

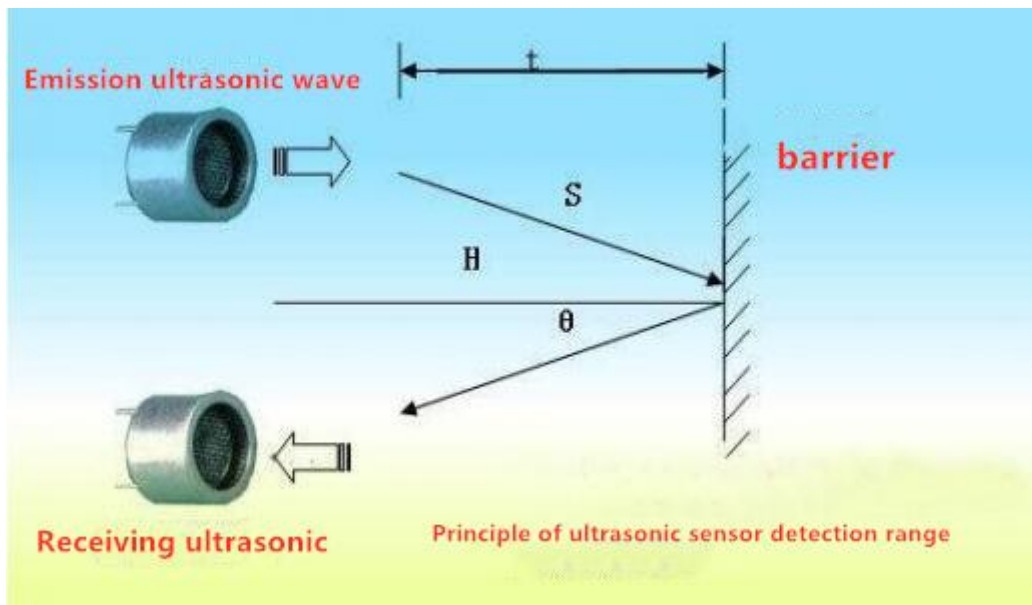
## Lesson 3 Introduction of Automatic Obstacle Avoidance

In this lesson, we will learn how to use RaspTank to achieve automatic obstacle avoidance.

### 3.1 Introduction of Automatic Obstacle Avoidance

Since the camera used by our Raspberry Pi robot is a monocular camera and cannot collect depth information, many of our robot products use ultrasonic ranging modules to obtain depth information and detect whether there are obstacles in a certain direction to get the distance of the obstacle.

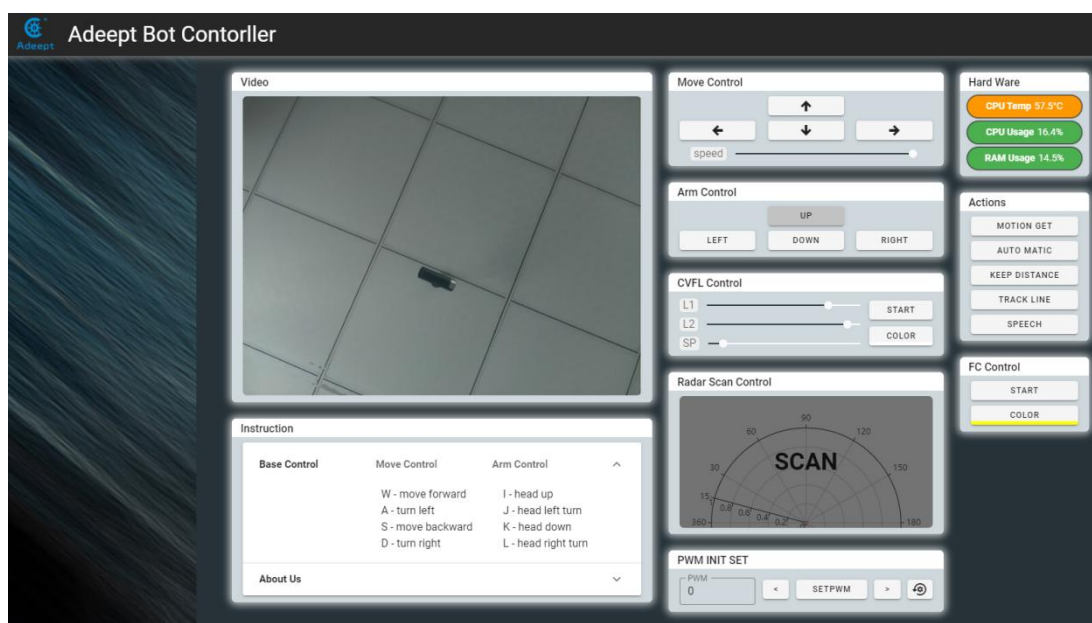
The principle of distance detection by ultrasonic ranging sensor: the method of detecting distance by ultrasonic is called echo detection method, that is, the ultrasonic transmitter emits ultrasonic waves in a certain direction, and the timer starts timing at the same time as the launch time. The ultrasonic waves propagate in the air and encounter obstacles on the way. When the object surface (object) is blocked, it will be reflected back immediately, and the ultrasonic receiver will immediately stop timing when the reflected ultrasonic wave is received. The propagation speed of ultrasonic waves in the air is 340m/s. According to the time  $t$  recorded by the timer, the distance  $s$  from the launch point to the obstacle surface can be calculated, namely:  $s=340t/2$ . Using this principle of ultrasound, the ultrasonic ranging module is widely used in practical applications, such as car reversing radar, unmanned aerial vehicle, and smart car.



## 3.2 Turning on Automatic Obstacle Avoidance

### Running the Automatic Obstacle Avoidance program

1. Turn on RaspTank, the boot time is about 30s-60s.
2. After RaspTank is turned on, enter the IP address of your Raspberry Pi with the Google browser of your mobile phone or computer, and access port 5000, for example: 192.168.3.44:5000 . The web controller will then be displayed on the browser.



3. Place the car on the prepared patrol track.
4. After clicking "AUTO MATIC", the robot will automatically avoid obstacles when encountering obstacles. .
5. When you want to terminate the Automatic Obstacle Avoidance function, you can click "AUTO MATIC" again.

### 3.3 Code

For the complete code, please refer to the file functions.py.

#### Import dependencies and initialize.

```
1. import time
2. import RPi.GPIO as GPIO
3. import json
4. import Adafruit_PCA9685
5.
6. pwm = Adafruit_PCA9685.PCA9685()
7. pwm.set_pwm_freq(50)
8.
9. Tr = 11      #Pin No. of Ultrasonic Module Input
10. Ec = 8      # Pin number of the output end of the ultrasonic module
11. servoPort = 1    #The number of the servo that controls the horizontal rotation of the ultrasonic module
12. servoMiddle = 330 #The middle position of the servo
13. servoLeft = 180  #Left position of the servo
14. servoRight = 480 #The right position of the servo
15. rangeKeep = 0.3  #Avoidance distance
16.
17. scanDir = 1      #Scan direction, 1 is from left to right, -1 is from right to left
18. scanPos = 1      #Store the current scan position (1 is the left, 2 is the middle, and 3 is the right)
19. scanNum = 3      #The number of scan positions (left, middle, and right, these are three positions)
20.
21. scanList = [0,0,0] #Save scan results
22.
23. GPIO.setmode(GPIO.BCM)
24. GPIO.setup(Tr, GPIO.OUT, initial=GPIO.LOW)
25. GPIO.setup(Ec, GPIO.IN)
```

## Main logic code

```

1. def checkdist():
2.     """ Refer to the realization of basic functions-ultrasonic module """
3.
4. while 1:
5.     print('Automatic obstacle avoidance mode')
6.     if scanPos == 1:
7.         pwm.set_pwm(servoPort, 0, servoLeft)
8.         time.sleep(0.3)
9.         scanList[0] = checkdist()
10.    elif scanPos == 2:
11.        pwm.set_pwm(servoPort, 0, servoMiddle)
12.        time.sleep(0.3)
13.        scanList[1] = checkdist()
14.    elif scanPos == 3:
15.        pwm.set_pwm(servoPort, 0, servoRight)
16.        time.sleep(0.3)
17.        scanList[2] = checkdist()
18.
19.    scanPos = scanPos + scanDir
20.
21.    if scanPos > scanNum or scanPos < 1:
22.        if scanDir == 1: scanDir = -1
23.        elif scanDir == -1: scanDir = 1
24.        scanPos = scanPos + scanDir*2
25.    print(scanList)
26.
27.    if min(scanList) < rangeKeep:
28.        if scanList.index(min(scanList)) == 0: #The shortest distance detected on the left
29.            """
30.            Turn right
31.            """
32.            print('Turn right')
33.        elif scanList.index(min(scanList)) == 1: #The shortest distance detected in the middle
34.            if scanList[0] < scanList[2]:
35.                """
36.                If the detected distance on the left is shorter than the right, turn to the right
37.                """
38.                print('Turn right')
39.            else:
40.                """

```

```
41.         Otherwise, turn left
42.         ""
43.         print('Turn left')
44.     elif scanList.index(min(scanList)) == 2: #The shortest distance detected on the right
45.         ""
46.         Turn Left
47.         ""
48.         print('Turn Left')
49.     if max(scanList) < rangeKeep:
50.         ""
51.         If the distances in the left, center, and right directions are all closer than rangeKeep, reverse
52.         ""
53.         print('reverse')
54.     else:
55.         ""
56.         All three directions are farther than rangeKeep
57.         ""
58.     print('Go forward')
```