# Lesson 2 Ultrasonic Detection and Digital Tube Display

1. Project Principle

In this lesson, ultrasonic sensor will be used to detect object and the detection result will be displayed on digital tube.

The used glowing ultrasonic ranging module integrates ultrasonic transmitting circuits, ultrasonic receiving circuits, digital processing circuits, etc. inside the ranging chip. The module adopts IIC communication interface, and can read the measured distance through IIC communication.
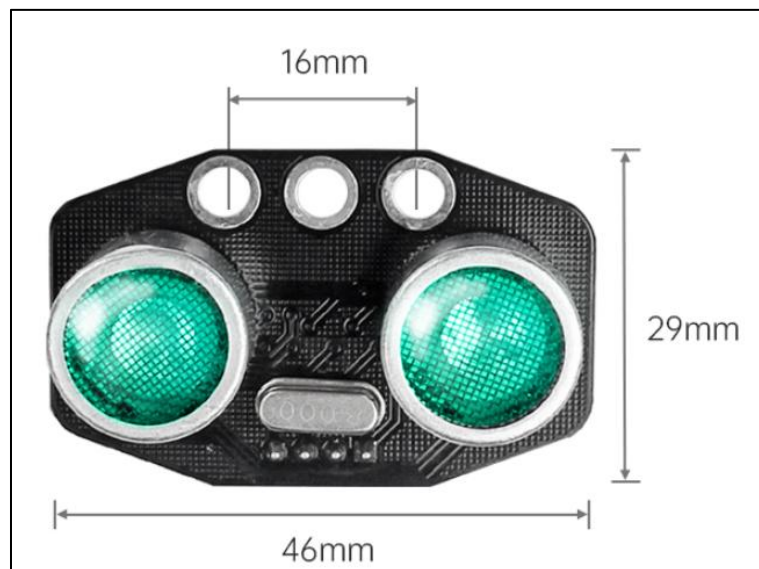
Ultrasonic sensors have two main components: the transmitter and the receiver.

The module will automatically send eight 40khz square waves and detect if there are signals are sent back. If there are signals back, output a high level. Then the duration time is time when the ultrasonic waves are sent and returns.

Measured distance(L) =(high level time* the speed of time(340M/S))/2.

The ultrasonic probes integrates two RGB lights, not only can adjust the light

brightness, but also through the red (R), green (G), blue (B) three color channel changes and their superposition on each other to achieve colorful color changes.

The digital tube has a 4-digit red LED for displaying numbers, decimal points and some special characters. This module is compact and easy to use, you can apply this module in robotics projects for displaying sensor values such as speed, time, fraction, temperature, distance, etc.

Firstly, import corresponding libraries and initialize ultrasonic sensor, buzzer, servo and digital tube module.

Then set the distance measurement conditions,three threshold intervals are set in program. Different intervals is distinguished with different colors.

2. Preparation

2.1 Hardware

Please assemble ultrasonic sensor and digital tube to the corresponding position on MaxArm according to the tutorial in folder "Lesson 1 Module Assembly" under the same directory.

2.2 Software

Please connect MaxArm to Arduino editor according to the tutorial in folder "4.
MaxArm Underlying Program Learning/Arduino Development/Lesson 1 Set
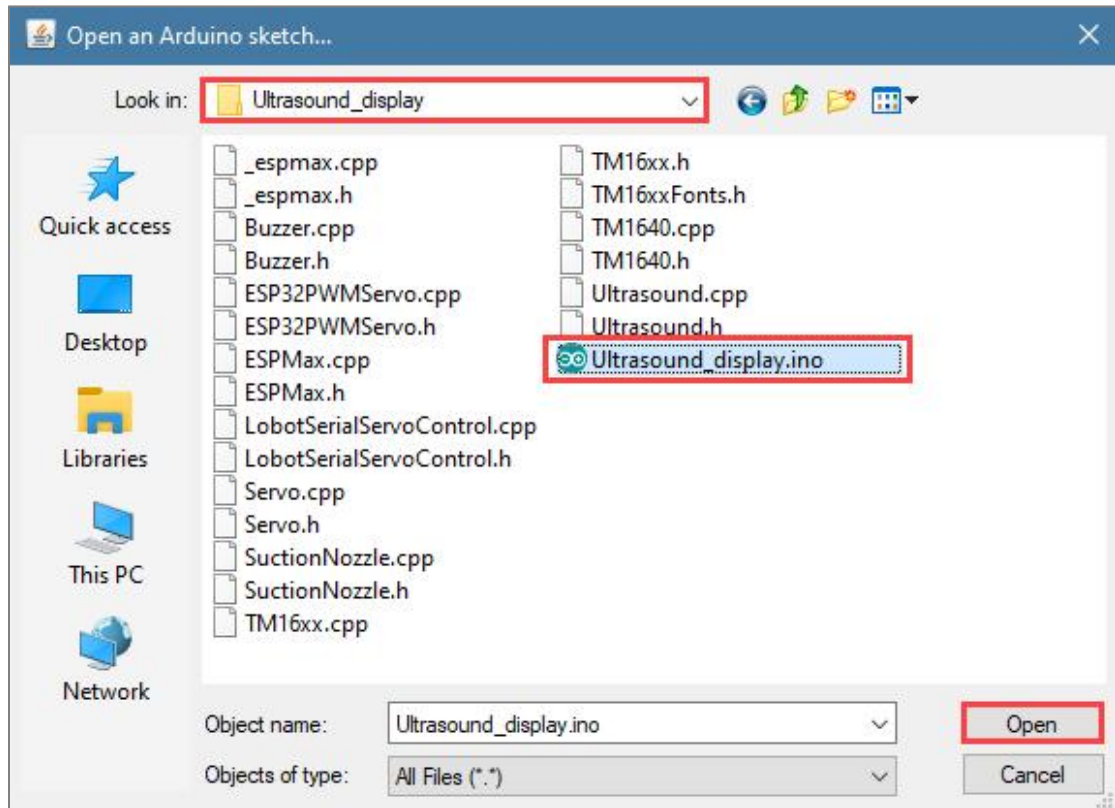Development Environment".

3. Program Download

1) Click on [arduino] icon to open Arduino IDE.
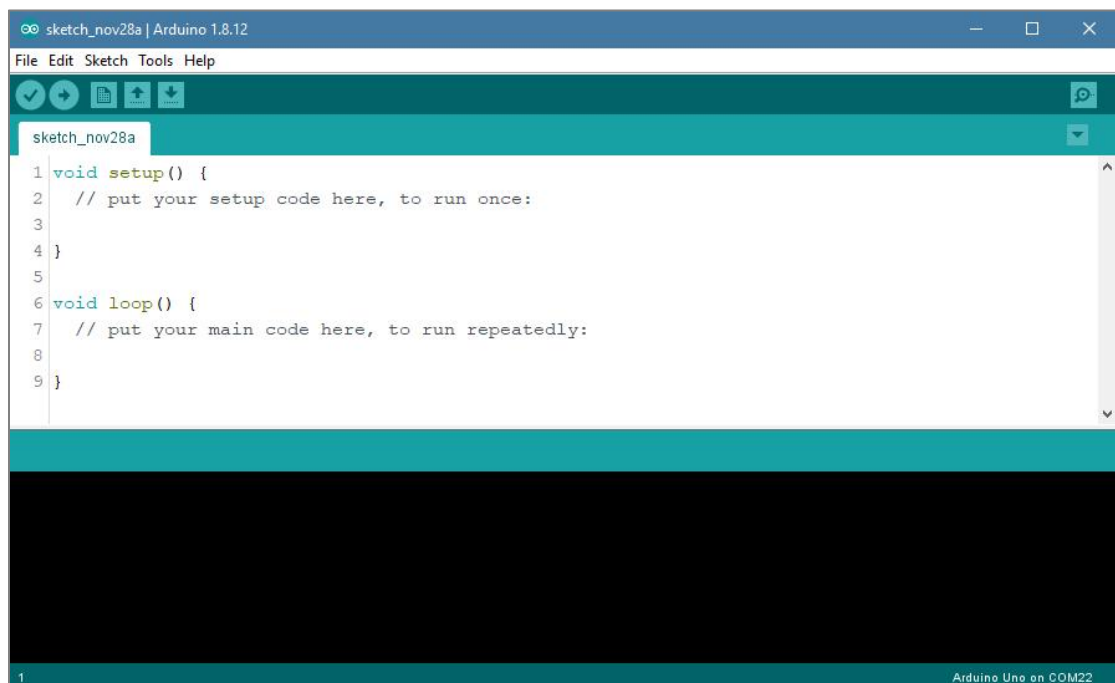
2) Click "File->Open" in turn.

3) Open the program "Ultrasound_display.ino" in the folder "6.Secondary Development/ Arduino Development/Sensor-extension Game/Program Files/ Ultrasonic Detection and Digital Tube Disply /Ultrasound_display".

4) Select the corresponding port of Arduino controller in "Tools->Port". (Here take the port "COM5" as example. Please select the port based on your computer. If COM1 appears, please do not select because it is the system communication port but not the actual port of the development port.)
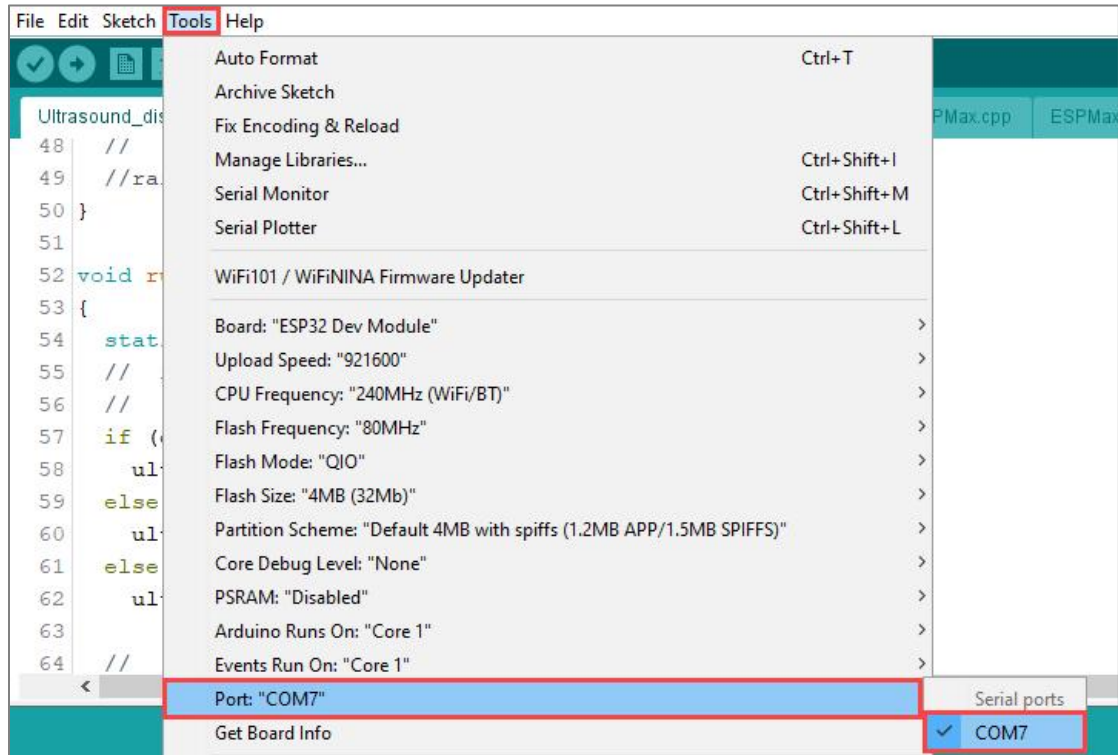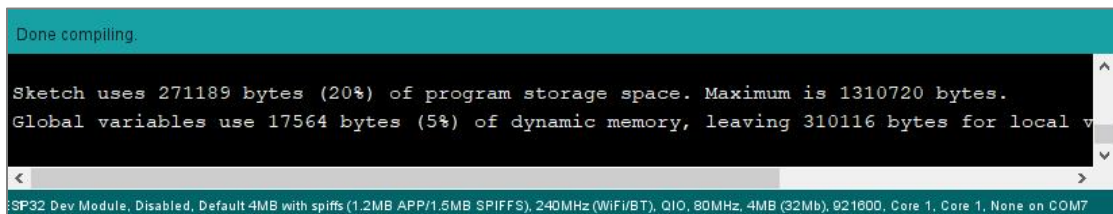
5) If you're not sure about the port number, please open the "This PC" and click "Properties->Device Manger" in turns to check the corresponding port number (the device is with CH340). Then select the correct port on Arduino editor.
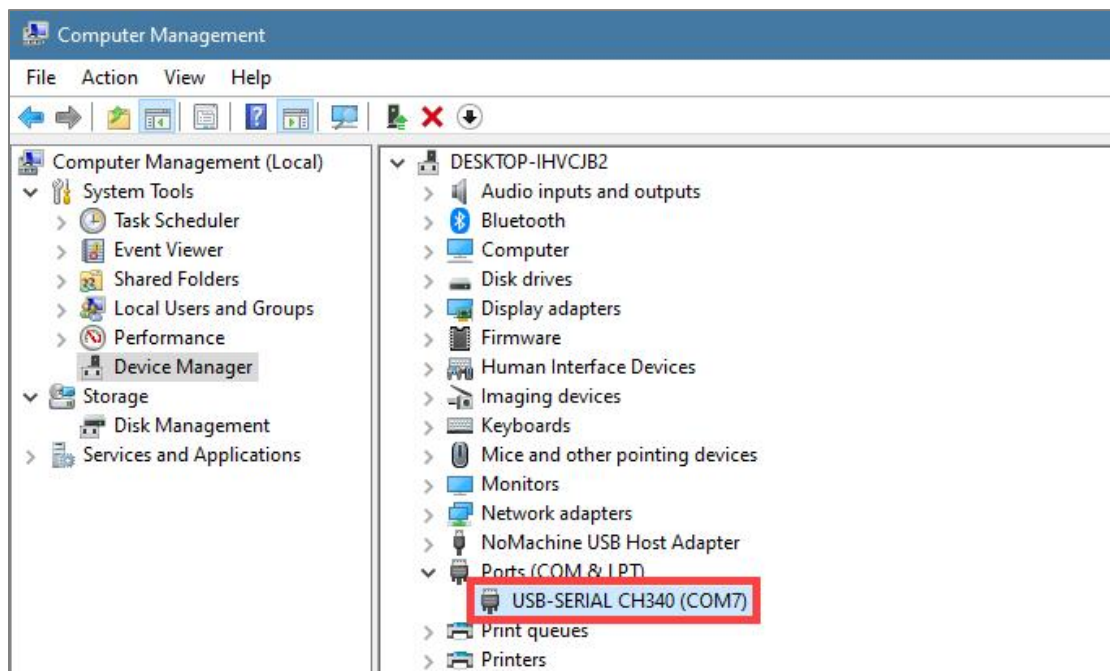
6) After selecting, confirm the board "ESP32 Dev Module" in the lower right corner and the port number "COM5" (it is an example here, please refer to the actual situation).

```
4                                              ESP32 Dev Module 在 COM5
```

7) Then click on ☑ icon to verify the program. If no error, the status area will display "Compiling->Compile complete" in turn. After compiling, the information such as the current used bytes, and occupied program storage space will be displayed.

```
Done compiling.

Sketch uses 271189 bytes (20%) of program storage space. Maximum is 1310720 bytes.
Global variables use 17564 bytes (5%) of dynamic memory, leaving 310116 bytes for local v

ESP32 Dev Module, Disabled, Default 4MB with spiffs (1.2MB APP/1.5MB SPIFFS), 240MHz (WiFi/BT), QIO, 80MHz, 4MB (32Mb), 921600, Core 1, Core 1, None on COM7
```

8) After compiling, click on ➡ icon to upload the program to the development board. The status area will display "Compiling->Uploading->Complete" in turn. After uploading, the status area will stop printing the uploading information.

```
Done uploading.

Leaving...
Hard resetting via RTS pin...

1                                              ESP32 Dev Module on COM7
```
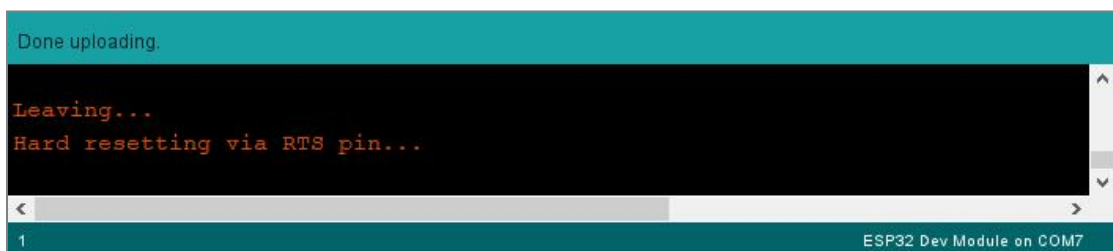
4. Project Outcome

Place a block or other objects in front of ultrasonic sensor, and then the corresponding distance will be displayed on digital tube. If the distance between sensor and object is less than 50cm, red light is on. If the distant is

between 50cm and 100cm, green light is on. When the distance is farther than 100cm, blue light is on.

5. Program Instruction

5.1 Import Function Library

Firstly, call ultrasonic sensor library, PWM servo library, buzzer library and other related libraries.

```
1 #include "ESPMax.h"
2 #include "Buzzer.h"
3 #include "Ultrasound.h"
4 #include "SuctionNozzle.h"
5 #include "ESP32PWMServo.h"
```

5.2 Ultrasonic Detection

Then set variables to read the measured distance.

```
32 void loop() {
33     char text[6];
34     int distance = ultrasound.GetDistance();
35     Serial.println(distance);
```

5.3 LED Display

Display the distance value on digital tube.

```
37     module.setDisplayToString(text);
```

5.4 Light color setting

If the distance between sensor and object is less than 50cm, green light is on.

If the distant is between 50cm and 100cm, red light is on.

When the distance is farther than 100cm, blue light is on.

```
32 void loop() {
33   char text[6];
34   int distance = ultrasound.GetDistance();
35   Serial.println(distance);
36   sprintf(text, "%4d", distance);   //
37   module.setDisplayToString(text);   //
38   if (distance > 0 && distance <= 50)
39     ultrasound.Color(0, 255, 0, 0, 255, 0); //Green
40   else if (distance > 50 && distance <= 100)
41     ultrasound.Color(255, 0, 0, 255, 0, 0); //Red
42   else if (distance > 100)
43     ultrasound.Color(0, 0, 255, 0, 0, 255); //Blue
44   delay(300);   //
```