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Complete Guide for Ultrasonic Sensor HC-**SR04**

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This post is all about the Ultrasonic Sensor HC – SR04. I'll explain how it works, show some features and share an Arduino Project example to help you with your projects.

Description

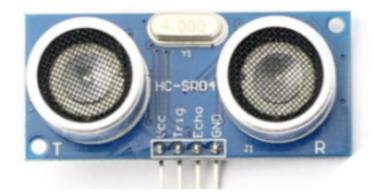
The HC-SR04 ultrasonic sensor uses sonar to determine distance to an object like bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. From 2cm to 400 cm or 1" to 13 feet. It operation is not affected by sunlight or black material like Sharp rangefinders are (although acoustically soft materials like cloth can be difficult to detect). It comes complete with ultrasonic transmitter and receiver module.

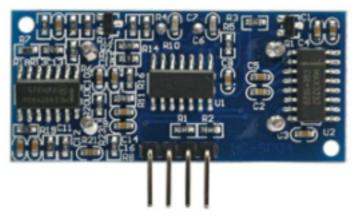
Features

- » Power Supply :+5V DC
- » Quiescent Current : <2mA
- » Working Current: 15mA
- » Effectual Angle: <15°</p>
- » Ranging Distance: 2cm 400 cm/1" 13ft
- » Resolution: 0.3 cm
- » Measuring Angle: 30 degree

- » Trigger Input Pulse width: 10uS
- » Dimension: 45mm x 20mm x 15mm

Sensor





Pins

» VCC: +5VDC

» Trig : Trigger (INPUT)

» Echo: Echo (OUTPUT)

» GND: GND

Arduino with HC - SR04 Sensor

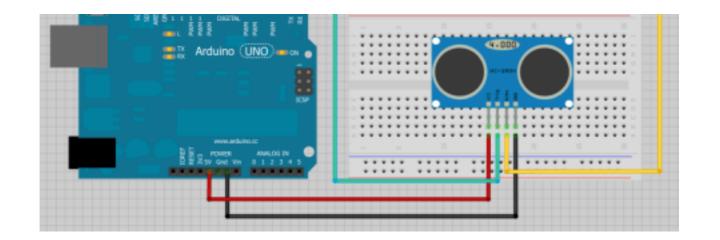
This sensor is really cool and popular among the Arduino Tinkerers. So I've decided to post a project example using this sensor. In this project the ultrasonic sensor read and write the distance in the serial monitor. It's really simple.

My goal is to help you understand how this sensor works and then you can use this example in your own projects.

Note: There's an Arduino library called NewPing that can make your life easier when using this sensor.

Schematics





Source code

```
/*
 * created by Rui Santos, http://randomnerdtutorials.com
 *
 * Complete Guide for Ultrasonic Sensor HC-SR04
 *
   Ultrasonic sensor Pins:
       VCC: +5VDC
        Trig : Trigger (INPUT) - Pin11
        Echo: Echo (OUTPUT) - Pin 12
        GND: GND
 * /
```

```
int trigPin = 11;  //Trig - green Jumper
int echoPin = 12;  //Echo - yellow Jumper
long duration, cm, inches;
void setup() {
  //Serial Port begin
 Serial.begin (9600);
 //Define inputs and outputs
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
}
void loop()
{
 // The sensor is triggered by a HIGH pulse of 10 or more
microseconds.
```

```
// Give a short LOW pulse beforehand to ensure a clean HIGH pulse:
digitalWrite(trigPin, LOW);
delayMicroseconds(5);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
// Read the signal from the sensor: a HIGH pulse whose
// duration is the time (in microseconds) from the sending
// of the ping to the reception of its echo off of an object.
pinMode(echoPin, INPUT);
duration = pulseIn(echoPin, HIGH);
// convert the time into a distance
cm = (duration/2) / 29.1;
inches = (duration/2) / 74;
Serial.print(inches);
Serial.print("in, ");
```

```
Serial.print(cm);
  Serial.print("cm");
  Serial.println();
  delay(250);
}
                              Projects/Ultrasonic Sensor HC-SR04.c view raw
```

Source code with NewPing

Below is an example using the NewPing library. Download the library here.

```
/*
 * Posted on http://randomnerdtutorials.com
 * created by http://playground.arduino.cc/Code/NewPing
* /
#include <NewPing.h>
```

```
#define TRIGGER_PIN 11
#define ECHO_PIN 12
#define MAX_DISTANCE 200
NewPing sonar(TRIGGER_PIN, ECHO_PIN, MAX_DISTANCE); // NewPing setup
of pins and maximum distance.
void setup() {
   Serial.begin(9600);
}
void loop() {
   delay(50);
   unsigned int uS = sonar.ping_cm();
   Serial.print(uS);
   Serial.println("cm");
                Projects/Ultrasonic Sensor HC-SR04 with NewPing.c view raw
```

Where to buy?

» Click here to get one.



NOTE: "If the HC-SR04 does not receive an echo then the output never goes low. Devanted and Parallax sensors time out after 36ms and I think 28ms respectively. If you use Pulsin as above then with no return echo the program will hang for 1 second which is the default timeout for Pulsin. You need to use the timeout parameter.

http://arduino.cc/en/Reference/PulseIn

The HC-SR04 barely works to 10 feet giving a total path length of 20 feet and a path time of about 20ms so set the timeout to something above that, say 25 or 30ms.

If you put a resistor, say 2k2 between E and T then only connect to T you can use the HC-SR04 from just one Arduino pin. Look up single pin operation of ultrasonic sensors.

Also if you are using a HC-SR04 with a PicAxe you need to up the clockspeed to at least 8MHz otherwise they don't see the start of the echo pulse so pulsin never starts. The HC-SR04 works fine with a BS2." by David Buckley

Thanks to my friend David to leave such an helpful comment!

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Thanks for reading, you can contact me by <u>leaving a comment</u>. If you like this post probably you might like my next ones, so please support me by subscribing my blog and my Facebook Page.

P.S. I've used this sensor in one of my previous project. Make sure you watch that

project now: Ultrasonic Sensor with LED's and buzzer

P.P.S. Click here to get one ultrasonic sensor

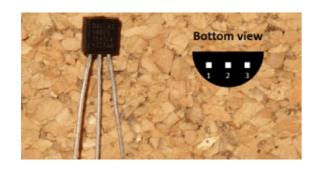


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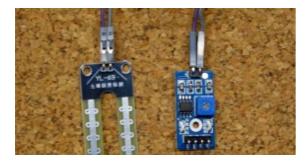
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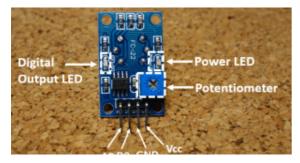
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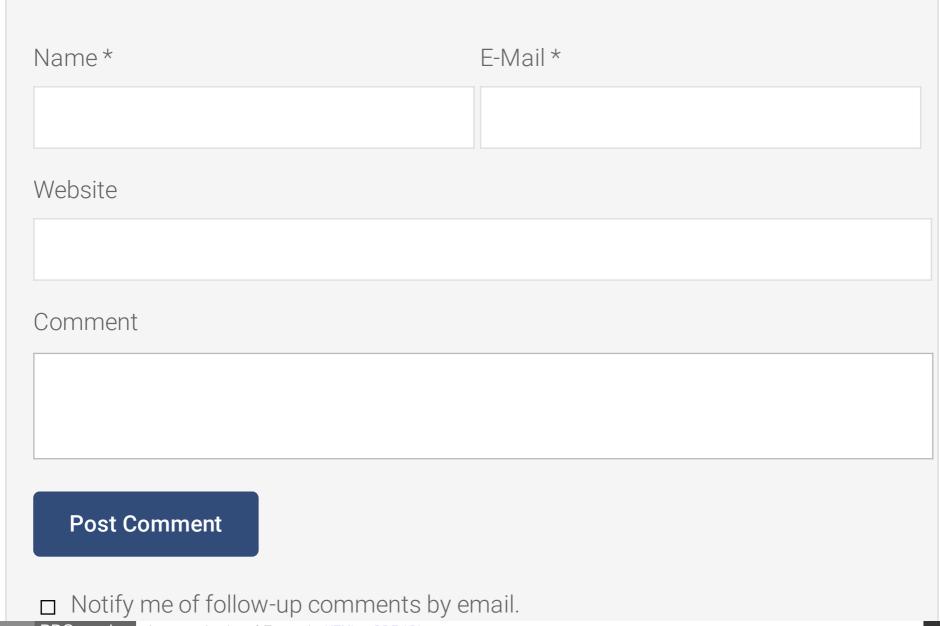
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Robert L. Pendergast says

November 17, 2013

Hi, Thanks for your interesting and informative projects.

→ Reply



Rui Santos says

November 17, 2013

Thanks Robert for your feedback.

I'm really glad you found this information useful! Thanks again, Rui Santos

→ Reply



Kshitij maurya says

September 19, 2015

Can u plzz tell me the procedure to make a drone at home

→ Reply



Rui Santos says



I intend to create a tutorial like that in the future, but right now I don't have any tutorial on that subject. thanks for asking!

→ Reply



Ganbat says

May 5, 2015

Hello, I want to that sensor in Drone, It is possible?

→ Reply



Abdul Irfan says

November 17, 2013

Hi, this is to me really helpful. Now I able to understand better how HC-SC04 work.. Hopefully you will keep on sharing this valuable knowledge.

Thank you very much ^_^

→ Reply



Rui Santos says

November 17, 2013

Thanks Abdul!

I'll try my best to create content every week.

See you in the next project, Rui Santos

→ Reply



imam says

November 18, 2013

make simple if use NewPing library.

the code like this.

#include

#define TRIGGER_PIN 12 #define ECHO_PIN 11 #define MAX_DISTANCE 200

NewPing sonar(TRIGGER_PIN, ECHO_PIN, MAX_DISTANCE); // NewPing setup of pins and maximum distance.

```
void setup() {
Serial.begin(9600);
void loop() {
delay(50);
unsigned int uS = sonar.ping_cm();
Serial.print(uS);
Serial.println("cm");
resource: http://playground.arduino.cc/Code/NewPing
→ Reply
```



Rui Santos says

November 18, 2013

yeah I've mentioned that library in the notes.

It's a really nice library specially when your working with robotics and using this sensor.

Thanks for sharing Iman!

→ Reply



Rui Santos says

November 25, 2013

I've added that example to my blog post! Thanks for sharing!

Have a nice day, Rui

→ Reply



raj says

December 14, 2013

hi rui, can we become friends, i am interested in robotics can u guide me, i m waiting......

→ Reply



Rui Santos says

December 15, 2013

Hi raj!

Sure go over to facebook and connect

with me.

https://www.facebook.com/RandomNe rdTutorials

All the best, Rui

→ Reply



Cathy says August 10, 2016

Thanks for this code! There is actually a small mistake in the code using the Ping library: pin 11 and 12 should be swapped to work with the wiring you are showing,

→ Reply



Rui Santos says

August 12, 2016

Thank you for letting me know! I'll fix that!

→ Reply



David says

November 18, 2013

Unfortunately you missed out the one thing that gives people trouble.

If the HC-SR04 does not receive an echo then the output never goes low.

Devantec and Parallax sensors time out after 36ms and I think 28ms respectively. If you use Pulsin as above then with no return echo the program will hang for 1 second which is the default timeout for Pulsin. You need to use the timeout parameter. http://arduino.cc/en/Reference/PulseIn

The HC-SR04 barely works to 10 feet giving a total path length of 20 feet and a path time of about 20ms so set the timeout to something above that, say 25 or 30ms.

If you put a resistor, say 2k2 between E and T then only connect to T you can use the HC-SR04 from just one Arduino pin. Look up single pin operation of ultrasonic sensors.

Also if you are using a HC-SR04 with a PicAxe you need to up the clockspeed to at least 8MHz otherwise they don't see the start of the echo pulse so pulsin never starts. The HC-SR04 works fine with a BS2.

→ Reply



Rui Santos says

November 19, 2013

Hi David,

I totally forgot that and some problems I wasn't aware of. Next weekend I'll try to update this post and add all those notes.

Thanks for such a detailed comment and for improving my content!

thanks again, Rui santos

→ Reply



Rui Santos says

November 25, 2013

Hi David,

I've added your comment to my blog post.

You really explained well some stuff that I wasn't aware of.

I hope you don't mind.

Thanks for your expertise.

Have a nice day, Rui

→ Reply



Andreas Dunker says

November 19, 2013

Hi,

very cool guide. Thanks for that! If you want to see a "real life example", please have look on my blog:

danimathblog.wordpress.com/tag/spider/

best regards **Andreas**

→ Reply



Rui Santos says

November 19, 2013

Hi Andreas, Thanks for taking the time to leave a comment and for sharing an awesome project! All the best, Rui Santos

→ Reply



Rodrigo says

November 24, 2013

Fala amigo, beleza?

Testando seu codigo esbarrei em um problema, quanto mais proximo um objeto do sensor, mais rapido o programa faz seu loop, achei isso muito estranho pois na ultima linha o "delayMicroseconds(300)" define basicamente que o loop sera dado a cada 300milisegundos (logico um pouco mais pq tem outros pequenos delays e tem o tempo de processamento), mas nao sei pq o loop fica mt acelerado, acho que ate a baixo de 300milisegundos.

Como o meu programa depende desse tempo, basicamente é um buzzer que almenta a frequencia de apitos com a proximidade de um objeto, nao funcionou com seu codigo. Porem usando a biblioteca NewPing, e usando como base o codigo exemplo que o Imam postou esse erro foi resolvido. Sabe me explicar o porque?



Rui Santos says

November 25, 2013

Olá Rodrigo, realmente é um erro um pouco estranho. Eu vou testar isso agora mesmo e tentar resolver.

assim que consiga resolver altero este post. Pode sempre usar a biblioteca NewPing. É mesmo muito boa e simplifica imenso o nosso trabalho.

Obrigado por notar esse erro.

Abraço, Rui

→ Reply



Rui Santos says

November 25, 2013

Olá Rodrigo, já resolvi o problema esqueci-me de fazer low ao trigPin no inicio do loop:

digitalWrite(trigPin, LOW); delayMicroseconds(5); digitalWrite(trigPin, HIGH); delayMicroseconds(10); digitalWrite(trigPin, LOW);

E isso estava a fazer com que o sensor se comporta-se de uma forma estranha. Já está resolvido. Obrigado!

Abraço, Rui





Paul says

December 22, 2013

is it possible that arduino uno can accomodate 4 ultrasonic sensors?

→ Reply



Rui Santos says

December 26, 2013

yes the Arduino can easily accomodate 4 ultrasonic

sensors.

Each sensor only requires 2 digitals pins. (4 ultrasonic sensors * 2 digital pins = 8) so you still have some pins left.

But you need to right a good code so they don't conflict with each other!

→ Reply



Gokul says

March 12, 2014

I glad of your work, but i want to know the internal working of the module. It consist of 3 ICs. I want to know the Working of them. Can you help me?

Reply



Distance sensors | Fabricio Ferreira says

March 26, 2014

[...] colleagues that were using Ultrasonic distance sensors, we borrowed it, did some tests (based on a tutorial) and found out it is way more precise and has a much wider range than the previous option. So, we [...]

→ Reply



Ali says

April 29, 2014

Hi . and thanks for this article .

i have a question about the sensor. after one trigger does it

continue to measure the distance, i mean if we want it to measure the distance for some time, do we need to send the trigger signal continuously?

→ Reply



Rui Santos says

May 3, 2014

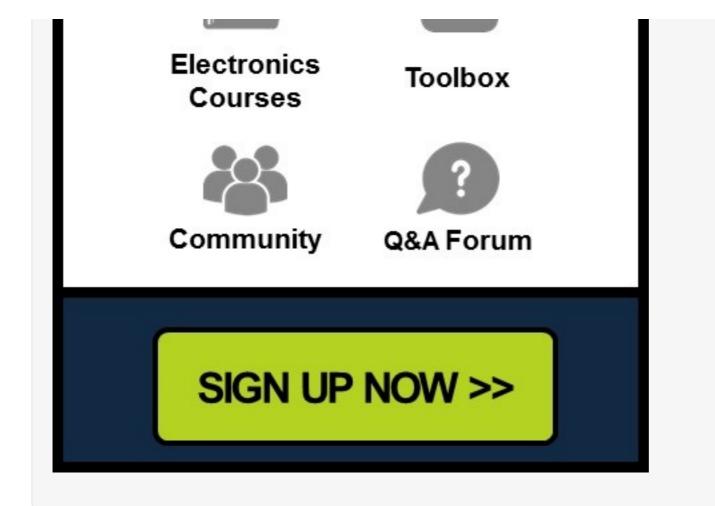
Hi Ali,

I'm not sure if this answer is exactly what you're asking... when you send the trigger after a few seconds you need to read that signal with the echo to see how much time it took the ultrasonic wave to touch the nearest object. So that means you need to keep repeating that process over and over again to measure the distance...

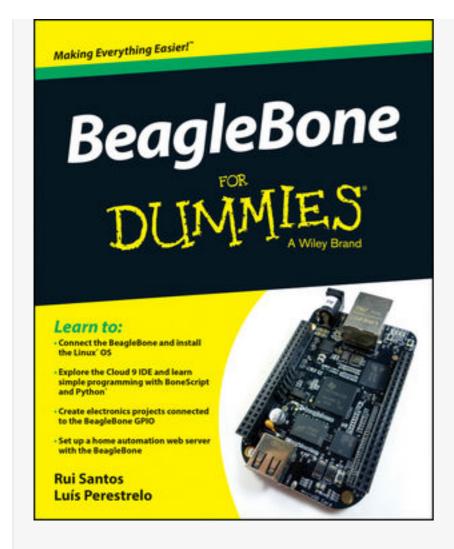
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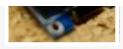
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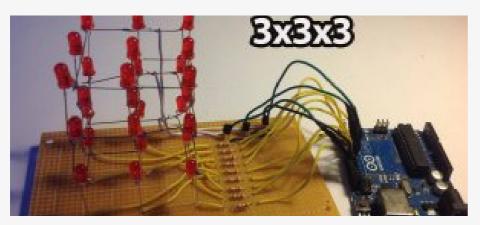
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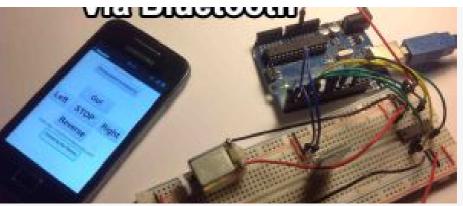
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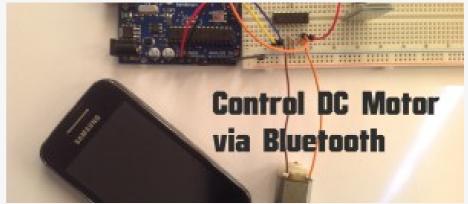
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