

# Practical 5: Programs using Ultrasonic Sensors

**Aim:**

To study the working of Ultrasonic sensors using Arduino

**Simulation Environment:** TinkerCAD (Free online simulator)

**Components:** Arduino UNO, HC-SR04 sensor

**Theory:**

The HC-SR04 is an inexpensive and widely used ultrasonic distance sensor module. It is often employed in various projects and applications, such as robotics, automation, and DIY electronics. The name "HC-SR04" is derived from the model or product code of this specific sensor module.

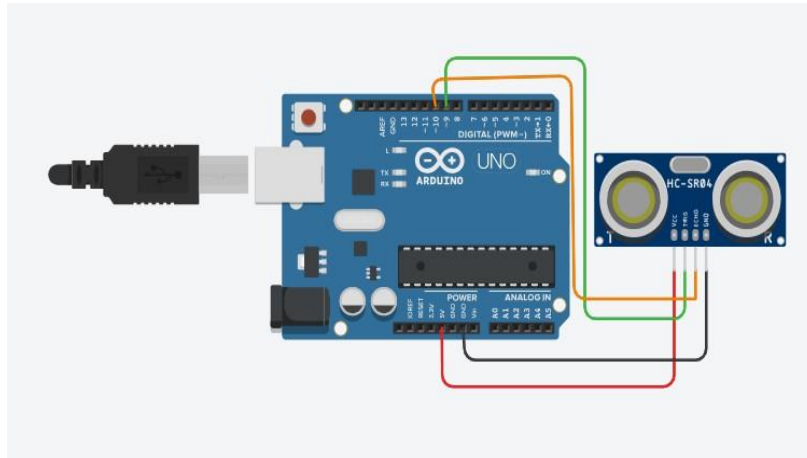
The HC-SR04 sensor utilizes ultrasonic sound waves to determine the distance between the sensor and an object. Here's how it works:

- a. **Ultrasonic Emission:** The sensor emits a high-frequency sound wave, usually in the ultrasonic range (around 40 kHz). This sound wave is inaudible to humans.
- b. **Sound Wave Reflection:** The emitted sound wave travels through the air until it encounters an object. When it hits the object, it bounces back towards the sensor.
- c. **Receiving the Echo:** The sensor has a built-in receiver to detect the reflected sound wave, also known as an echo.
- d. **Calculating Distance:** By measuring the time it takes for the sound wave to travel to the object and back (i.e., the time it takes for the echo to return), the HC-SR04 can calculate the distance to the object using the speed of sound in the air (approximately 343 meters per second or 1125 feet per second at room temperature).
- e. **Output:** The sensor provides the calculated distance as an output in the form of a digital pulse or duration in microseconds that can be easily converted to distance in centimeters or inches.

This distance measuring technique is non-contact, making it suitable for a wide range of applications, including obstacle avoidance in robots, measuring liquid levels, and more. The HC-SR04 sensor is popular among hobbyists and electronics enthusiasts due to its affordability, ease of use, and compatibility with microcontrollers like Arduino and Raspberry Pi.

It typically has four pins: VCC (power supply), GND (ground), Trig (trigger), and Echo (echo signal output).

### Circuit Diagram:



### Pin Connections:

Arduino	HC-SR04 Sensor
5V	V <sub>CC</sub>
GND	GND
Pin 9	TRIG
Pin 10	ECHO

### Code:

```
// Define the pins for the ultrasonic sensor
const int trigPin = 9; // Arduino digital pin for the trigger
const int echoPin = 10; // Arduino digital pin for the echo
// Variables to store the duration and distance
long duration;
int distance;
void setup() {
```

```

// Initialize serial communication for debugging
Serial.begin(9600);
// Define the trigger and echo pins as OUTPUT and INPUT
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
}
void loop() {
// Trigger a pulse to the sensor
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
// Measure the duration of the pulse from the echo
duration = pulseIn(echoPin, HIGH);
// Calculate the distance based on the speed of sound
distance = duration * 0.034 / 2; // Divide by 2 because the sound travels to the object and
back
// Print the distance to the serial monitor
Serial.print("Distance: ");
Serial.print(distance);
Serial.println(" cm");
// Add a delay between measurements
delay(1000); // 1 second
}

```