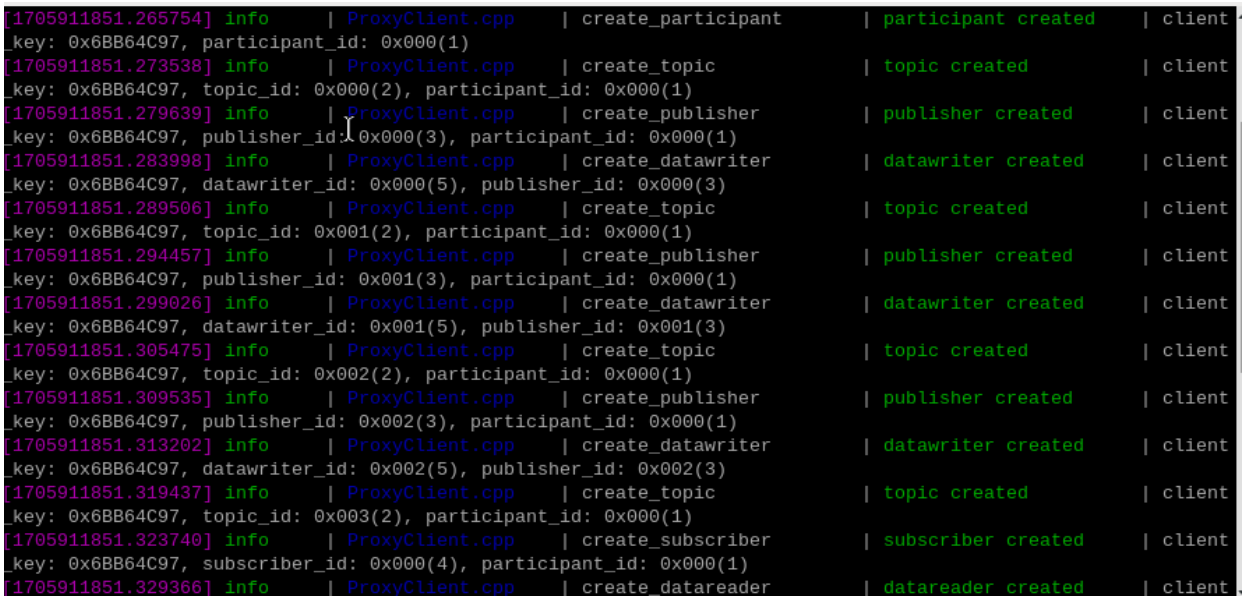
2.1、Start and connect to the agent

After the Raspberry Pi is successfully powered on, open the terminal and enter the following command to open the agent.

```
sh ~/start_agent_rpi5.sh
```



Press the reset button on the microROS control board and wait for the car to connect to the agent. The connection is successful as shown in the figure below.

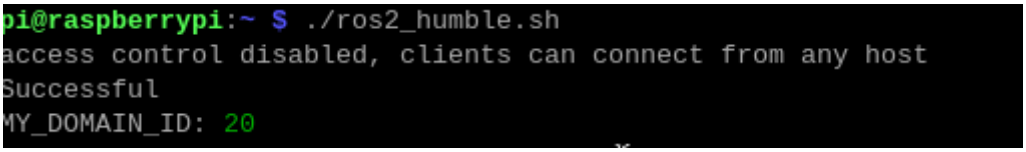


2.2、Enter the car docker

Open another terminal and enter the following command to enter docker.

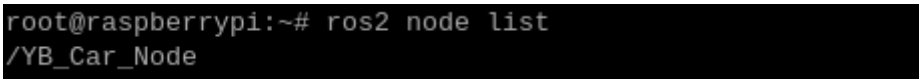
```
sh ros2_humble.sh
```

When the following interface appears, you have successfully entered docker, and you can now control the car through commands.



Enter the following command in the terminal to query the agent node.

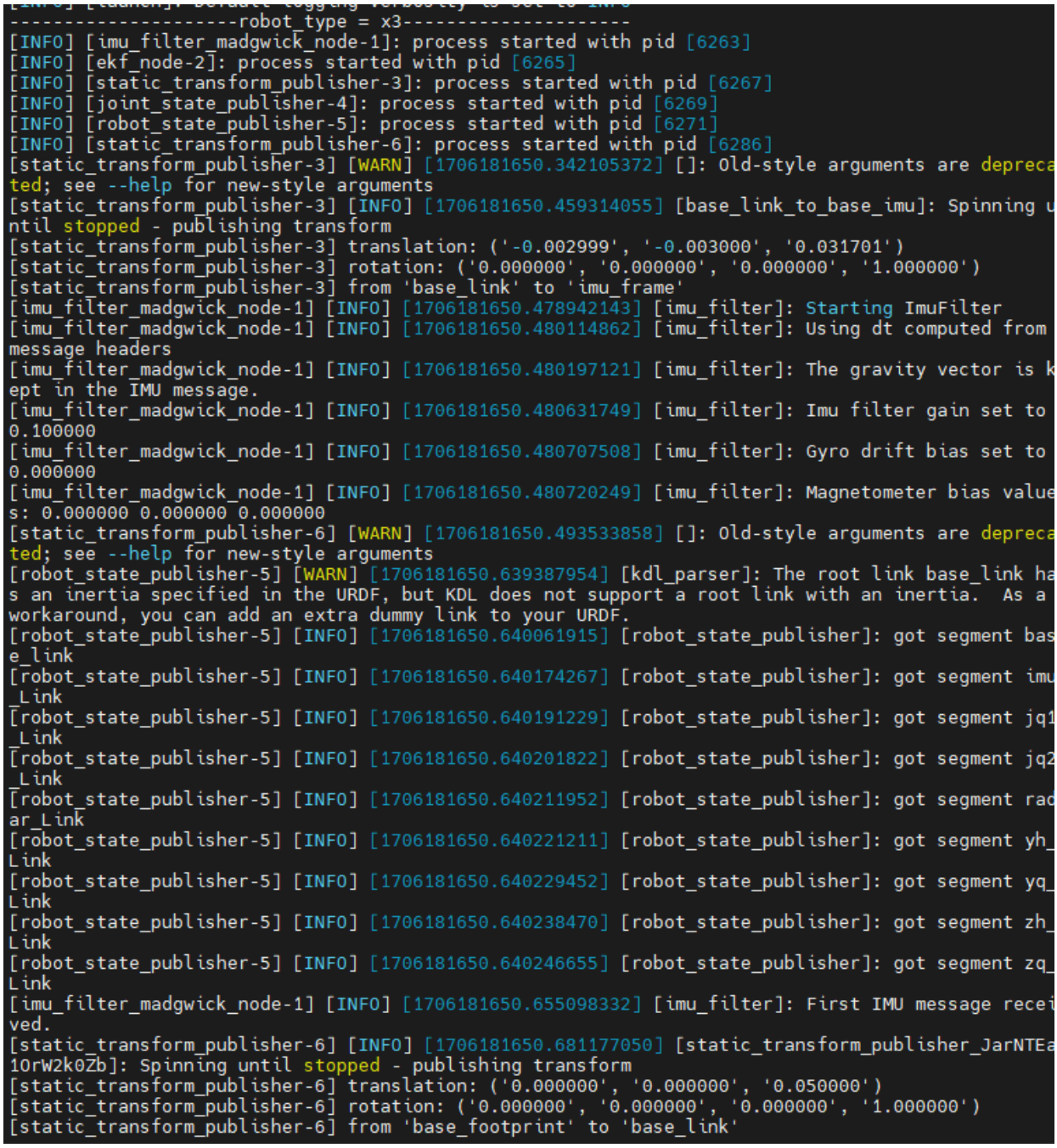
```
ros2 node list
```



3、starting program

First, start the car's underlying data processing program. This program will release the TF transformation of odom->base_footprint. With this TF change, you can calculate "how far the car has gone" and input it at the terminal.

```
ros2 launch yahboomcar_bringup yahboomcar_bringup_launch.py
```



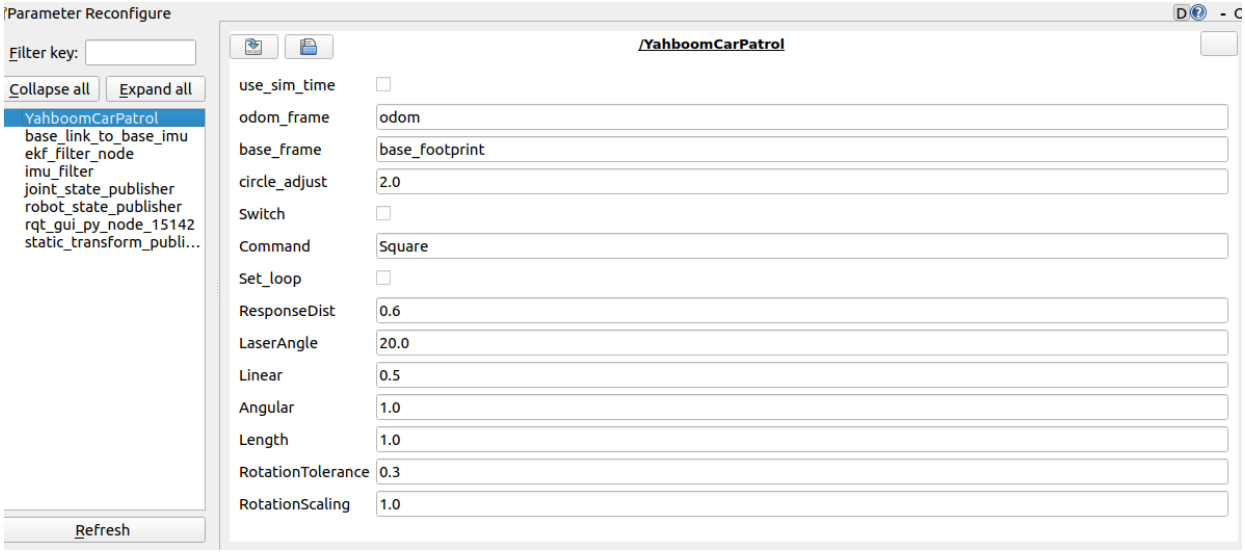
Then start the radar patrol program and enter the following command in the terminal.

```
ros2 run yahboomcar_bringup patrol
```

```
root@raspberrypi:~/yahboomcar_ws# ros2 run yahboomcar_bringup patrol
import finish
create done
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
Switch False
```

Open the parameter adjuster, give the patrol route, and enter the following commands in the terminal.

```
ros2 run rqt_reconfigure rqt_reconfigure
```



Note: There may not be the above nodes when you first open it. You can see all nodes after clicking Refresh. The displayed YahboomCarPatrol is the patrol node.

4、start patrol

In the rqt interface, find the YahboomCarPatrol node. The [Command] inside is the set patrol route. Here we take the square patrol route as an example. The following will explain what types of patrol routes there are. After setting the route in [Command], click Switch to start patrolling.

```
turn_angle:  0.17911648981488432
error:  1.3916798369800123
Switch True
Spin
turn_angle:  0.17934253341968265
error:  1.3914537933752138
Switch True
Spin
turn_angle:  0.1793904759153327
error:  1.391405850879564
Switch True
Spin
turn_angle:  0.1793904759153327
error:  1.391405850879564
Switch True
Spin
turn_angle:  0.1797085278291798
error:  1.3910877989657169
Switch True
Spin
turn_angle:  0.17977750173709192
error:  1.3910188250578046
Switch True
Spin
turn_angle:  0.17977750173709192
error:  1.3910188250578046
Switch True
Spin
turn_angle:  0.17986721520192547
error:  1.3909291115929712
Switch True
Spin
turn_angle:  0.17986721520192547
error:  1.3909291115929712
```

Taking a square as an example, first walk in a straight line, then rotate 90 degrees, then walk in a straight line, then rotate 90 degrees, and so on, until the completed route is a square. If you encounter an obstacle while walking, it will stop and the buzzer will sound.

```
Length
distance:  5.138314275626346
obstacles
Switch True
Length
distance:  5.121662891248637
obstacles
Switch True
Length
distance:  5.121662891248637
obstacles
Switch True
Length
distance:  5.09916912722615
obstacles
Switch True
Length
```

As shown in the picture above, obstacles will be printed when encountering obstacles.

Other parameters of the rqt interface are described as follows:

- odom_frame：The coordinate system name of the odometer
- base_frame：The name of the base coordinate system
- circle_adjust：When the patrol route is circular, this value can be used as a coefficient to adjust the size of the circle. See the code for details.
- Switch：Function enable switch
- Command：There are several types of patrol routes: **[LengthTest]** - straight patrol, [Circle] - circle patrol, **[Square]** - square patrol, **[Triangle]** - triangle patrol.
- Set_loop：The development of re-patrol will continue patrolling in a circular pattern with the set route after setting it up.
- ResponseDist：Obstacle detection distance
- LaserAngle：Radar detection angle
- Linear：Linear speed
- Angular：Angular velocity
- Length：straight line distance
- RotationTolerance：Tolerance value allowed for rotation error
- RotationScaling：rotation scaling factor

After modifying the above parameters, you need to click on the blank space to transfer the parameters into the program.

5、Code analysis

Source code reference path

```
/root/yahboomcar_ws/src/yahboomcar_bringup/yahboomcar_bringup
```

patrol.py，The core code is as follows.

Create radar and remote control data subscribers

```
self.sub_scan = self.create_subscription(LaserScan,"/scan",self.LaserScanCallback,1)
self.sub_joy = self.create_subscription(Bool,"/JoyState",self.JoyStateCallback,1)
```

Creation speed, buzzer data publisher

```
self.pub_cmdVel = self.create_publisher(Twist,"cmd_vel",5)
self.pub_Buzzer = self.create_publisher(UInt16,'/beep',1)
```

Monitor the TF transformation of odom and base_footprint, calculate the current XY coordinates and rotation angle.

```
def get_position(self):
    try:
        now = rclpy.time.Time()
```

```
        trans = self.tf_buffer.lookup_transform(self.odom_frame,self.base_frame,now)
        return trans
    except (LookupException, ConnectivityException, ExtrapolationException):
        self.get_logger().info('transform not ready')
        raise
        return
self.position.x = self.get_position().transform.translation.x
self.position.y = self.get_position().transform.translation.y

def get_odom_angle(self):
    try:
        now = rclpy.time.Time()
        rot = self.tf_buffer.lookup_transform(self.odom_frame,self.base_frame,now)
        #print("oring_rot: ",rot.transform.rotation)
        cacl_rot = PyKDL.Rotation.Quaternion(rot.transform.rotation.x,
rot.transform.rotation.y, rot.transform.rotation.z, rot.transform.rotation.w)
        #print("cacl_rot: ",cacl_rot)
        angle_rot = cacl_rot.GetRPY()[2]
        return angle_rot
    except (LookupException, ConnectivityException, ExtrapolationException):
        self.get_logger().info('transform not ready')
        raise
        return
self.odom_angle = self.get_odom_angle()
```

Two important functions are linear advancing and rotation Spin. All patrol routes are nothing more than a combination of linear motion and rotation.

advancing

```
def advancing(self,target_distance):
    self.position.x = self.get_position().transform.translation.x
    self.position.y = self.get_position().transform.translation.y
    move_cmd = Twist()
    self.distance = sqrt(pow((self.position.x - self.x_start), 2) +
                         pow((self.position.y - self.y_start), 2))
    self.distance *= self.LineScaling
    print("distance: ",self.distance)
    self.error = self.distance - target_distance
    move_cmd.linear.x = self.Linear
    if abs(self.error) < self.LineTolerance :
        print("stop")
        self.distance = 0.0
        self.pub_cmdVel.publish(Twist())
        self.x_start = self.position.x;
        self.y_start = self.position.y;
        self.Switch  =
rclpy.parameter.Parameter('Switch',rclpy.Parameter.Type.BOOL,False)
        all_new_parameters = [self.Switch]
        self.set_parameters(all_new_parameters)
        return True
    else:
```

```
        if self.Joy_active or self.warning > 10:
            if self.moving == True:
                self.pub_cmdVel.publish(Twist())
                self.moving = False
                b = UInt16()
                b.data = 1
                self.pub_Buzzer.publish(b)
                print("obstacles")
            else:
                #print("Go")
                b = UInt16()
                b.data = 0
                self.pub_Buzzer.publish(UInt16())
                self.pub_cmdVel.publish(move_cmd)
                self.moving = True
                return False
```

Spin

```
def Spin(self,angle):
    self.target_angle = radians(angle)
    self.odom_angle = self.get_odom_angle()
    self.delta_angle = self.RotationScaling * self.normalize_angle(self.odom_angle -
self.last_angle)
    self.turn_angle += self.delta_angle
    print("turn_angle: ",self.turn_angle)
    self.error = self.target_angle - self.turn_angle
    print("error: ",self.error)
    self.last_angle = self.odom_angle
    move_cmd = Twist()
    if abs(self.error) < self.RotationTolerance or self.Switch==False :
        self.pub_cmdVel.publish(Twist())
        self.turn_angle = 0.0
        return True
    if self.Joy_active or self.warning > 10:
        if self.moving == True:
            self.pub_cmdVel.publish(Twist())
            self.moving = False
            b = UInt16()
            b.data = 1
            self.pub_Buzzer.publish(b)
            print("obstacles")
    else:
        b = UInt16()
        b.data = 0
        self.pub_Buzzer.publish(UInt16())
        if self.Command == "Square" or self.Command == "Triangle":
            move_cmd.angular.z = copysign(self.Angular, self.error)
        elif self.Command == "Circle":
            length = self.Linear * self.circle_adjust / self.Length
            move_cmd.linear.x = self.Linear
```

```
            move_cmd.angular.z = copysign(length, self.error)
        self.pub_cmdvel.publish(move_cmd)
    self.moving = True
```

Now that we have the functions of straight line and rotation, we can arrange and combine them according to the patrol route. Taking a square as an example.

```
def Square(self):
    if self.index == 0:
    print("Length")
    #First walk in a straight line for 1 meter
    step1 = self.advancing(self.Length)
    #sleep(0.5)
    if step1 == True:
        #self.distance = 0.0
        self.index = self.index + 1;
        self.Switch  =
rclpy.parameter.Parameter('Switch',rclpy.Parameter.Type.BOOL,True)
        all_new_parameters = [self.Switch]
        self.set_parameters(all_new_parameters)
    elif self.index == 1:
        print("Spin")
        #Rotate 90 degrees
        step2 = self.Spin(90)
        #sleep(0.5)
        if step2 == True:
            self.index = self.index + 1;
            self.Switch  =
rclpy.parameter.Parameter('Switch',rclpy.Parameter.Type.BOOL,True)
            all_new_parameters = [self.Switch]
            self.set_parameters(all_new_parameters)
.....
```