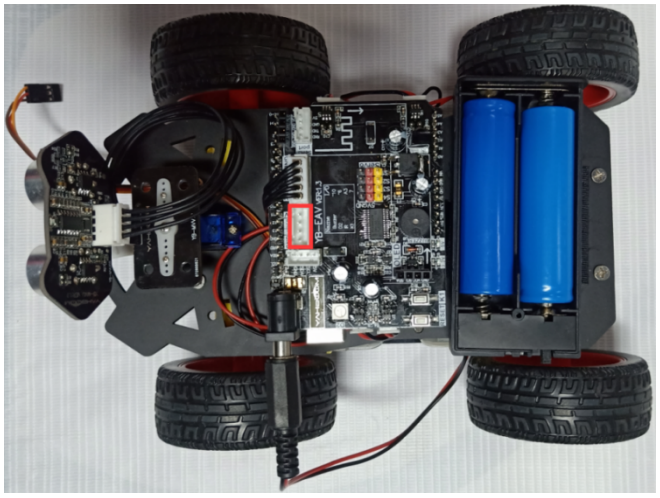
Expand course ---7.Ultrasonic avoid servo

1. Learning goal

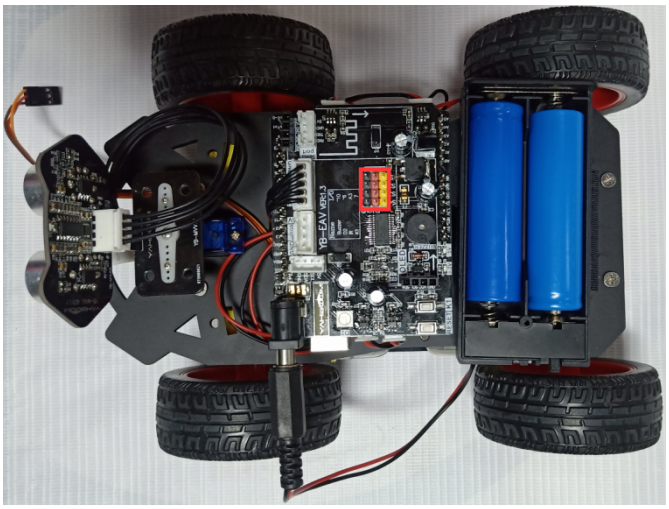
In this lesson, we will learn how to achieve ultrasonic obstacle avoidance with servo.

2. Preparation

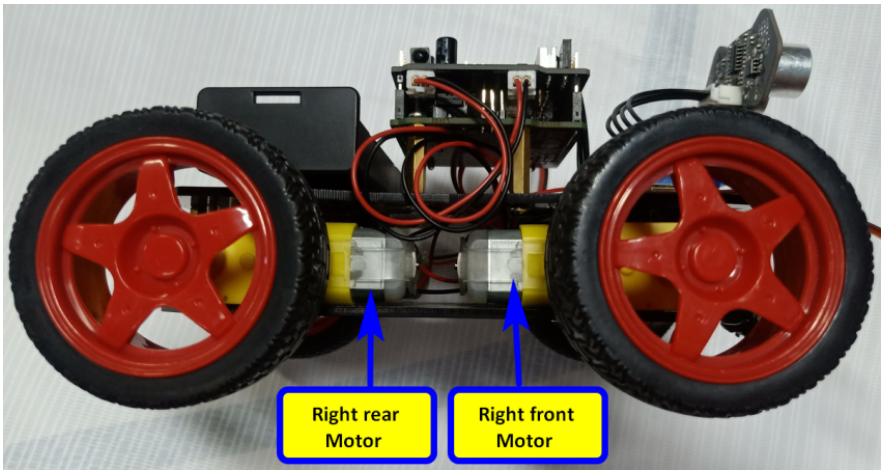
2.1 The position of the ultrasonic port on the expansion board. As shown below.

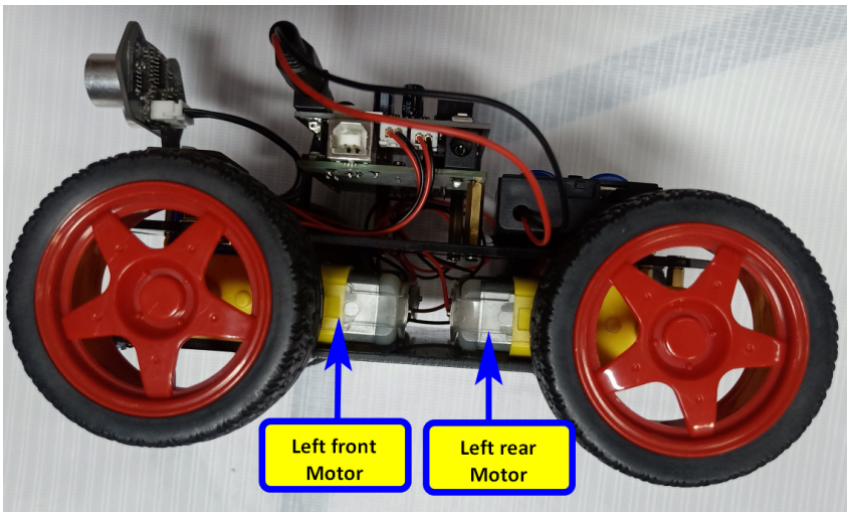


2.2 The position of the servo port on the expansion board. As shown below.



2.3 The position of the motor on the robot car. As shown below.

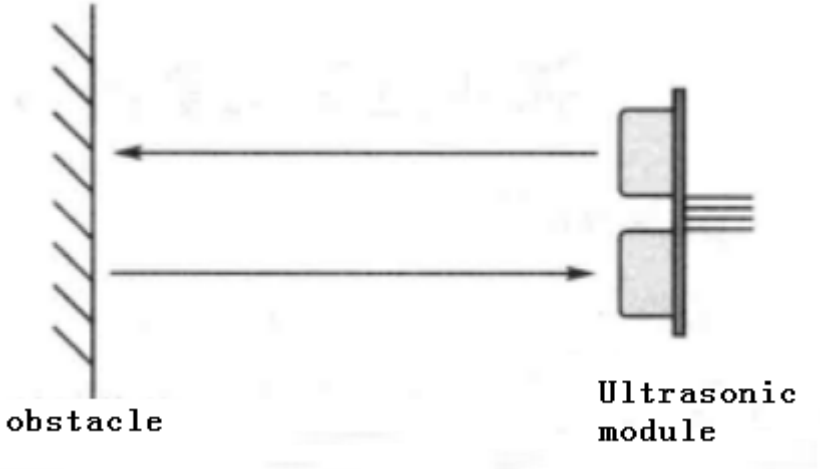




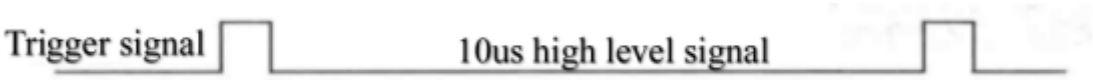
2.4 The pin of UNO board is connected the pins of motor, servo and ultrasonic module on the expansion board .

3. **Principle of experimental**

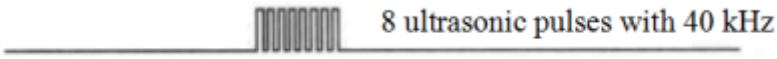
The ultrasonic module is a sensor that uses ultrasonic characteristics to detect the distance. It has two ultrasonic probes for transmitting and receiving ultrasonic waves. The range of measurement is 3-450 cm.



(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.

PCA9685 chip and UNO board adopt I2C communication method. I2C address is 0x40.

connection as shown below.

PCA9685 chip	Right front Motor
10	Forward
11	Reverse

PCA9685 chip	Right rear Motor
8	Forward
9	Reverse

PCA9685 chip	Left front Motor
13	Forward
12	Reverse

PCA9685 chip	Left rear Motor
15	Forward
14	Reverse

The working principle of the servo:

The control signal enters the signal modulation chip from the channel of the receiver to obtain the bias voltage of the DC. It has a reference circuit inside, which generates a reference signal with a period of 20ms and a width of 1.5ms. It will compares the DC bias voltage with the voltage of the potentiometer to obtain a voltage difference and output. The positive and negative of the voltage difference is outputted to the motor drive chip to determine the forward and reverse of the motor.

Servo rotation angle is by adjusting the duty ratios of PWM (pulse width modulation) signal. The standard PWM (pulse width modulation) signal has a fixed period of 20ms (50Hz). Theoretically, pulse width distribution should be between 1 ms to 2 ms, but in fact between pulse width can be 0.5 ms and 2.5 ms. Pulse width and the servo rotation angle 0°～180° corresponds, as shown below.

0.5ms----------0°
1.0ms----------45°
1.5ms----------90°
2.0ms----------135°
2.5ms----------180°

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			
Tarcking 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
Buzzer	Control buzzer				10

From the hardware interface manual, we can know that ultrasonic module are driven by Pin 12.
From the hardware interface manual, we can know that four motor of the robot car are driven by PWM by PCA9685 chip.

From the hardware interface manual, we can know that three servos are driven by PWM by PCA9685 chip.

4. About code

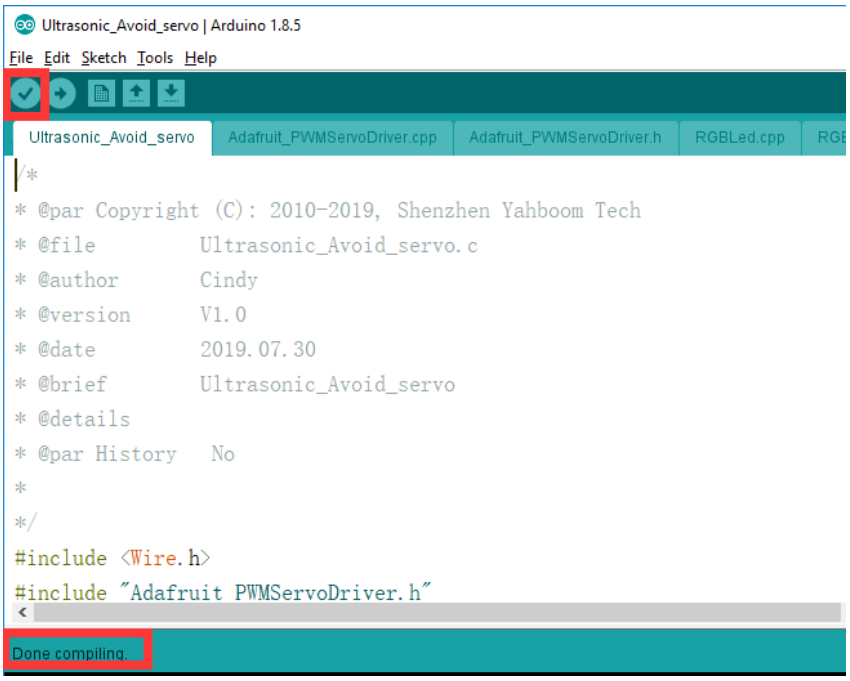
For the code of this course, please refer to: **Ultrasonic_Avoid_servo.ino** in the **Ultrasonic_Avoid_servo** folder.

```
void Ultrasonic_avoid_servo()
{
  int LeftDistance = 0;      //LeftDistance
  int RightDistance = 0;     //RightDistance
  int FrontDistance = 0;     //FrontDistance
  mRgb.setColor(0,RGB_GREEN);   //There are two RGB light on the
Ultrasonic module No.1 and No.2
  mRgb.show();
  Servo_180(0, 0);          //Servo rotate 0°（test right distance）
  delay(500);
  Distance();
  RightDistance = distance;

  Servo_180(0, 180);          //Servo rotate 180°（test left distance）
  delay(500);
  Distance();
  LeftDistance = distance;

  Servo_180(0, 90);          //Servo rotate 90°（test front distance）
  delay(500);
  Distance();
  FrontDistance = distance;

  if (LeftDistance < 25 && RightDistance < 25 && FrontDistance < 25)
  {
    brake();
    delay(200);
    mRgb.setColor(0,RGB_PURPLE);
    mRgb.show();
    spin_right(70);
    delay(950);
    brake();
    delay(200);
  }
  else if (LeftDistance >= RightDistance)
  {
    brake();
```

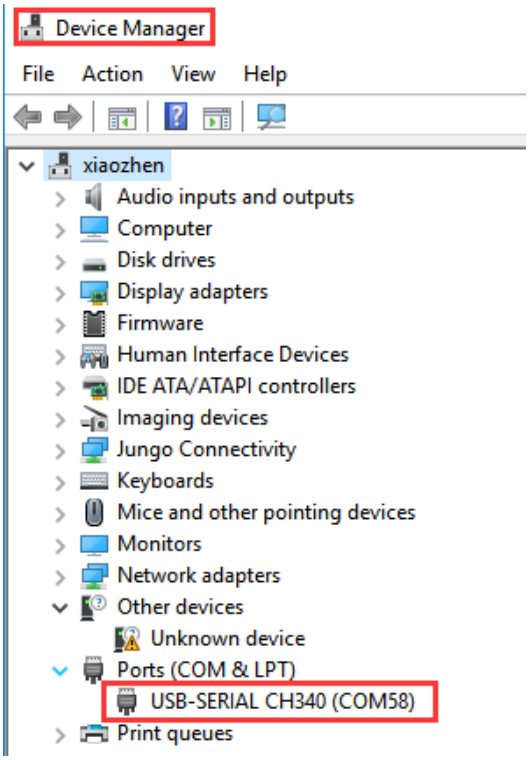
```
      delay(200);
      mRgb.setColor(0,RGB_BLUE);
      mRgb.show();
      spin_left(70);
      delay(650);
      brake();
      delay(200);
   }
   else if (LeftDistance < RightDistance)
   {
      brake();
      delay(200);
      mRgb.setColor(0,RGB_YELLOW);    //There are two RGB light on the
Ultrasonic module No.1 and No.2
      mRgb.show();
      spin_right(70);       //When approaching obstacles,turn right at about 90
degrees
      delay(650);
      brake();
      delay(200);
   }
}

void loop()
{
       Distance_test();
       if ( distance < 25 )
       {
           brake();
           delay(300);
           Ultrasonic_avoid_servo();
       }
       else if( distance >= 25 )
       {
           run(80);
       }
}
```

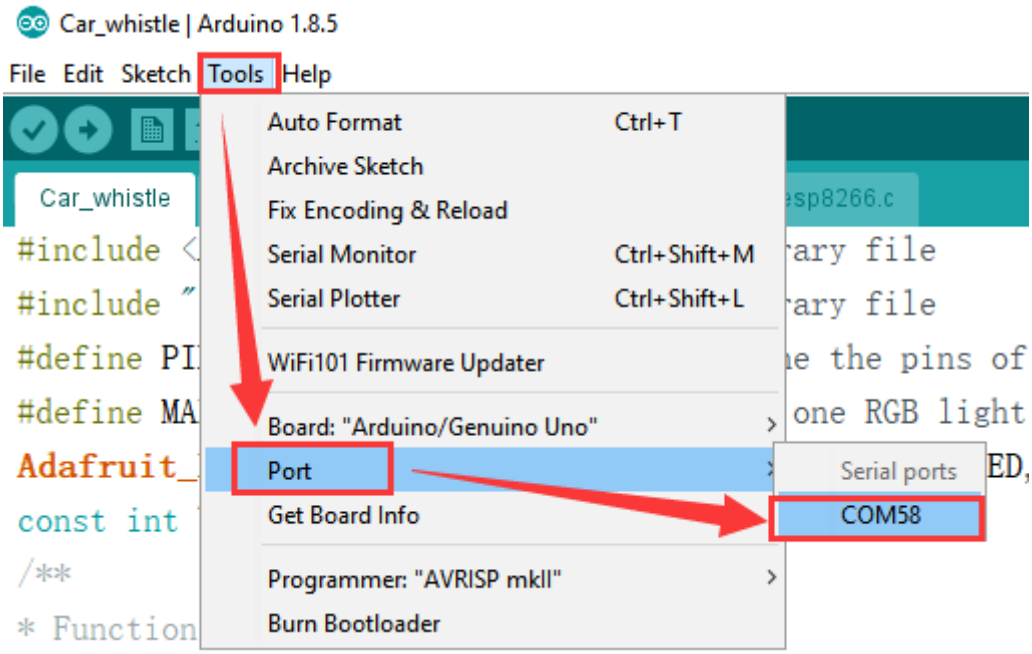
5. Compiling and downloading code

5.1 We need to open the **Ultrasonic_Avoid_servo.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.

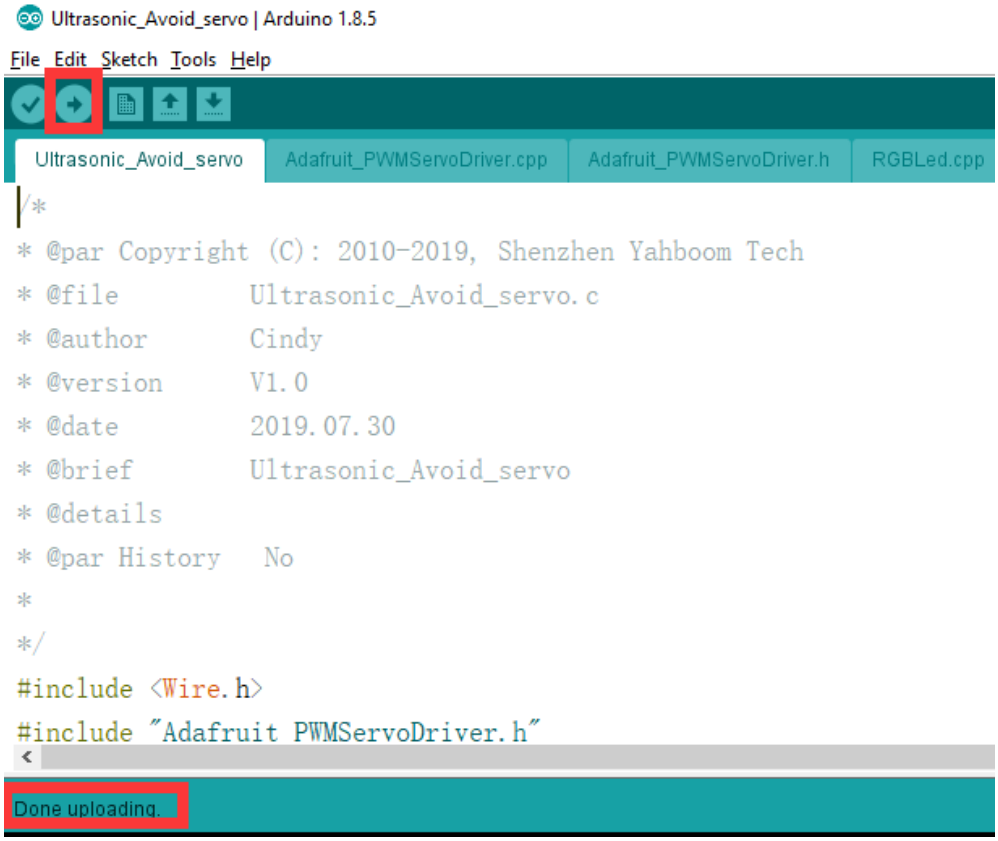


5.2 In the menu bar of Arduino IDE, we need to select 【Tools】---【Port】---selecting the port that the serial number displayed by the device manager just now, as shown in the figure below.





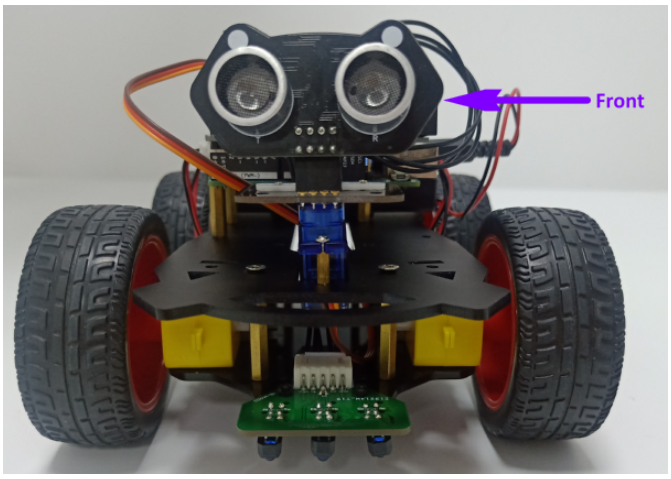
5.3 After the selection is completed, you need to click "→"under the menu bar to upload the code to the UNO board. When the word "**Done uploading**" appears in the lower left corner, the code has been successfully uploaded to the UNO board, as shown in the figure below.



6. Experimental phenomena

After the program is downloaded. We need to wait for servo rotate to

90°(Front), as shown below.



Then, we need to press K1 on the expansion board, the robot car will advance. When there are obstacles in front of it, the car will spin left or spin right to avoid obstacles. And RGB light of ultrasonic module will change different color.

!Note:

It just avoid some obstacles in front. The side is the blind spot of the ultrasonic module.

If the experiment is not very good, you can modify the program according to the actual situation.