

Menoufia University

Faculty of Electronic Engineering

Embedded Systems (Lab.)

(Ultrasonic Sensor)

DEPARTMENT:

↪ **Department of Engineering and Computer Science, 4rd year**

STUDENT NAME:

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↪ سكشن (1)
↪ مجموعه (8)

Overview of ultrasonic sensor HC-SR04:

The HC-SR04 ultrasonic sensor uses sonar to determine the distance to an object. This sensor reads from 2cm to 400cm (0.8inch to 157inch) with an accuracy of 0.3cm (0.1inches), which is good for most hobbyist projects. In addition, this particular module comes with ultrasonic transmitter and receiver modules.

Wire connecting direct as following:

- 5V Supply
- Trigger Pulse Input
- Echo Pulse Output
- 0V Ground



Timing diagram and how does it work:

The Timing diagram is shown below. You only need to supply a short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8-cycle burst of ultrasound at 40 kHz and raise its echo. The Echo is a distance object that is pulse width and the range in proportion. You can calculate the range through the time interval between sending trigger signal and receiving echo signal.

Formula: $\mu\text{S} / 58 = \text{centimeters}$ or $\mu\text{S} / 148 = \text{inch}$;

Or

Knowing the speed of sound in air (340 meters per second at room temperature), and considering that the sound wave travels to the object and back, the distance can be calculated using the formula:

Distance = (Time × Speed of Sound) / 2

Task #6 (ultrasonic sensor HC - SR04):

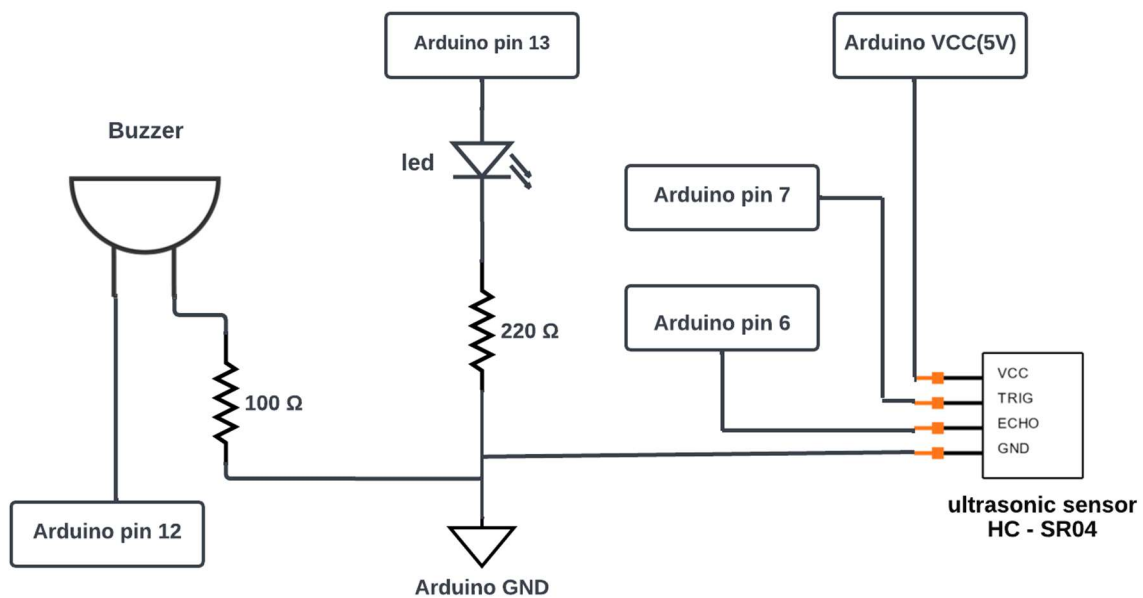
We will use an ultrasonic sensor of type HC - SR04 to determine the distance between an opponent and the sensor, and based on the distance, action will be taken.

- If the distance is greater than 3 meters, the LED is on
- If the distance is less than 3 meters, the LED will change and remain a blinking LED
- If the distance is less than 2 metres, the LED is blinking and the buzzer is working.

Required components for this lab:

- Breadboard
- Wires (male - male)
- 1 ultrasonic sensor HC - SR04.
- 1 buzzer.
- 1 resistor in range of 100Ω to $1K\Omega$.
- 1 led.
- 1 resistor in range of 220Ω to $1K\Omega$.

Circuit diagram:



Code:

```
#define trig 7
#define echo 6
#define led 13
#define buzzer 12
long duration =0.0 ;
int distance = 0 ;

void setup() {
  pinMode(trig, OUTPUT);
  pinMode(echo, INPUT);
  pinMode(led, OUTPUT);
  pinMode(buzzer, OUTPUT);
  Serial.begin(9600);
}

void loop() {
  digitalWrite(trig, LOW);
  delayMicroseconds(2);
  digitalWrite(trig, HIGH);
  delayMicroseconds(10);
  digitalWrite(trig, LOW);

  duration = pulseIn(echo, HIGH);
  distance= duration / 58;
  //distance= duration*0.034/2;
  if (distance > 300) {
    digitalWrite(led, HIGH);
    noTone(buzzer);    // Stop sound...
  } else if (distance > 200) {
    noTone(buzzer);    // Stop sound...
    digitalWrite(led, HIGH);
    delay(500);
    digitalWrite(led, LOW);
    delay(500);
  } else {
    tone(buzzer, 100 ,1000); // Send 100Hz sound signal...
    digitalWrite(led, HIGH);
    delay(300);
    digitalWrite(led, LOW);
    delay(300);
  }
  Serial.print("Distance in CM: ");
  Serial.println(distance);
}
```

Simulation:

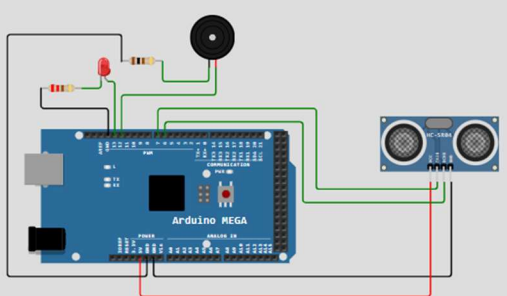
My Simulation to run code: <https://wokwi.com/projects/396978152238596097>

WOKWI SAVE SHARE ultrasonic sensor by mego Docs

sketch.ino diagram.json Library Manager

```
1 #define trig 7
2 #define echo 6
3 #define led 13
4 #define buzzer 12
5
6 long duration = 0.0 ;
7 int distance = 0 ;
8
9 void setup() {
10   pinMode(trig, OUTPUT);
11   pinMode(echo, INPUT);
12   pinMode(led, OUTPUT);
13   pinMode(buzzer, OUTPUT);
14   Serial.begin(9600);
15 }
16
17
18 void loop() {
19   digitalWrite(trig, LOW);
20   delayMicroseconds(2);
21   digitalWrite(trig, HIGH);
22   delayMicroseconds(10);
23   digitalWrite(trig, LOW);
24
25   long duration = pulseIn(echo, HIGH);
26
27 }
```

Simulation

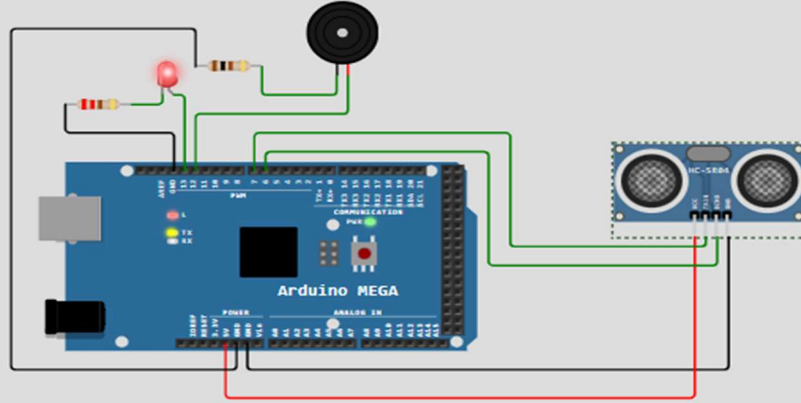


Simulation

00:29.052 8%

Editing Ultrasonic Distance Sensor

Distance: 400cm



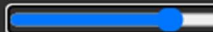
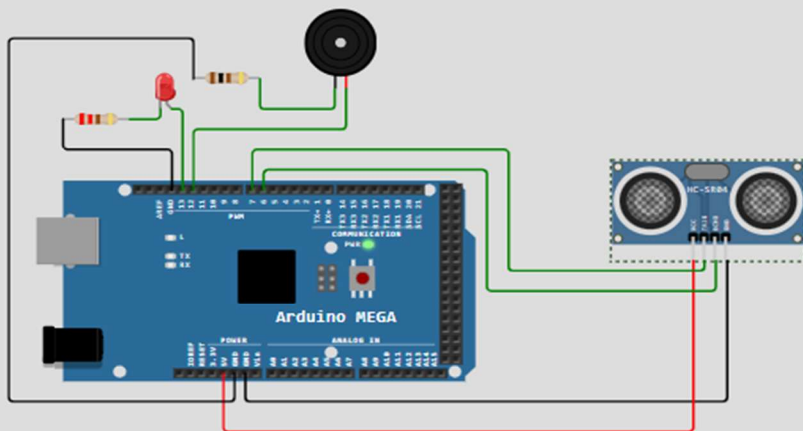
Distance in CM: 400
Distance in CM: 400
Distance in CM: 400

Simulation



01:22.290 92%

Editing Ultrasonic Distance Sensor

Distance:  300cm

Distance in CM: 300

Distance in CM: 299

Distance in CM: 300

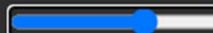
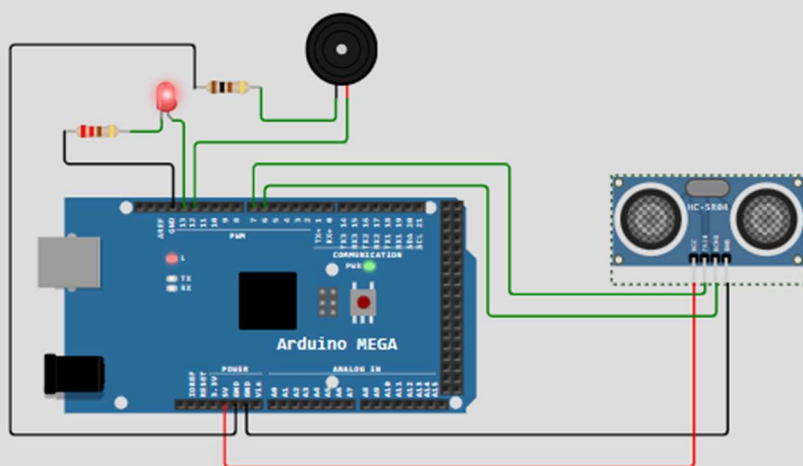


Simulation



01:55.403 95%

Editing Ultrasonic Distance Sensor

Distance:  245cm

Distance in CM: 244

Distance in CM: 245

Distance in CM: 245

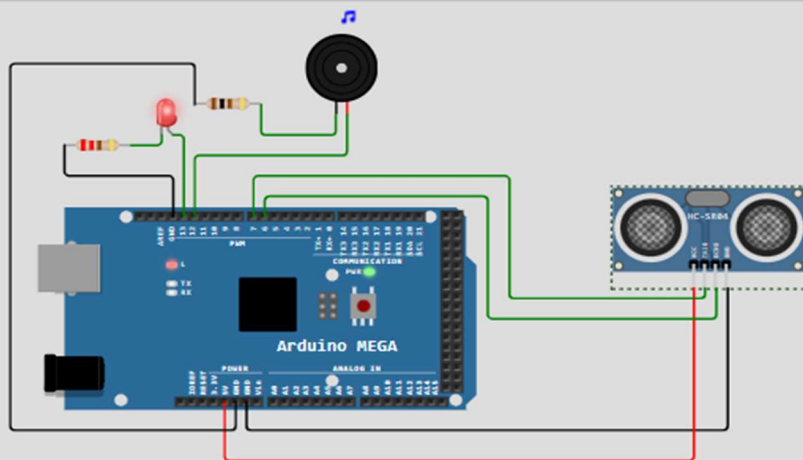


Simulation



02:35.235 71%

Editing Ultrasonic Distance Sensor

Distance:  200cm

Distance in CM: 199

Distance in CM: 199

Distance in CM: 199

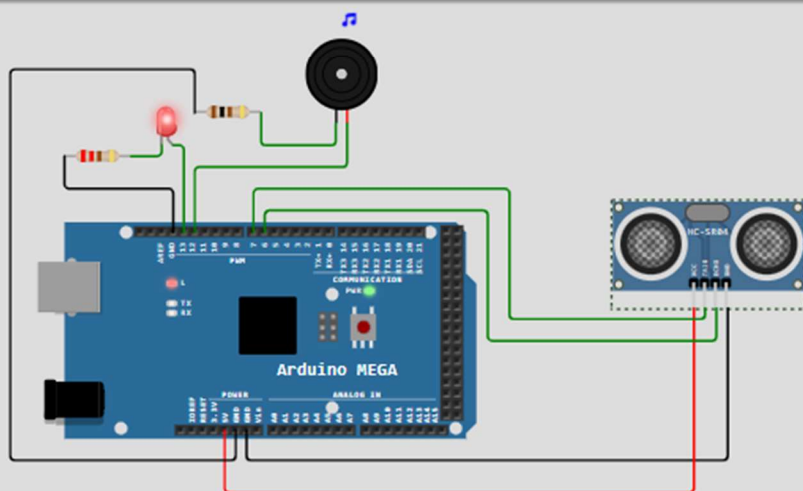


Simulation



03:03.853 100%

Editing Ultrasonic Distance Sensor

Distance:  159cm

Distance in CM: 158

Distance in CM: 158

Distance in CM: 158

