

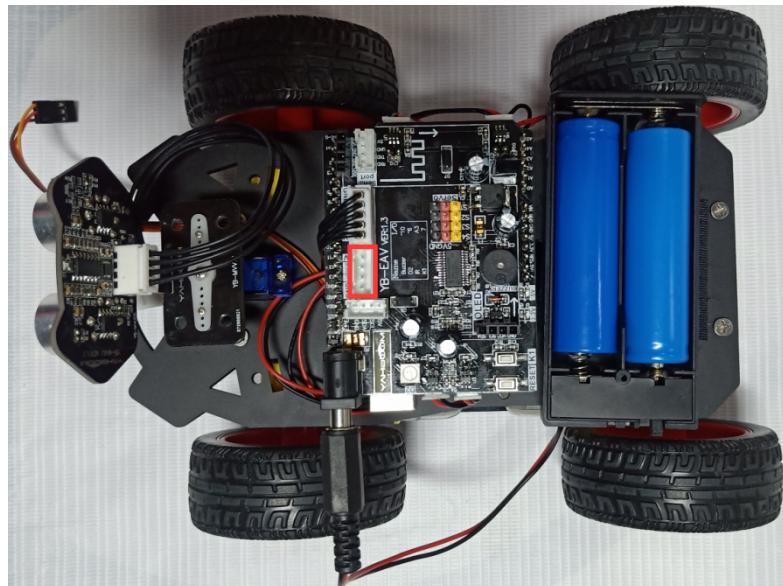
Basic course ---7.Ultrasonic Ranging

1. Learning goal

In this lesson, we will learn how to use ultrasonic module.

2. Preparation

2.1 The position of the ultrasonic port on the expansion board. As shown below.

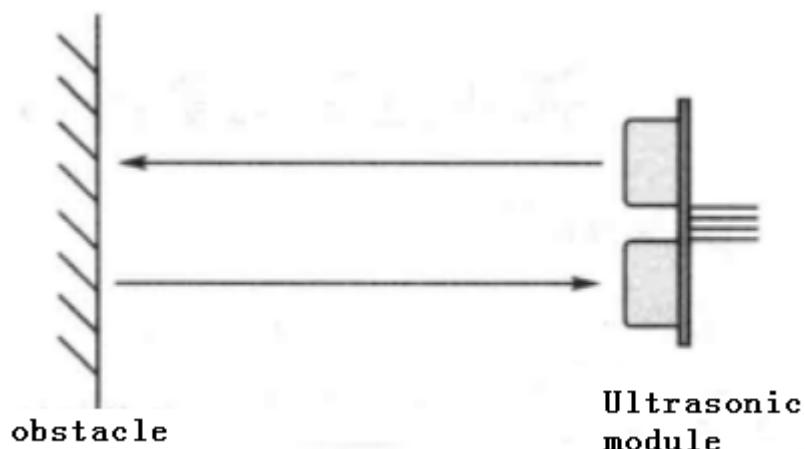


2.2 The pin of UNO board is connected the pins on the expansion board .

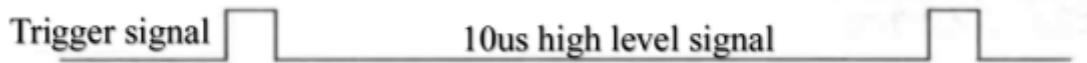
Classification	Function	The number of Drive chip PCA9685	Drive Method	Connection with CPU	Uno board
Left Motor	Left front motor forward	LINB(13)	PCA9685	I2C_SDA/I2C_SCL	A4/A5
	Left front motor reverse	LINA(12)			
	Left rear motor forward	RINB(15)			
	Left rear motor reverse	RINA(14)			
Right Motor	Right front motor forward	LED10			
	Right front motor reverse	LED11			
	Right rear motor forward	LED8			
	Right rear motor reverse	LED9			
Servo	Control S1	LED0			
	Control S2	LED1			
	Control S3	LED2			
	Control S4	S1(3)			
LOGO light	Control bluelight	LED7			
Tracking sensor	Left tracking sensor				A0
	Middle tracking sensor				A1
	Right tracking sensor				A2
Ultrasonic sensor	Ultrasonic Echo		Uno board drive directly		12
	Ultrasonic RGB light				11
Key	K1				7
IR	IR control				A3
Bluetooth interface	RX				0
	TX				1
On board RGB Light	RGB Light on expansion board				6
	Control buzzer				10

3. Principle of experimental

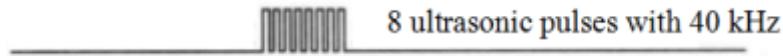
The ultrasonic module is a sensor that uses ultrasonic characteristics to detect the distance. It has two ultrasonic probes for transmitting and receiving ultrasonic waves. The range of measurement is 3-450 cm.



- (1) You need to input a high level signal of at least 10us to the Trig pin to trigger the ranging function of the ultrasonic module.



(2) After the ranging function is triggered, the module will automatically send out 8 ultrasonic pulses with 40 kHz and automatically detect whether there is a signal return. This step is done internally by the module.



(3) When the module detects an echo signal, the ECHO pin will output a high level. The high level duration is the time from when the ultrasonic wave is sent to when it returns. You can calculate the distance by using the time function to calculate the high level duration.

Formula: Distance = High level duration * Speed of sound(340M/S)/2.

From the hardware interface manual, we can know that ultrasonic module are driven by Pin 12.

4. About code

For the code of this course, please refer to: [Ultrasonic_Ranging.ino](#) in the [Ultrasonic_Ranging](#) folder.

```
#include <Wire.h>
#include <Adafruit_PWMServoDriver.h>
Adafruit_PWMServoDriver pwm = Adafruit_PWMServoDriver(0x40);
const int SingPin = 12;
float distance;

void setup()
{
    pwm.begin();
    pwm.setPWMFreq(60); //Analog servos run at ~60 Hz
    updates
        LOGO_breathing_light(255, 40, 5); //Gradually light the blue light of the
    Yhaboom_LOGO
        Serial.begin(9600);
        Serial.println("Ultrasonic sensor:");
}

void LOGO_breathing_light(int brightness, int time, int increment)
{
```

```

if (brightness < 0)
{
    brightness = 0;
}
if (brightness > 255)
{
    brightness = 255;
}
for (int b = 0; b < brightness; b += increament)
{
    int newb = map(b, 0, 255, 0, 4095);
    pwm.setPWM(7, 0, newb);
    delay(time);
}
}

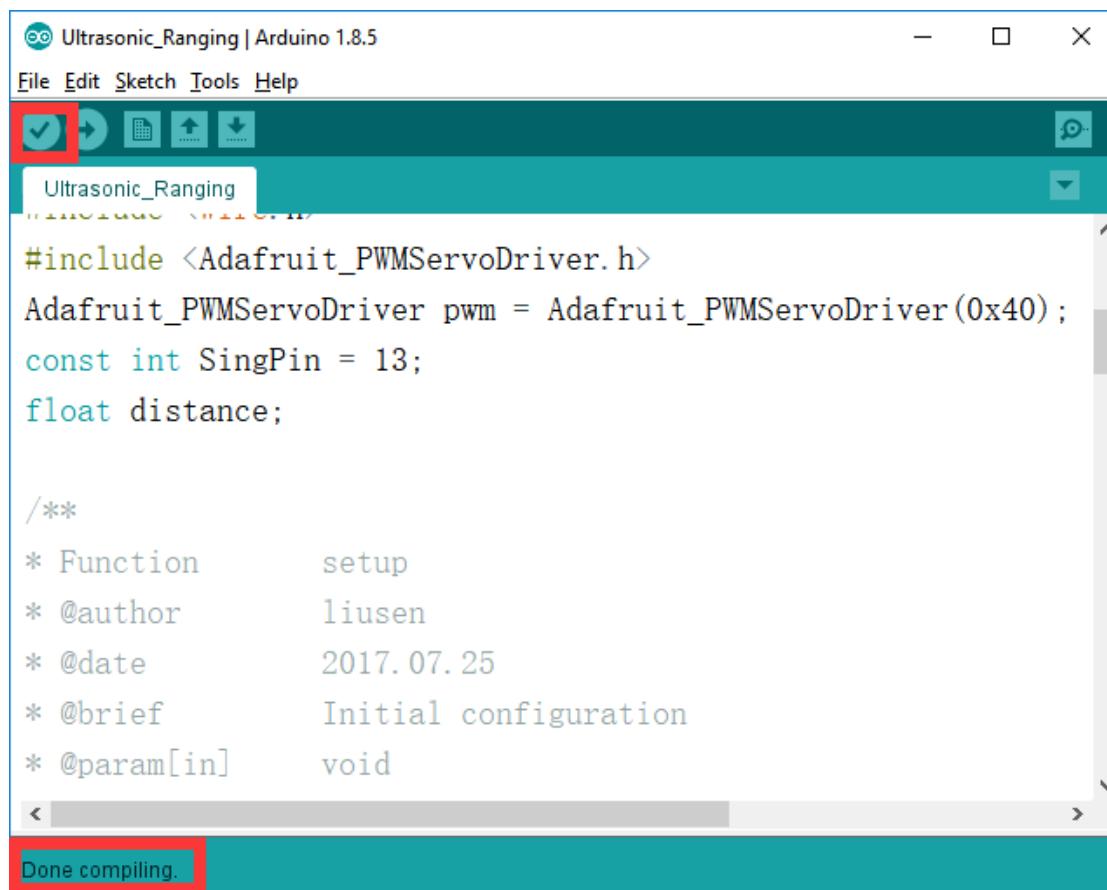
void loop()
{
    pinMode(SingPin,OUTPUT);
    digitalWrite(SingPin, LOW);
    delayMicroseconds(2);
    digitalWrite(SingPin, HIGH);
    delayMicroseconds(10);
    digitalWrite(SingPin, LOW);

    pinMode(SingPin, INPUT);
    delayMicroseconds(50);
    distance = pulseIn(SingPin, HIGH) / 58.00;
    Serial.print("distance is :");
    Serial.print(distance);
    Serial.print("cm");
    Serial.println();
    delay(1000);
}

```

5. Compiling and downloading code

5.1 We need to open the **Ultrasonic_Ranging.ino** file by Arduino IDE software. Then click “√” under the menu bar to compile the code, and wait for the word "**Done compiling**" in the lower left corner, as shown in the figure below.



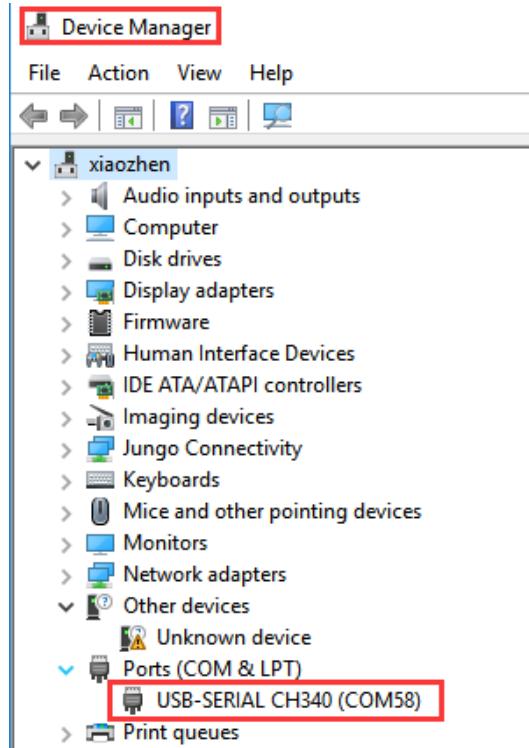
The screenshot shows the Arduino IDE interface. The title bar reads "Ultrasonic_Ranging | Arduino 1.8.5". The menu bar includes File, Edit, Sketch, Tools, and Help. Below the menu is a toolbar with icons for upload, download, and serial monitor. The main area displays the following C++ code:

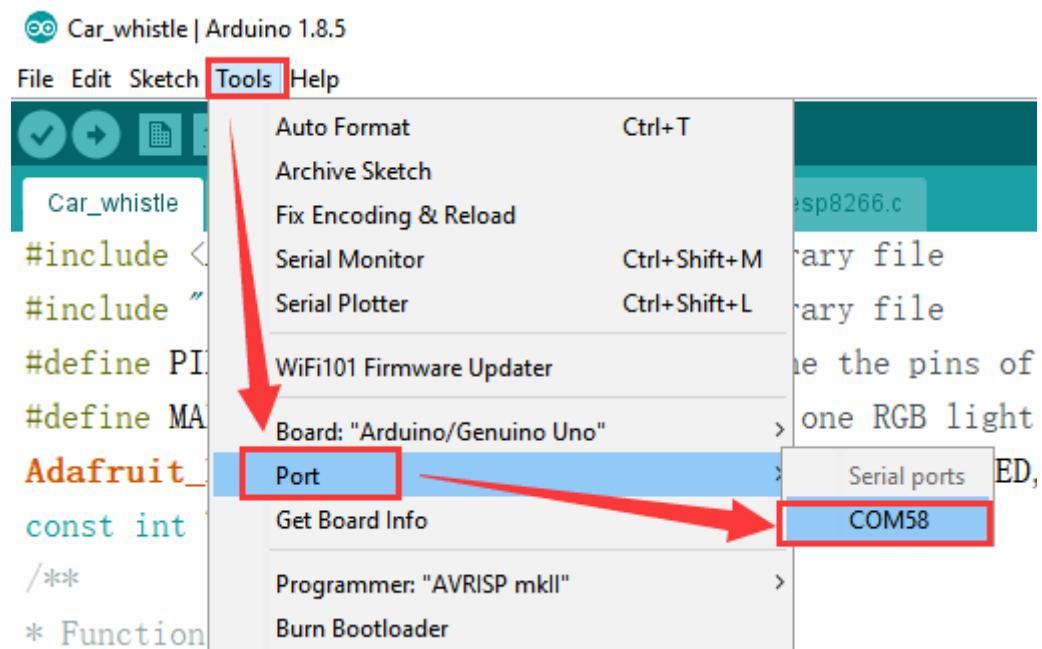
```
#include <Adafruit_PWMServoDriver.h>
Adafruit_PWMServoDriver pwm = Adafruit_PWMServoDriver(0x40);
const int SingPin = 13;
float distance;

/**
 * Function      setup
 * @author       liusen
 * @date         2017.07.25
 * @brief        Initial configuration
 * @param[in]    void
 */

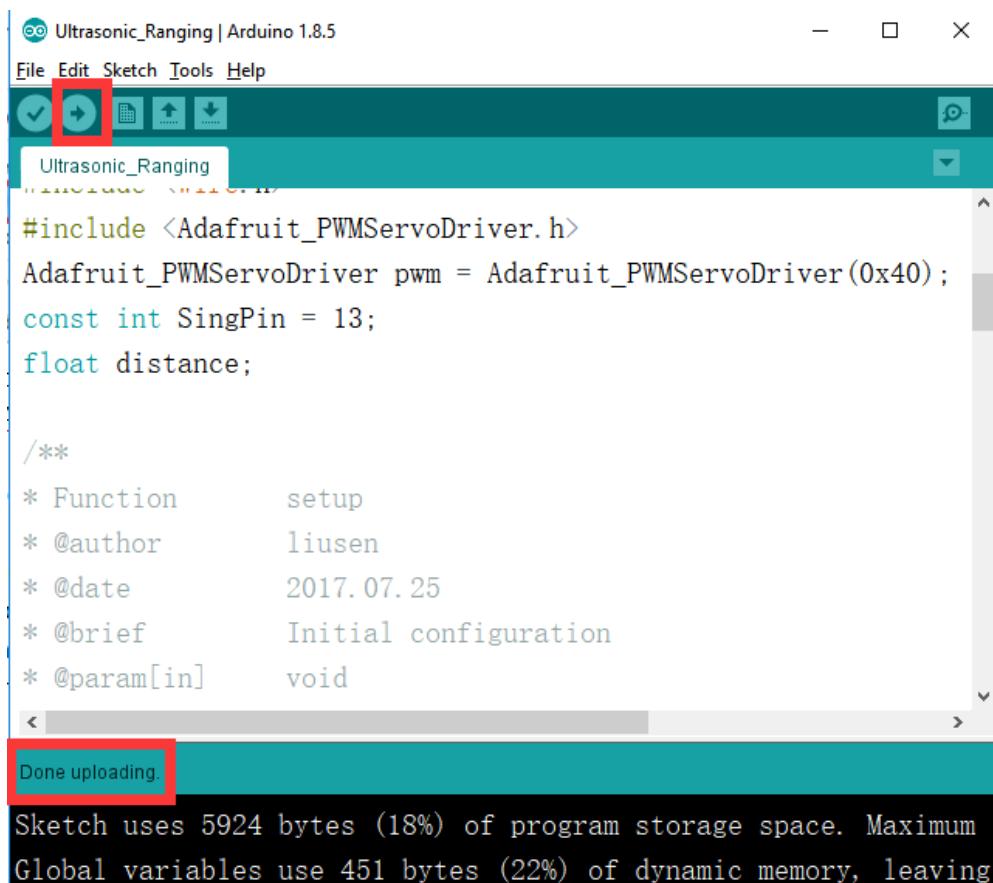
Done compiling.
```

5.2 In the menu bar of Arduino IDE, we need to select 【Tools】---【Port】---selecting the port that the serial number displayed by the device manager just now, as shown in the figure below.



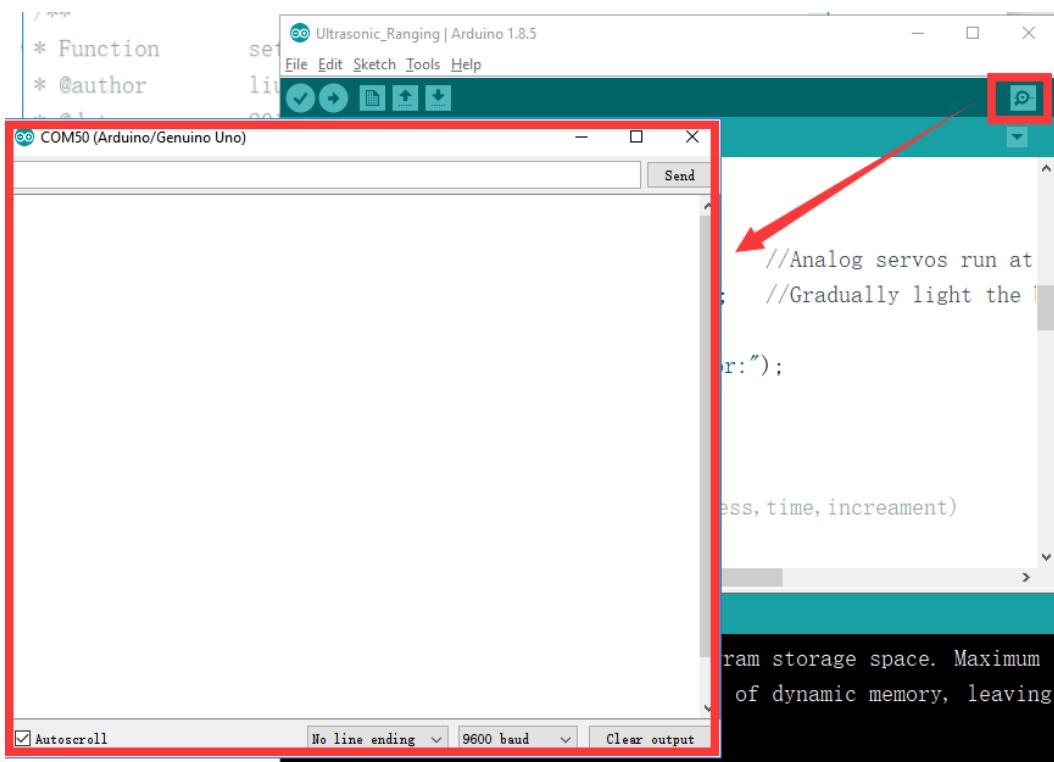


5.3 After the selection is completed, you need to click "→" under the menu bar to upload the code to the UNO board. When the word "**Done uploading**" appears in the lower left corner, the code has been successfully uploaded to the UNO board, as shown in the figure below.

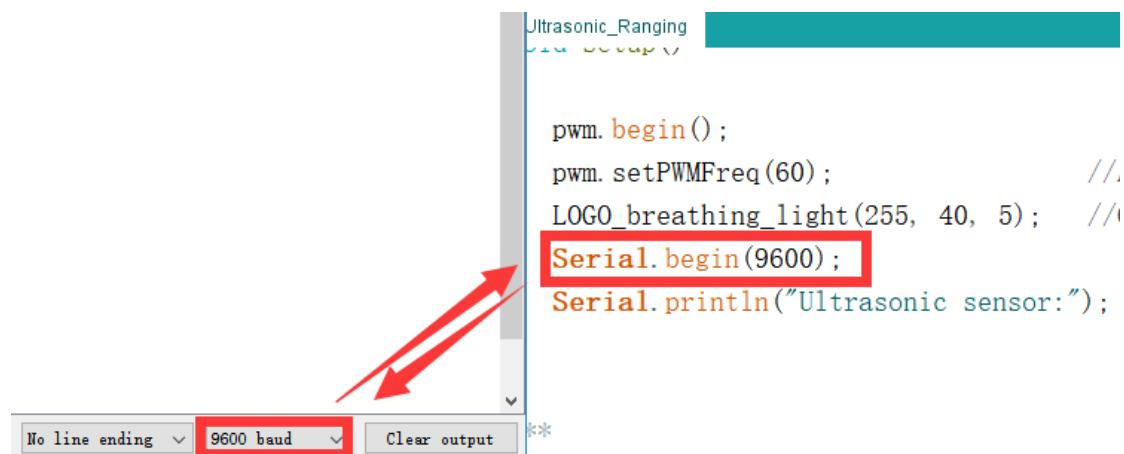


6. Experimental phenomena

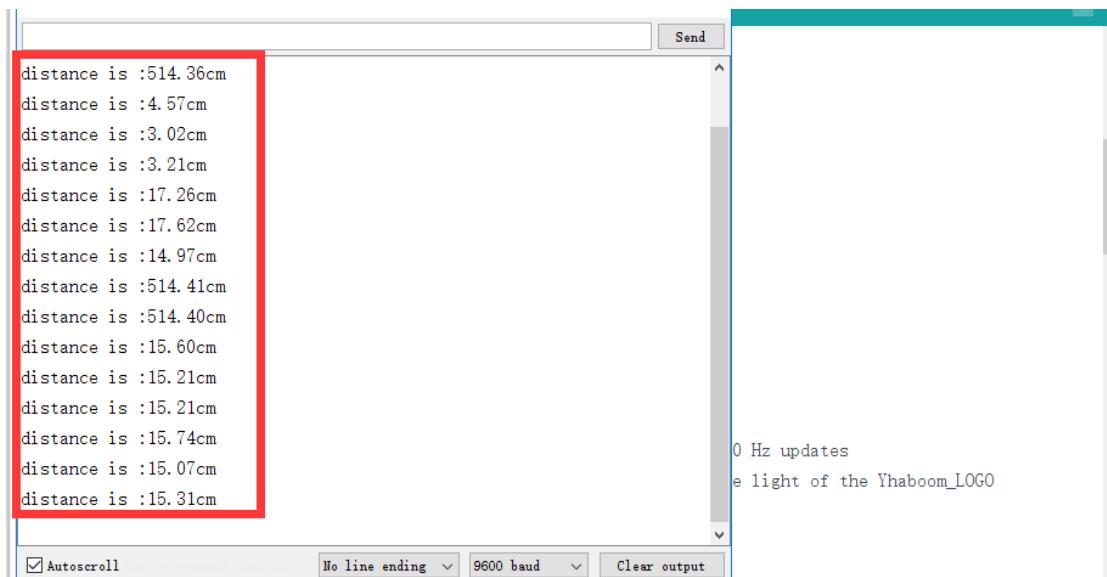
After the program is downloaded. We need to open the **Serial Monitor** in the upper right corner of the Arduino IDE interface.



And we need to select the same baud rate as set in the program. As shown below.



Next, we will see that the distance detected by the current ultrasonic module is printed on the serial monitor.



A screenshot of a terminal window titled "YAHBOOM". The window displays a series of distance measurements followed by a logo update message. The text is highlighted with a red box.

```
distance is :514.36cm  
distance is :4.57cm  
distance is :3.02cm  
distance is :3.21cm  
distance is :17.26cm  
distance is :17.62cm  
distance is :14.97cm  
distance is :514.41cm  
distance is :514.40cm  
distance is :15.60cm  
distance is :15.21cm  
distance is :15.21cm  
distance is :15.74cm  
distance is :15.07cm  
distance is :15.31cm
```

0 Hz updates
e light of the Yhaboom LOGO

At the bottom of the window, there are several configuration options:

- Autoscroll
- No line ending
- 9600 baud
- Clear output