

EIE3105: Ultrasonic Sensor

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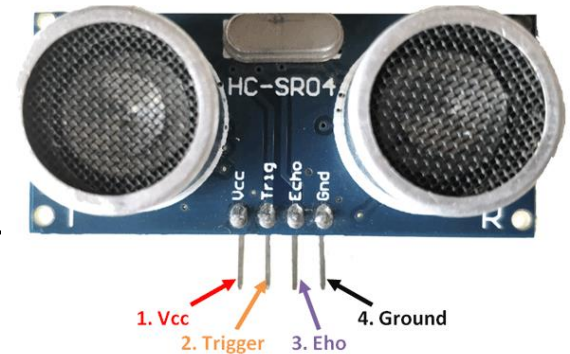
Ultrasonic Sensor

- HC-SR04 (Outlook)



Ultrasonic Sensor

- Pin Description



Pin No.	Pin Name	Description
1	Vcc	The Vcc pin powers the sensor, typically with +5V
2	Trigger	Trigger pin is an Input pin. This pin has to be kept high for 10 μ s to initialize measurement by sending US (Ultrasonic Sensor) wave.
3	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4	Ground	This pin is connected to the Ground of the system.

Ultrasonic Sensor

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

Ultrasonic Sensor

- Working principle
 - This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required.
 - The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver.
 - The sensor works with the simple high school formula that

$$\text{Distance} = \text{Speed} \times \text{Time}$$

Ultrasonic Sensor

- The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module.



Ultrasonic Sensor

- To calculate the distance using the formulae, we should know the speed and time.
- Since we are using the Ultrasonic wave, we know the universal speed of US wave at room conditions which is 330 m/s.
- The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken.

Ultrasonic Sensor

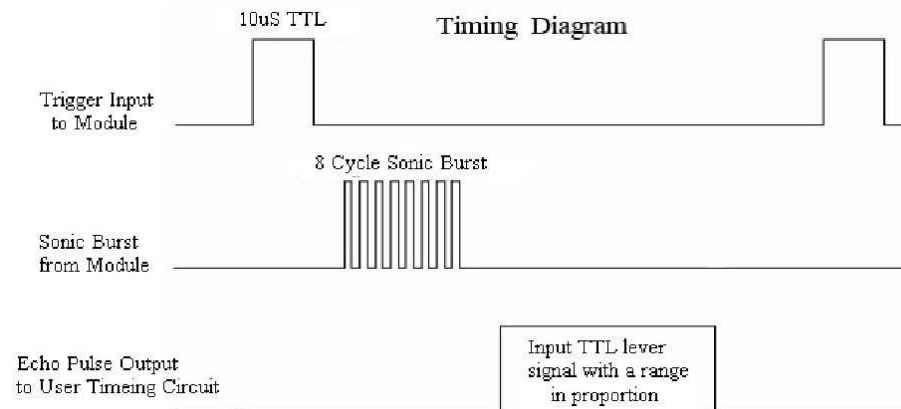
- Now simply calculate the distance using a microcontroller.
- Power the Sensor using a regulated +5V through the Vcc and Ground pins of the sensor.
- The current consumed by the sensor is less than 15 mA and hence can be directly powered by the on board 5V pins (If available).
- The Trigger and the Echo pins are both I/O pins and hence they can be connected to I/O pins of the microcontroller.

Ultrasonic Sensor

- To start the measurement, the trigger pin has to be made high for 10 μ s and then turned off.
- This action will trigger an ultrasonic wave at frequency of 40 Hz from the transmitter and the receiver will wait for the wave to return.
- Once the wave is returned after it getting reflected by any object, the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor.

Ultrasonic Sensor

- The amount of time duration that the Echo pin stays high is measured by the MCU as it gives the information about the time taken for the wave to return back to the Sensor.
- We can use Input Capture to measure the time duration and hence calculate the distance travelled by the US wave.



Reference Readings

- <https://components101.com/sensors/ultrasonic-sensor-working-pinout-datasheet>

End