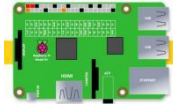
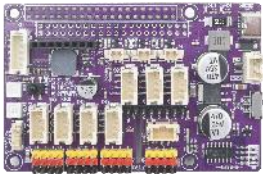




## Lesson12 How to Control the Ultrasonic Module

In this lesson, we will learn how to read the data of the ultrasonic ranging module.

### 12.1 Components used in this Lesson

Components	Quantity	Picture
Raspberry Pi	1	
Aadept Robot HAT V3.2	1	
ultrasonic module	1	
4 pin cable	1	

### 12.2 Introduction of Ultrasonic Ranging

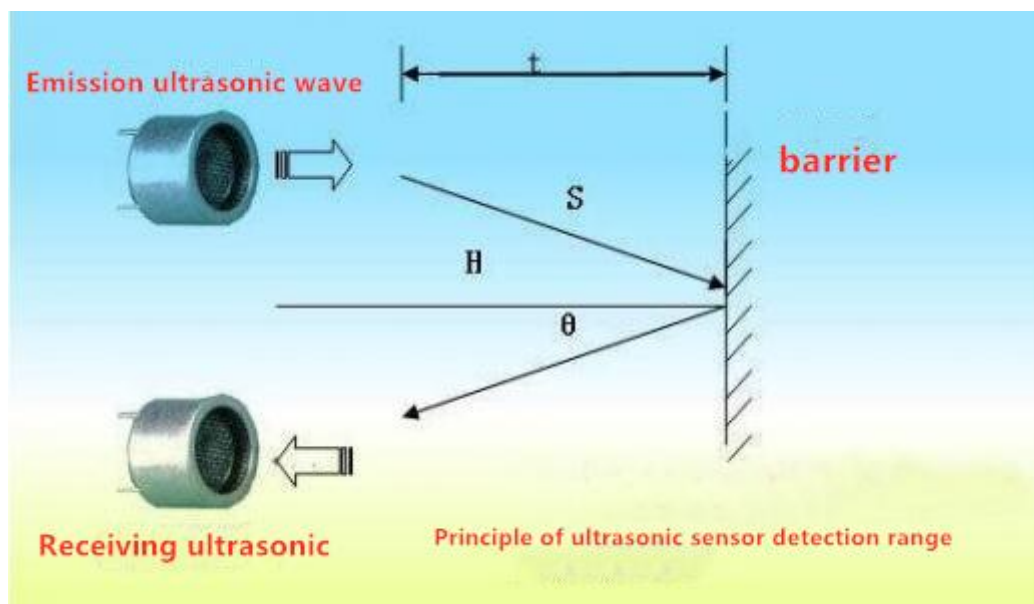
The ultrasonic ranging module used in our RaspTank Metal product has four pins, namely VCC, GND, Echo and Trig. The HC-SR04 can provide a non-contact distance sensing function of 2cm-400cm, and the ranging accuracy can reach 3mm; The module includes an ultrasonic transmitter, receiver and control circuit. The basic working principle is as follows:

Use IO port TRIG to trigger distance measurement, and give a high level signal of at least 10us.

The module automatically sends eight 40khz square waves, and automatically detects whether there is a signal return.

There is a signal return, and a high level is output with the IO port ECHO. The duration of the high level is the time from emission to return of the ultrasonic wave.

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.

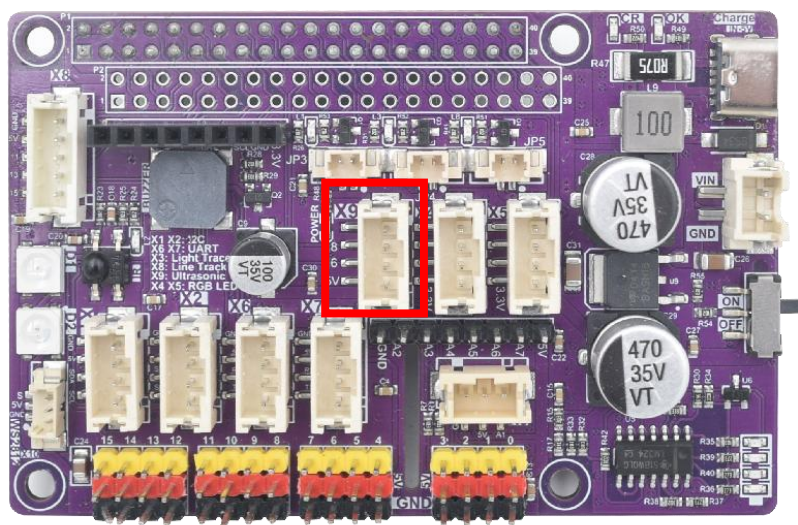
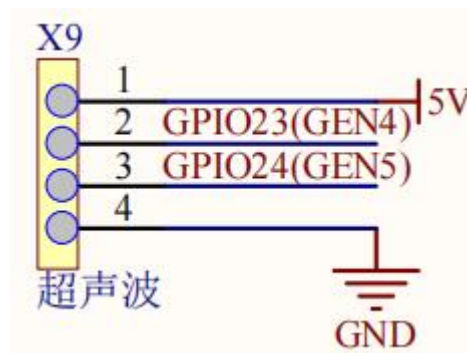


When using Adept Robot HAT V3.2 expansion board, the ultrasonic sensor needs to be connected to the Ultrasonic interface on the driver board, and must not be connected to the IIC

port to avoid burning the ultrasonic module. (IIC is an interface used to connect I2C devices, and the pin positions of VCC and GND are different from Ultrasonic).

### 12.3 Wiring Diagram (Circuit Diagram)

When using Aadeept Robot HAT V3.2 expansion board, you need to connect the ultrasonic sensor to the Ultrasonic interface on the driver board. Do not connect it to the IIC port to avoid burning the ultrasonic module. (IIC is an interface used to connect I2C devices, and the pin positions of VCC and GND are different from Ultrasonic).



## 12.4 Obtain Data from Ultrasonic Sensor

### Run code

1. Remotely log in to the Raspberry Pi terminal.

```
Linux raspberrypi 4.19.118-v7l+ #1311 SMP Mon Apr 27 14:26:42 BST 2020 armv7l

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Sat Aug 29 08:17:49 2020 from 192.168.3.208

SSH is enabled and the default password for the 'pi' user has not been changed.
This is a security risk - please login as the 'pi' user and type 'passwd' to set
a new password.

pi@raspberrypi:~ $
```

2. Enter the command and press Enter to enter the folder where the program is located:

```
cd Adeept_RaspTank_Metal/examples/
```

```
pi@raspberrypi:~ $ cd Adeept_RaspTank_Metal/examples/
pi@raspberrypi:~/Adeept_RaspTank_Metal/examples $
```

3. View the contents of the current directory file:

```
ls
```

```
pi@raspberrypi:~/Adeept_RaspTank_Metal/examples $ ls
01_LED.py 02_Buzzer.py 03_Servo.py 04_Motor.py 05_WS2812.py 06_Ultrasonic.py 07_TrackingLine.py
```

4. Enter the command and press Enter to run the program:

```
sudo python3 06_Ultrasonic.py
```

```
pi@raspberrypi:~/Adeept_RaspTank_Metal/examples $ sudo python3 06_Ultrasonic.py
/usr/lib/python3/dist-packages/gpiozero/input_devices.py:852: PWMSoftwareFallback: For more accurate readings
e the pigpio pin factory. See https://gpiozero.readthedocs.io/en/stable/api\_input.html#distancesensor-hc-sr04
more info
  warnings.warn(PWMSoftwareFallback(
24.79 cm
24.79 cm
24.79 cm
24.79 cm
24.78 cm
24.78 cm
```

5. After successfully running the program, the command window will display the distance data of the obstacle detected by the ultrasonic sensor. When you use an object to approach it directly in front of the ultrasonic sensor, the detected distance data will change.

6. When you want to terminate the running program, you can press the shortcut key "**Ctrl + C**" on the keyboard.

## 12.5 Code

```
1. from gpiozero import DistanceSensor
2. from time import sleep

3. Tr = 23
4. Ec = 24
5. sensor = DistanceSensor(echo=Ec, trigger=Tr,max_distance=2) # Maximum detection distance 2m.

6. # Get the distance of ultrasonic detection.
7. def checkdist():
8.     return (sensor.distance) *100 # Unit: cm

9. if __name__ == "__main__":
10. while True:
11.     distance = checkdist()
12.     print("%.2f cm" %distance)
13.     sleep(0.05)
```