

Lesson 3 Hurdle Clearing

1. Getting Ready

Place the map on a flat and smooth surface and set the hurdle in the corresponding position on the map.

The specific placement method for the map and tool can refer to the video and file in “12.Athletics Sport Lessons/Lesson 1 Tools Assembly and Map Placement”.

2. Working Principle

The working principle of this this lesson is as follow:

The color is recognized through Lab color space firstly. Then convert RGB color into Lab color space, and proceed binarization, and dilation and erosion process to obtain the contour of the target color. Mark the target color with blue line, and obtain the coordinate parameter of the target to complete the color recognition.

Next, control the robot to move toward the hurdle. According to the target coordinate to judge, if the robot is in the middle of the target hurdle, it will move forward. When reaching to the set range, it will execute the hurdling action. Otherwise, control robot to move left or right to the middle of the target, and then execute the hurdling action.

The source code of the program is located
in/home/pi/TonyPi/Extend/Hurdles.py

```

6 import time
7 import math
8 import threading
9 import numpy as np
10 sys.path.append('/home/pi/TonyPi/')
11 import hiwonder.Misc as Misc
12 import hiwonder.Board as Board
13 import hiwonder.PID as PID
14 import hiwonder.ActionGroupControl as AGC
15 import hiwonder.yaml_handle as yaml_handle
16
17 if sys.version_info.major == 2:
18     print('Please run this program with python3!')
19     sys.exit(0)
20
21 # 跨栏
22
23 go_forward = 'go_forward'
24 go_forward_one_step = 'go_forward_one_step'
25 turn_right = 'turn_right_small_step_a'
26 turn_left = 'turn_left_small_step_a'
27 left_move = 'left_move_20'
28 right_move = 'right_move_20'
29 go_turn_right = 'turn_right'
30 go_turn_left = 'turn_left'
31
32 lab_data = None
33 servo_data = None
34
35 def load_config():
36     global lab_data, servo_data
37
38     lab_data = yaml_handle.get_yaml_data(yaml_handle.lab_file_path)
39     servo_data = yaml_handle.get_yaml_data(yaml_handle.servo_file_path)
40
41 load_config()
42
43 # 初始位置
44 def initMove():
45     Board.setPWMServoPulse(1, 1050, 500)
46     Board.setPWMServoPulse(2, servo_data['servo2'], 500)

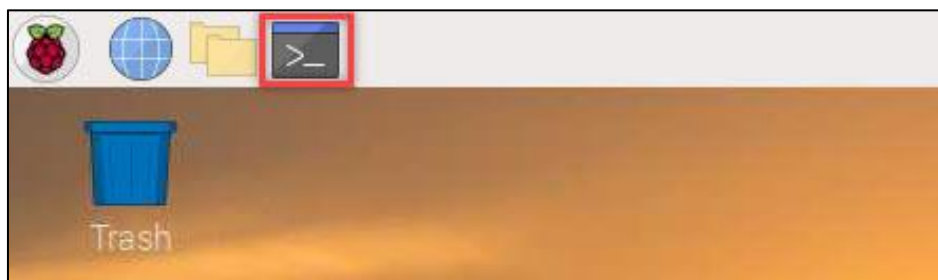
```

3. Operation Steps

i The entered command must pay attention to case sensitivity and space.

1) Turn on the robot and connect to Raspberry Pi desktop with VNC.

2) Click  or press “Ctrl+Alt+T” to open LX terminal.



3) Enter “cd TonyPi/Extend/” and press “Enter” to come to the directory of game programmings.

```
pi@raspberrypi:~ $ cd TonyPi/Extend/
```

4) Enter “python3 Hurdles.py” command, and then press “Enter” to start the game.

```
pi@raspberrypi:~ $ cd TonyPi/Extend/  
pi@raspberrypi:~/TonyPi/Extend $ python3 Hurdles.py
```

5) If want to exit the game, press “Ctrl+C” in the LX terminal. Please try multiple times if fail to exit.

4. Project Outcome

Place hurdle within TonyPi Pro’s vision range. TonyPi Pro will adjust the position according to the blue line recognized, and then slowly approach the hurdle. When the line in the image transmitted by camera overlaps the blue line on hurdle, the robot will lift its foot over the hurdle.

5. Function Extension

5.1 Modify Hurdling Position

The program defaults that after the robot detects the blue hurdle, it starts hurdling at a distance of 1000 from the line. If the robot starts hurdling at a closer distance, the data should be decreased; If the robot starts hurdling at a farther distance, the data should be increased. In this section, robot start hurdling at the distance of 1020 from the line. You can refer to the following steps to operate:

1) Enter “cd TonyPi/Extend/” and press “Enter” to come to the directory of game programmings.

```
pi@raspberrypi:~ $ cd TonyPi/Extend/
```

2) Enter command “sudo vim Hurdles.py” and press “Enter” to open the game programming file.

```
pi@raspberrypi:~ $ cd TonyPi/Extend/  
pi@raspberrypi:~/TonyPi/Extend $ sudo vim Hurdles.py
```

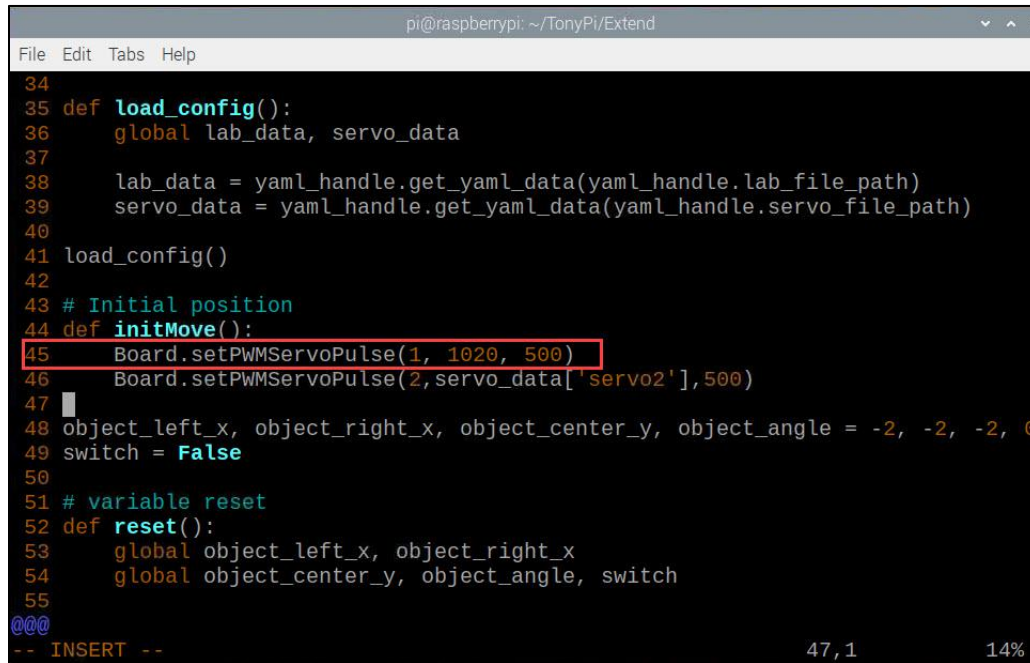
3) Find the code framed in the following figure:

```
43 # Initial position  
44 def initMove():  
45     Board.setPWMServoPulse(1, 1000, 500)  
46     Board.setPWMServoPulse(2, servo_data['servo2'], 500)  
47  
48 object_left_x, object_right_x, object_center_y, object_angle = -2, -2, -2, 0  
49 switch = False  
50  
51 # variable reset  
52 def reset():
```

4) Press “i” on keyboard. When “Insert” appears in the lower left corner, which means it has entered the editing mode.

```
43 # Initial position  
44 def initMove():  
45     Board.setPWMServoPulse(1, 1000, 500)  
46     Board.setPWMServoPulse(2, servo_data['servo2'], 500)  
47  
48 object_left_x, object_right_x, object_center_y, object_angle = -2, -2, -2, 0  
49 switch = False  
50  
51 # variable reset  
52 def reset():  
53     global object_left_x, object_right_x  
-- INSERT --  
47,1 13%
```

5) Modify “1000” in “Board.setPWMServoPulse(1, 1000, 500)” to “1020”, as the figure shown below:



```

pi@raspberrypi: ~/TonyPi/Extend
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34
35 def load_config():
36     global lab_data, servo_data
37
38     lab_data = yaml_handle.get_yaml_data(yaml_handle.lab_file_path)
39     servo_data = yaml_handle.get_yaml_data(yaml_handle.servo_file_path)
40
41 load_config()
42
43 # Initial position
44 def initMove():
45     Board.setPWMServoPulse(1, 1020, 500)
46     Board.setPWMServoPulse(2, servo_data['servo2'], 500)
47
48 object_left_x, object_right_x, object_center_y, object_angle = -2, -2, -2, 0
49 switch = False
50
51 # variable reset
52 def reset():
53     global object_left_x, object_right_x
54     global object_center_y, object_angle, switch
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```
193     img_copy = img.copy()
194     img_h, img_w = img.shape[:2]
195
196     # Hurdle
197     object_left_x, object_right_x, object_center_y, object_angle = color_ide
198     ntify(img, img_copy, target_color = 'blue')
199     print('hurdles',object_left_x, object_right_x, object_center_y, object_a
200     ngle)# Print the position angle parameter
201
202
203     return img_copy
204
205 if __name__ == '__main__':
206
207     from CameraCalibration.CalibrationConfig import *
```

- 2) Press “i” on keyboard to enter the editing mode, and then modify “blue” in “object_left_x, object_right_x, object_center_y, object_angle = color_identify(img, img_copy, target_color = 'blue')” to “green”.

```
193     img_copy = img.copy()
194     img_h, img_w = img.shape[:2]
195
196     # Hurdle
197     object_left_x, object_right_x, object_center_y, object_angle = color_ide
198     ntify(img, img_copy, target_color = 'green')
199     print('hurdles',object_left_x, object_right_x, object_center_y, object_a
200     ngle)# Print the position angle parameter
201
202
203     return img_copy
204
205 if __name__ == '__main__':
206
207     from CameraCalibration.CalibrationConfig import *
-- INSERT --
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199,118 82%

- 3) After modification, refer to step (6) in “5.1 Modify Hurdling Position” to save the modified code.