Color tracking

Note: The virtual machine, ROS-wifi image transmission module and ESP32 communication board ROS_DOMAIN_ID need to be consistent, and both need to be set to 20. You can view [ESP32 communication board parameter configuration] to set the ESP32 communication board ROS_DOMAIN_ID, and view the tutorial [Connecting MicroROS Agent] to determine whether the ID is consistent.

Before running the experiment, please make sure that the microros balance car and ROS-wifi image transmission module have correctly enabled the agent on the virtual machine (linux with humbleROS2 system)

1. Program function description

MicroROS balance car color tracking has the ability to identify multiple colors at any time, and independently store the currently identified color, and control the car to track and detect the identified color left and right.

MicroROS balance car color tracking can also realize the function of HSV real-time control. By adjusting the high and low thresholds of HSV, the interfering colors are filtered out, so that the blocks can be identified in complex environments. If the effect of color picking is not ideal, the car needs to be moved to different environments for calibration at this time, so that it can recognize the color we need in complex environments.

2. Program code reference path

```
~/yahboomcar_ws/src/yahboom_esp32ai_car/yahboom_esp32ai_car/colorTracker.py
```

- colorTracker.py

Mainly complete image processing, calculate the center coordinates of the tracked object, and calculate the car's movement speed data for the chassis based on the center coordinates and depth information of the tracked object.

3. Program startup

3.1. Startup command

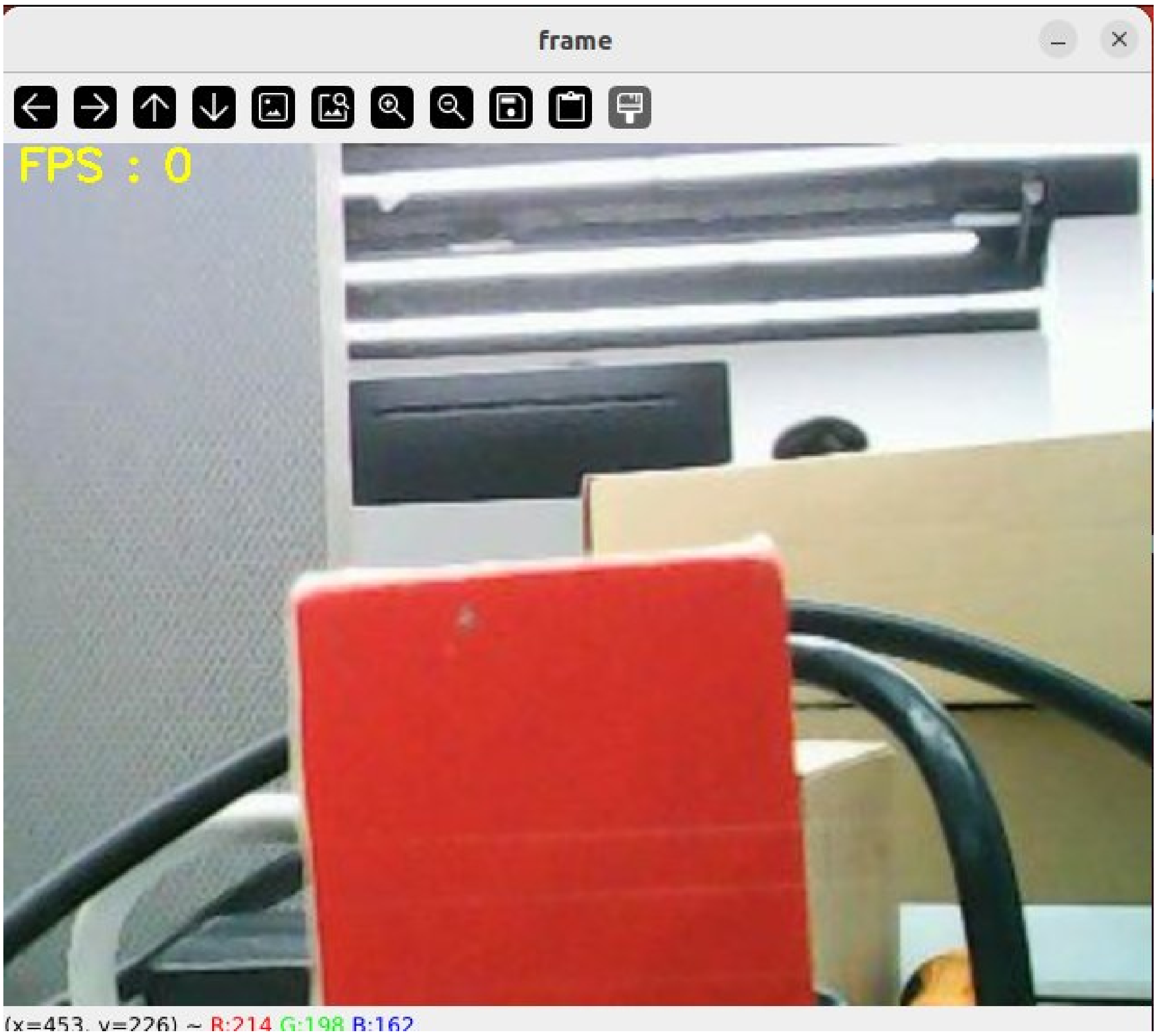
Input in terminal,

```
#Start chassis driver
ros2 launch yahboomcar_bringup yahboomcar_bringup_launch.py
```

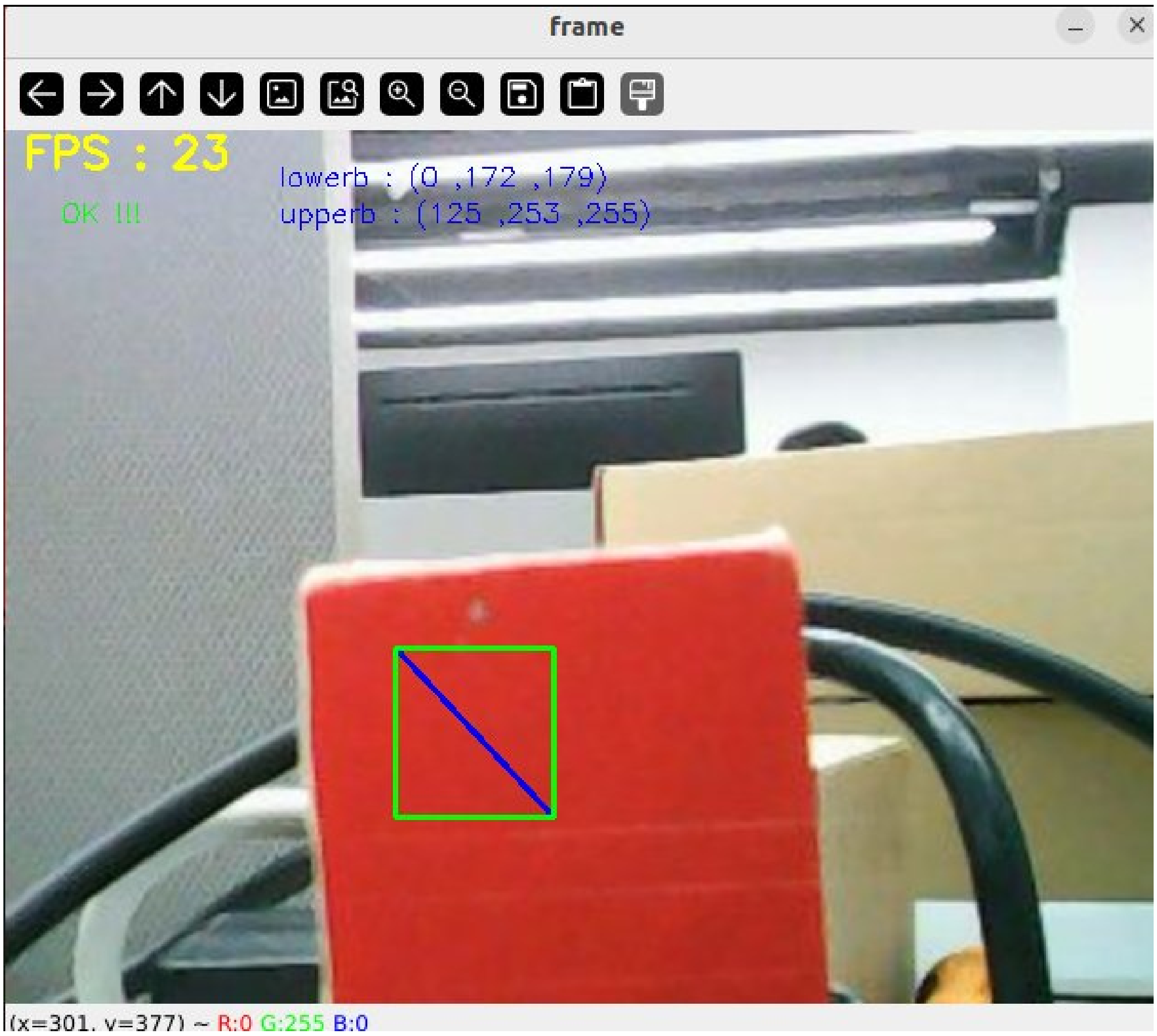
```
#Start color tracking program
ros2 run yahboom_esp32ai_car colorTracker
```

If the camera image is inverted, you need to see **3. Camera image correction (select)** document to correct it yourself, this experiment will not be described.

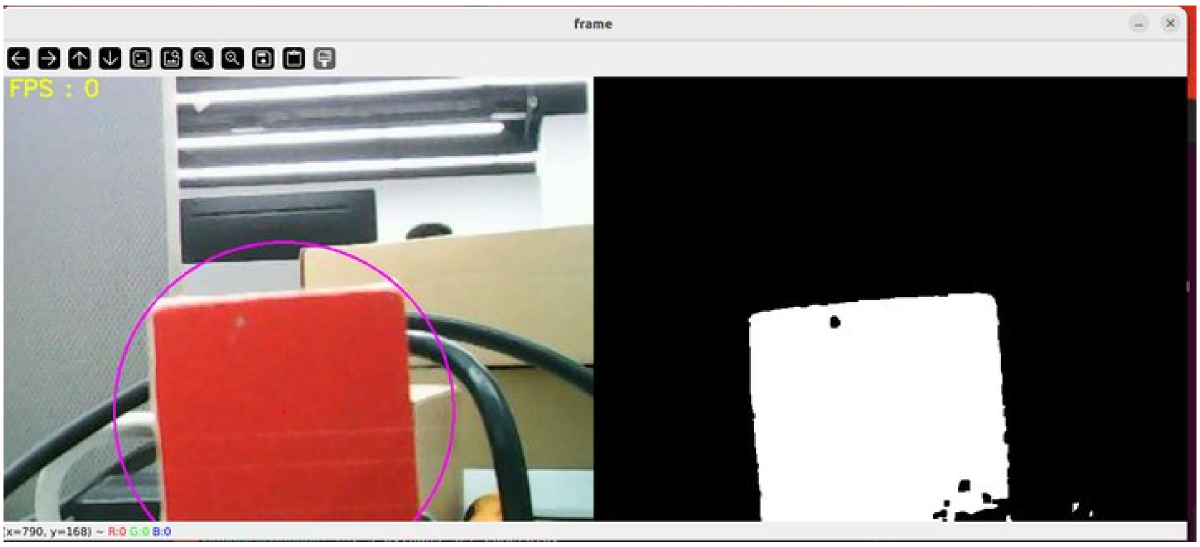
Taking tracking red as an example, after the program is started, the following screen will appear,



Then press the r/R key on the keyboard to enter the color selection mode, and use the mouse to frame an area (the area can only have one color),



After selection, the effect is as shown below,

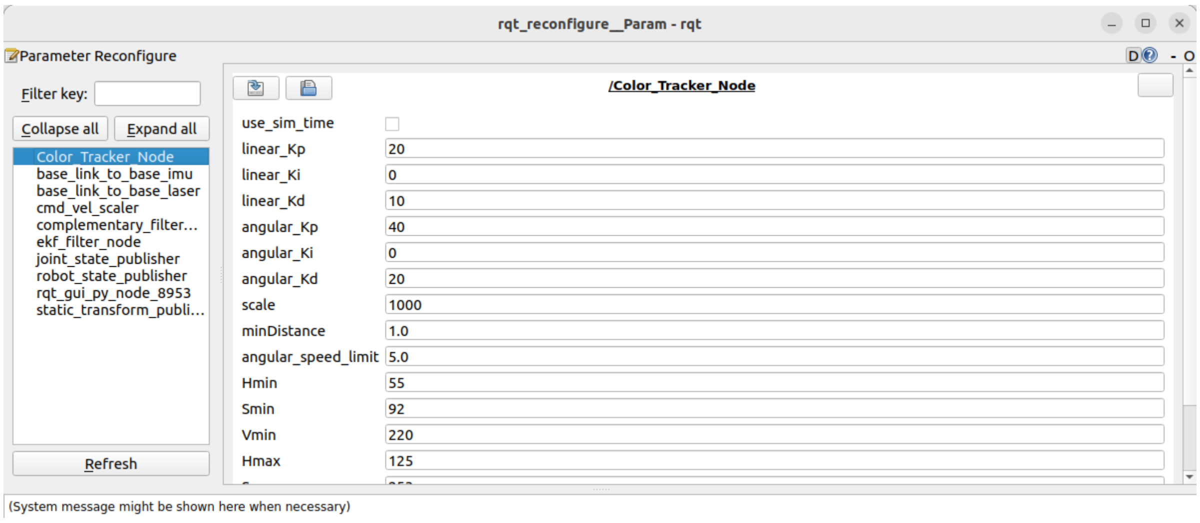


Then, press the space bar to enter the tracking mode, move the object slowly, and you can see that the robot will track the color block left and right.

Press the space bar to see the speed calculated by pid.

3.2, Dynamic parameter adjustment

```
ros2 run rqt_reconfigure rqt_reconfigure
```



rqt_reconfigure__Param - rqt

Parameter Reconfigure

Filter key:

Collapse all | Expand all

Color_Tracker_Node
base_link_to_base_imu
base_link_to_base_laser
cmd_vel_scaler
complementary_filter...
ekf_filter_node
joint_state_publisher
robot_state_publisher
rqt_gui_py_node_8953
static_transform_publi...

Refresh

/Color_Tracker_Node

use_sim_time	
linear_Kp	20
linear_Ki	0
linear_Kd	10
angular_Kp	40
angular_Ki	0
angular_Kd	20
scale	1000
minDistance	1.0
angular_speed_limit	5.0
Hmin	55
Smin	92
Vmin	220
Hmax	125

(System message might be shown here when necessary)

After modifying the parameters, click the blank space in the GUI to write the parameter value, and press the R key to take effect and reset. Or directly modify the source code, and then recompile and update. As can be seen from the above figure,

- colorTracker mainly adjusts the three parameters of angularPID to make the car tracking more sensitive.

4, Core code

4.1, colorTracker.py

This program has the following functions:

- Open the camera and get the image;
- Get keyboard and mouse events for switching modes and picking colors;
- Process the image and publish the center coordinates of the tracked object and publish it.

Some core codes are as follows,

```
#Get keyboard and mouse events and get the value of hsv
if action == 32: self.Track_state = 'tracking' #space
elif action == ord('i') or action == ord('I'): self.Track_state = "identify"
elif action == ord('r') or action == ord('R'): self.Reset()
elif action == ord('q') or action == ord('Q'): self.cancel()
if self.Track_state == 'init':
    cv.namedWindow(self.windows_name, cv.WINDOW_AUTOSIZE)
    cv.setMouseCallback(self.windows_name, self.onMouse, 0)
    if self.select_flags == True:
        cv.line(rgb_img, self.cols, self.rows, (255, 0, 0), 2)
        cv.rectangle(rgb_img, self.cols, self.rows, (0, 255, 0), 2)
        if self.Roi_init[0] != self.Roi_init[2] and self.Roi_init[1] !=
self.Roi_init[3]:
            rgb_img, self.hsv_range = self.color.Roi_hsv(rgb_img, self.Roi_init)
            self.gTracker_state = True
            self.dyn_update = True
        else: self.Track_state = 'init'
```

```
#Calculate the value of the center coordinates, self.circle stores the xyz value
rgb_img, binary, self.circle = self.color.object_follow(rgb_img, self.hsv_range)

#Publish the center coordinates message
threading.Thread(target=self.execute, args=(self.circle[0], self.circle[1],
self.circle[2])).start()
def execute(self, x, y, z):
    position = Position()
    position.anglex = x * 1.0
    position.angley = y * 1.0
    position.distance = z * 1.0
    self.pub_position.publish(position)
```

```
#Define the topic data that the subscriber needs to receive
self.sub_JoyState = self.create_subscription(Bool,'/JoyState',
 self.JoyStateCallback,1)
self.sub_img = self.create_subscription(
    CompressedImage, '/espRos/esp32camera', self.handleTopic, 1)
#Define speed publisher
self.pub_cmdVel = self.create_publisher(Twist,'/cmd_vel',10)

#Important callback function
self.handleTopic

#x value and z value are calculated based on angular velocity and linear velocity
self.execute(x, y,z)

#Processing function
def execute(self, color_x, color_radius):
    if self.Joy_active == True:
        if self.Start_state == True:
            self.PID_init()
            self.Start_state = False
        return
    self.Start_state = True
    if z == 0:
        print("Not Found")
        self.pub_cmdVel.publish(Twist())

    # Initialize twist object
    twist = Twist()

    # twist.linear.x = self.linear
    [z_Pid, x_Pid] = self.lian_pid.update([(x - 320) * 1.0 / 12, (z - 130) / 10])
    print("z_Pid:{:.2f}, x_Pid:{:.2f},x:{:.2f},z:{:.2f}".format(z_Pid, x_Pid, x,
z))
    if self.img_flip == True:
        twist.angular.z = -z_Pid
    else:
        twist.angular.z = +z_Pid

    if abs(x - 320) < 40 or z_Pid > 1.0 and z_Pid < -1.0:
        twist.angular.z = 0.0
        self.pub_cmdVel.publish(twist)
```