Ultrasonic Sensor

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ULTRASONIC SENSOR

➢It is essential to give eyes to your robocar for preventing crashes. Ultrasonic sensors, also known as transducers, have a similar working system as a radar or sonar by interpreting the echoes of radio or sound waves generated by the sensor.

➢Objectives: **detect obstacles** and the **distance to obstacles**.

Hcsr04 ultrasonic sensor

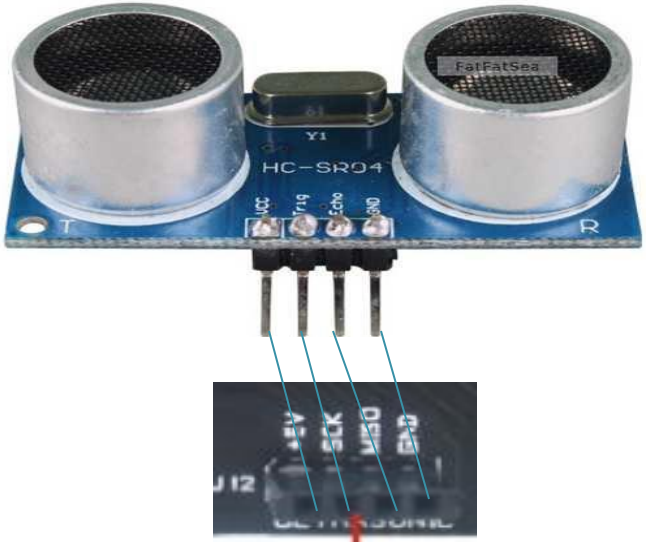
Pin description:

VCC – 5V, +ve of the power supply

TRIG – Trigger Pin

ECHO – Echo Pin

GND – -ve of the power supply



HC-SR04 Sensor Features

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 450cm
- Practical Measuring Distance: 2cm to 80cm
- Accuracy: 3mm
- Measuring angle covered: <15°
- Operating Current: <15mA
- Operating Frequency: 40Hz

The HC-SR04 module hosts the ultrasonic **transmitter**, the **receiver** and **control** circuit.
The HR-SR04 has four pins namely Vcc, Trigger, Echo, GND and they are explained in detail below:

1) **VCC**: 5V DC supply voltage is connected to this pin.

2) **Trigger**: The **trigger signal** for starting the transmission is given to this pin. The trigger signal must be a pulse with 10uS high time.
When the module receives a valid trigger signal, it issues 8 pulses of 40KHz ultrasonic sound from the transmitter.
The echo of this sound is picked by the receiver.

3) **Echo**: At this pin, the module outputs will be received as a waveform with high time proportional to the distance.

4) **GND**: Ground is connected to this pin.

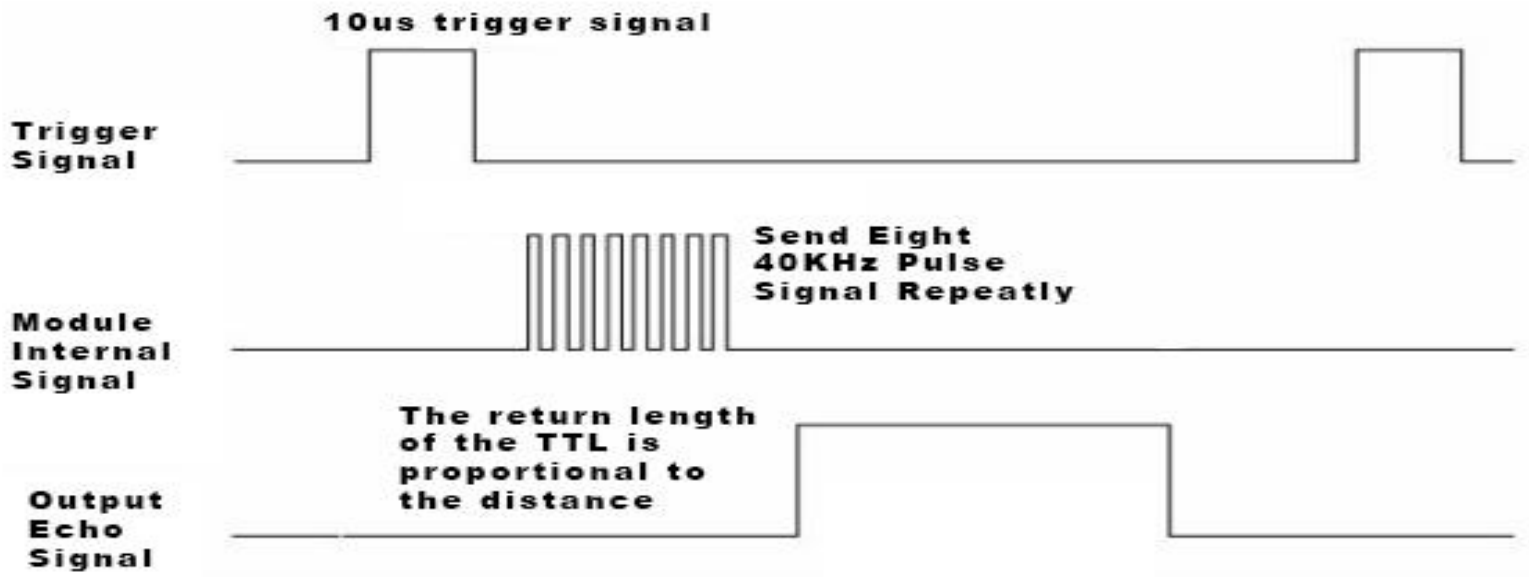
Working principle

- firstly, transmit at least 10us high level pulse to the Trig pin (module automatically sends eight square wave of 40Khz) .

- 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.

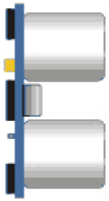
Working principle

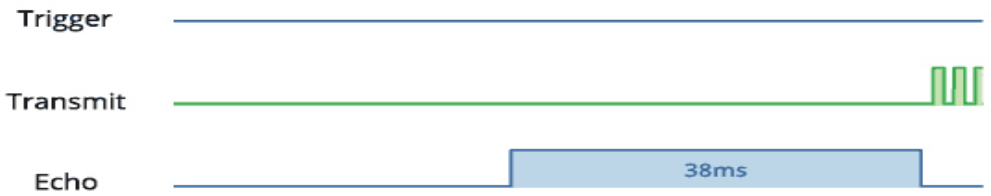


Case-1,

If those waveform pulses generated by Trig are not reflected back, then the Echo signal will timeout after 38 mS (38 milliseconds) and return low.

Thus, a 38 mS pulse indicates that there is no obstacle within the range of the sensor.



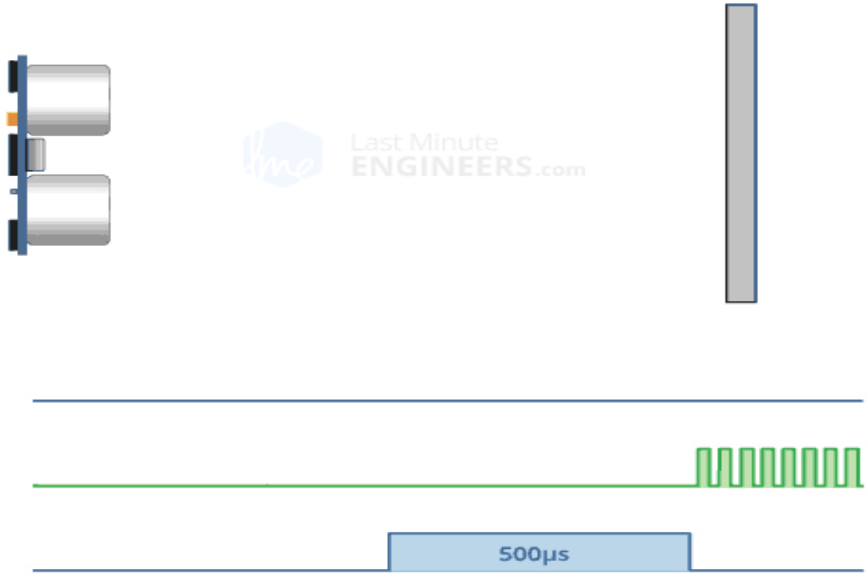


Ref: 1

Case2:

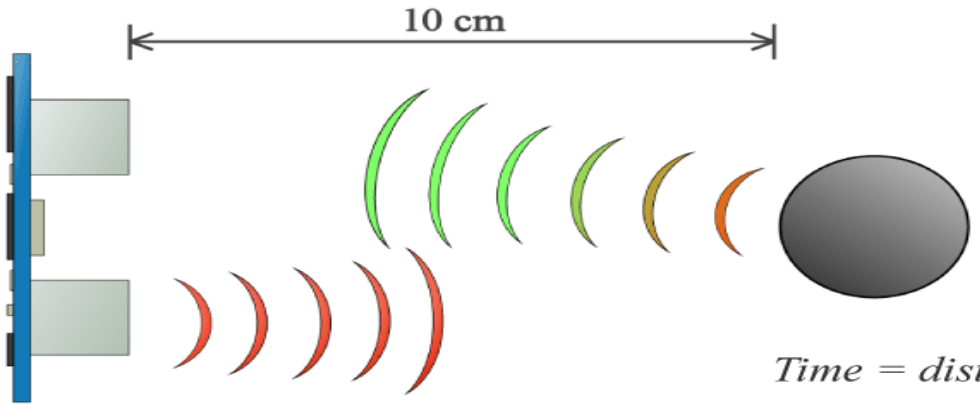
If those waveform pulses are reflected back, then the Echo pin goes low as soon as the signal is received.

This produces a pulse whose width varies between 150 µS to 25 mS, depending upon the time it took for the signal to be received.



Ref: 1

Calculate Distance to Obstacle



speed of sound:

$v = 340\ m/s$

$v = 0{,}034\ cm/\mu s$

Time = distance / speed:

$t = s / v = 10 / 0{,}034 = 294\ \mu s$

Distance:

$s = t \cdot 0{,}034 / 2$

Programming of Ultrasonic

Arduino Code – Using NewPing Library

```
// NewPing setup of pins and maximum distance.
#include <NewPing.h>
#define TRIGGER_PIN  13
#define ECHO_PIN     12
#define MAX_DISTANCE 200

NewPing sonar(TRIGGER_PIN, ECHO_PIN, MAX_DISTANCE);
float duration, distance;

void setup()
{
        Serial.begin(9600);
}

void loop()
{
        // Send ping, get distance in cm
        distance = sonar.ping_cm();

        // Send results to Serial Monitor
        Serial.print("Distance = ");

        if (distance >= 400 || distance <= 2)
        {
                Serial.println("Out of range");
        }
        else
```

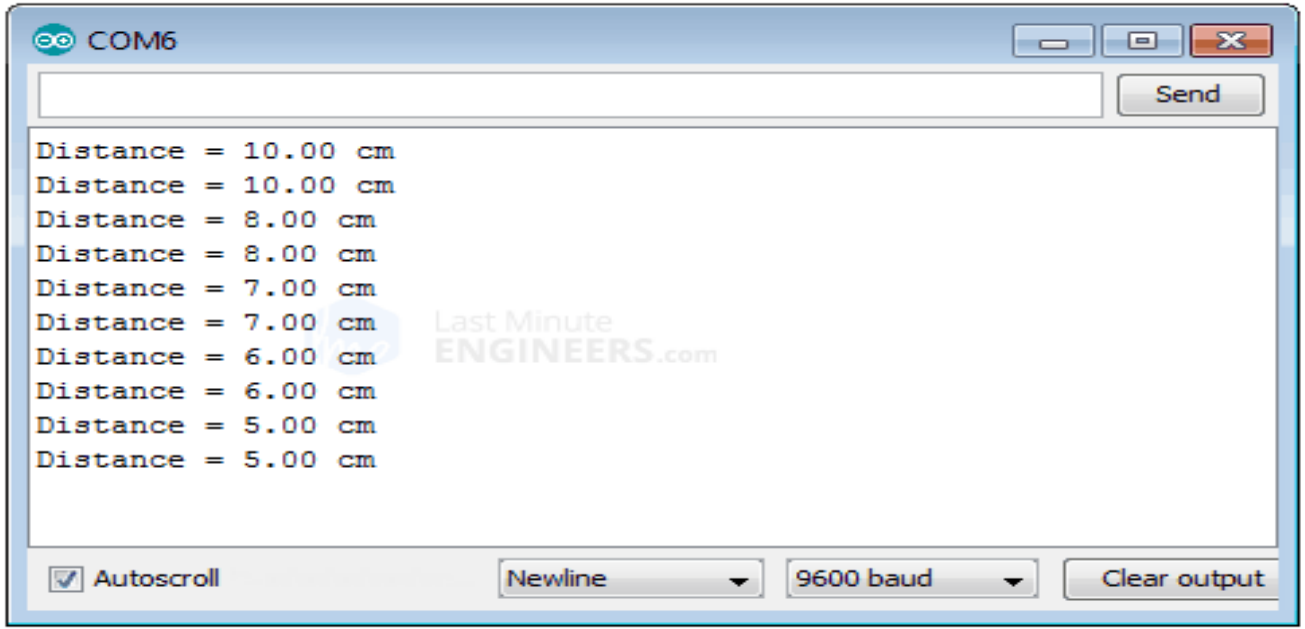
Contd..

```
        else
        {
                Serial.print(distance);
                Serial.println(" cm");
        }
        delay(500);

 if(distance<30)      //here we set the object range 15cm.
{
  stopp();           //Put your stopp buggy code here
}
else
{
  Normalline();      //Put your Normalline follow code buggy code here
}

}
```

Output in Serial Monitor



Buggy code: Ultrasonic Sensor Example (1/2)

```
const int trigPin = 13;
const int echoPin = 12;
long duration;
int distanceCm, distanceInch;

void setup() {
                pinMode(trigPin, OUTPUT);
                pinMode(echoPin, INPUT);
                Serial.begin(9600);
//  initialize digital pin motor as an output
      pinMode(5, OUTPUT);   // Right +ve)
      pinMode(6, OUTPUT);   // Right -ve
      pinMode(7, OUTPUT);   // Left -ve
      pinMode(8, OUTPUT);   // Left +ve
}
```

Ultrasonic Sensor Example (2/2)

```
void loop() {
                digitalWrite(trigPin, LOW);
                delayMicroseconds(2);
                digitalWrite(trigPin, HIGH);
                delayMicroseconds(10);
                digitalWrite(trigPin, LOW);
    duration = pulseIn(echoPin, HIGH);
    distanceCm= (duration*0.034)/2;
    distanceInch = (duration*0.0133)/2;
Serial.println(distanceCm);

if(distanceCm<30)     //here we set the object range 15cm.
{
  //Put your logical code here for robocar
}
```

Thanks

Reference:

1. https://lastminuteengineers.com/arduino-sr04-ultrasonic-sensor-tutorial/