HC-SR04 User Guide

Part 1 Ultrasonic Introduction

1. 1 Ultrasonic Definition

The human ear can hear sound frequency around 20HZ ~ 20KHZ, and ultrasonic is the sound wave beyond the human ability of 20KHZ .

1.2 Ultrasonic distance measurement principle

Ultrasonic transmitter emitted an ultrasonic wave in one direction, and started timing when it launched. Ultrasonic spread in the air, and would return immediately when it encountered obstacles on the way. At last, the ultrasonic receiver would stop timing when it received the reflected wave. As Ultrasonic spread velocity is 340m / s in the air, based on the timer record **t**, we can calculate the distance (s) between the obstacle and transmitter, namely: s = 340t / 2, which is so- called time difference distance measurement principle

The principle of ultrasonic distance measurement used the already-known air spreading velocity, measuring the time from launch to reflection when it encountered obstacle, and then calculate the distance between the transmitter and the obstacle according to the time and the velocity. Thus, the principle of ultrasonic distance measurement is the same with radar.

Distance Measurement formula is expressed as: L = C X T

In the formula, L is the measured distance, and C is the ultrasonic spreading velocity in air, also, T represents time (T is half the time value from transmitting to receiving).

1.3 Ultrasonic Application

Ultrasonic Application Technology is the thing which developed in recent decades. With the ultrasonic advance, and the electronic technology development, especially as high-power semiconductor device technology matures, the application of ultrasonic has become increasingly widespread:

- Ultrasonic measurement of distance, depth and thickness;
- Ultrasonic testing;
- Ultrasound imaging;
- Ultrasonic machining, such as polishing, drilling;
- Ultrasonic cleaning;
- Ultrasonic welding;

Part 2 HC-SR04 Ultrasonic Module Introduction

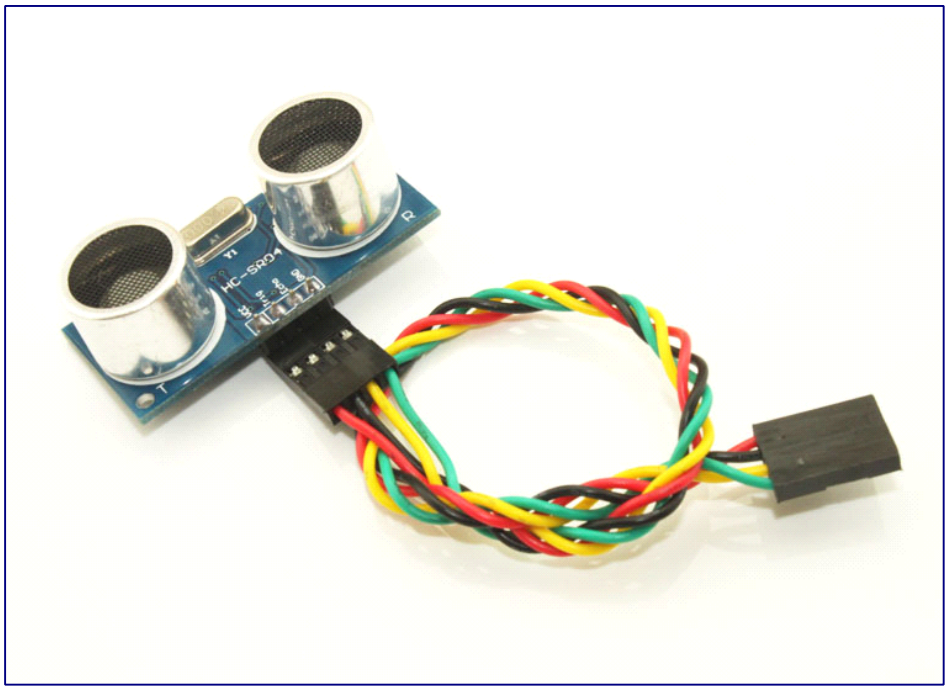
2.1 Product Features

- Stable performance
- Accurate distance measurement
- High-density
- Small blind

Application Areas:

- Robotics barrier
- Object distance measurement
- Level detection
- Public security
- Parking detection

2.2 Product Image



2.3、Module pin definitions

Types	Pin Symbol	Pin Function Description
HC-SR04	VCC	5V power supply
	Trig	Trigger pin
	Echo	Receive pin
	GND	Power ground

2.4、Electrical parameters

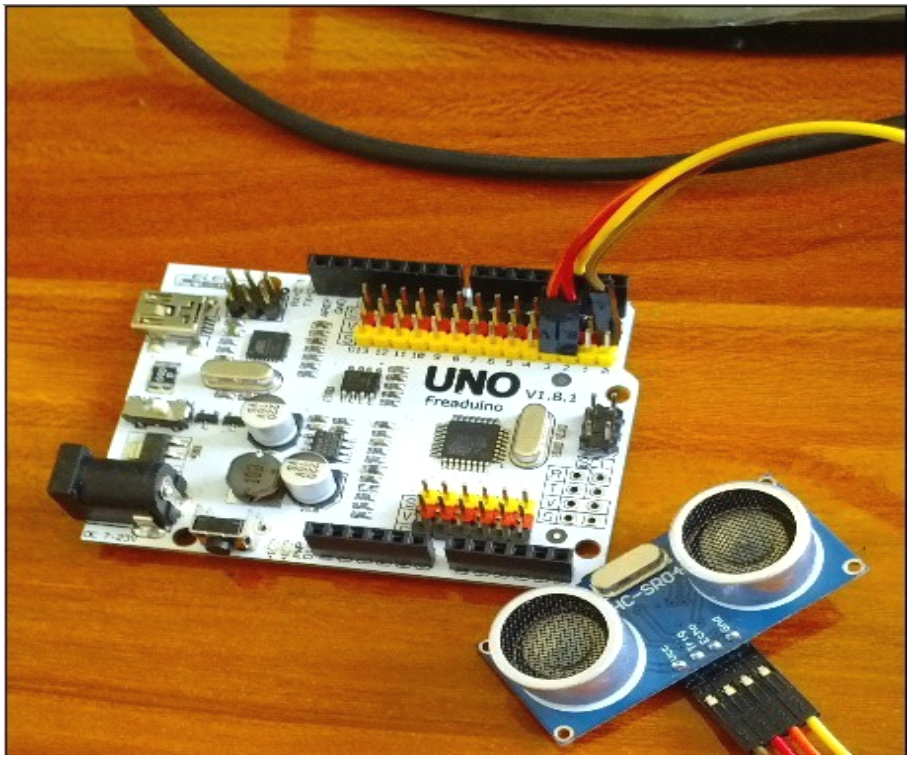
Electrical Parameters	HC-SR04 Ultrasonic Module
Operating Voltage	DC-5V
Operating Current	15mA
Operating Frequency	40KHZ
Farthest Range	4m
Nearest Range	2cm
Measuring Angle	15 Degree
Input Trigger Signal	10us TTL pulse
Output Echo Signal	Output TTL level signal, proportional with range
Dimensions	45*20*15mm

2.5 Module operating Principle

Set low the Trig and Echo port when the module initializes , firstly, transmit at least 10us high level pulse to the Trig pin (module automatically sends eight 40K square wave), and then wait to capture the rising edge output by echo port, at the same time, open the timer to start timing. Next, once again capture the falling edge output by echo port, at the same time, read the time of the counter, which is the ultrasonic running time in the air. According to the formular: test distance = (high level time * ultrasonic spreading velocity in air) / 2, you can calculate the distance to the obstacle.

Part3 Use Freaduino UNO to test HC-SR04

3.1 Freaduino uno and HC-SR04 Connection



Connection Description：D2<------>Trig D3<------>Echo (The users can define the connection pin by themselves)

Note： You need to set the Freaduino UNO switch in 5V Side when use together with HC-SR04 Module.

3.2 HCSR04 library function description

Long timing()

Function name: timing
Parameters: None
Return Value: the time of ultrasonic from the transmitter to the receiver

float CalcDistance(long microsec,int metric)

Function name：CalcDistance

- microsec: the time of ultrasonic from the transmitter to the receiver
- metric: Set the unit of the return value (the value of 1 for cm, and the value of 0 for in)

Return Value: the measured distance

3.3 Add the HC-SR04 Library

Step1:Download the Demo Code of HCSR04 Ultrasonic from address http://www.elecfreaks.com/store/download/product/Sensor/HC-SR04/HCSR04Ultrasonic_demo.zip and then unpack it to get the file of HCSR04 Ultrasonic.

Step2: Add the file of HCSR04 Ultrasonic in the file of Arduino-1.0.X / libraries.

Step3:If you can see the Example of HCSR04 Ultrasonic in Arduino IDE, the adding of HC-SR04 library has been successful.

3.4 Test the Module with the Examples of Library File

1. Open Arduino IDE 1.0.X, and choose the corresponding board and serial port.
2. Click file/ examples/ HCSR04Ultrasonic until the code pop up.
3. Compiling sketch until Done uploading appears, which represents the uploading has been successful.
4. Open serial monitor and set the corresponding BaudRate.
5. If you see similar information in serial monitor as below, you succeeded.

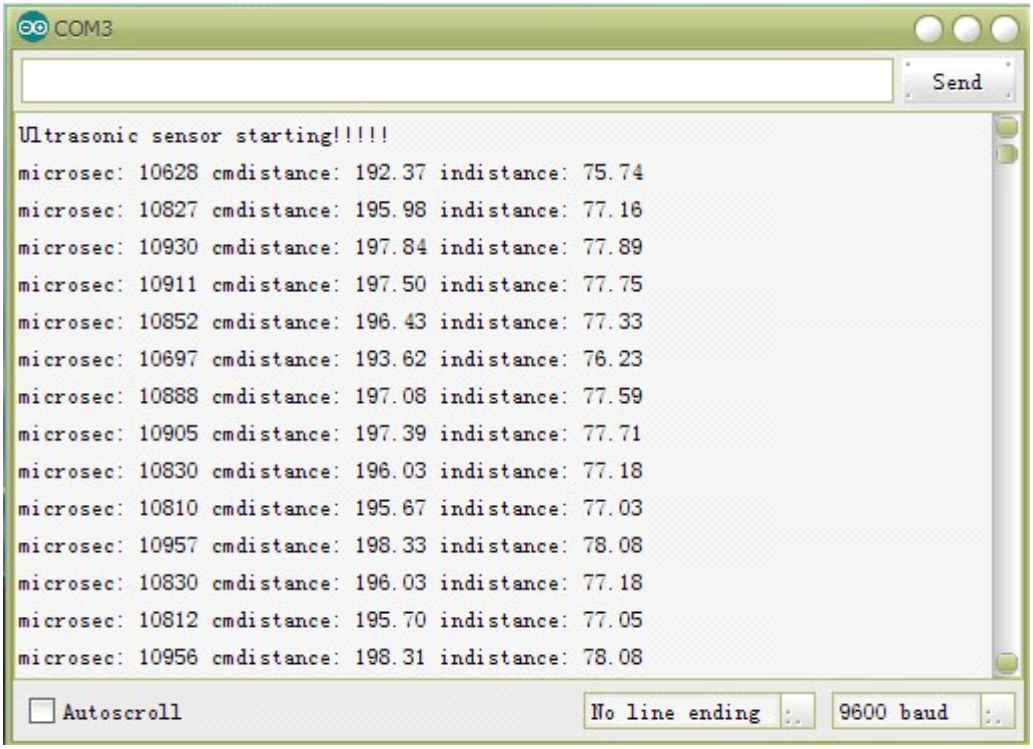


Chart 3、HC-SR04 testing results