DHA SUFFA UNIVERSITY
MEASUREMENT & INSTRUMENTATION LAB
ME-3103L
Lab # 04
Ultrasonic Sensor

Name: _____ **Reg. #** M E - __ __ __ __ __ __

Class: _____ **Section:** _____ **Max Marks:** 20

INSTRUCTIONS

I.   Submit all the lab tasks and post lab tasks printed on A4 paper with **question**, **code**, **picture** and **schematic** of circuit, stapled together with lab manual and filled rubrics.
II. Explain the code by adding **comments**. Marks will be **deducted** for programs without explanation.
III. The due date of submission is exactly **7 days after performing the lab.**
IV. Reports handed **after the deadline** will not be considered.
V.   It is always good to mention your name, ID and page # on each page.

OBJECTIVE

To understand the working of Ultrasonic Sensor and perform the measurement on serial monitor using Arduino.

EQUIPMENT

- 1 x Arduino Uno (w/ USB cable)
- 1 x Ultrasonic Sensor
- 1 x Breadboard
- Jumper Wires

COMMANDS

- **#define**
  syntax: #define constantName value
  example: #define ledPin 3

- **Pulse In**
  example:
  pulseIn(pin, value);

- **Microsecond Delay**
  example:
  delayMicroseconds(us);

## SCHEMATIC AND WORKING OF THE SENSOR

Ultrasonic Sensor HC-SR04 is a sensor that can measure distance. It emits an ultrasound at 40 000 Hz (40kHz) which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance.

The configuration pin of HC-SR04 is VCC (1), TRIG (2), ECHO (3), and GND (4). The supply voltage of VCC is +5V and you can attach TRIG and ECHO pin to any Digital I/O in your Arduino Board.
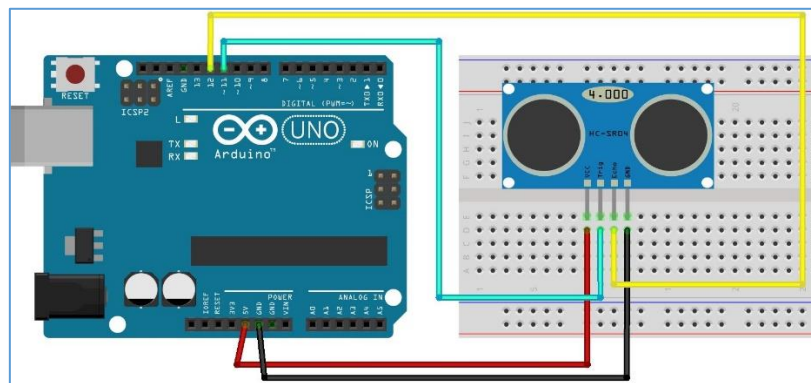

In order to generate the ultrasound we need to set the Trigger Pin on a High State for 10 µs. That will send out an 8 cycle sonic burst which will travel at the speed sound and it will be received in the Echo Pin. The Echo Pin will output the time in microseconds the sound wave travelled.
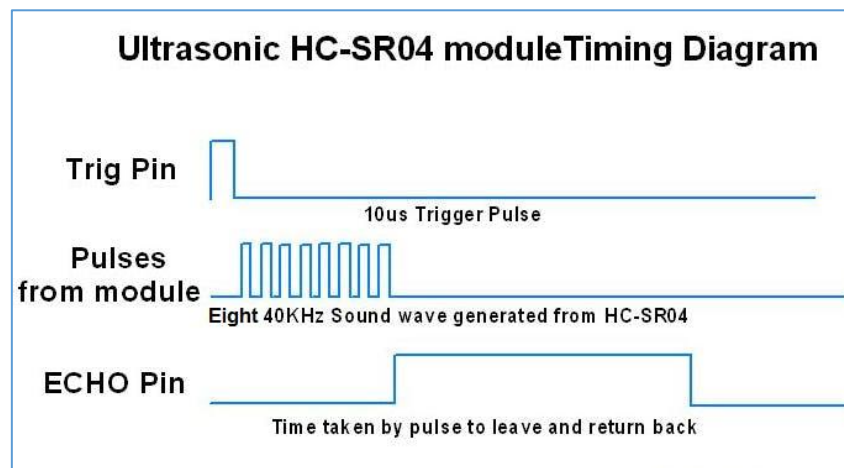
The pulseIn() function has 2 parameters, the first one is the name of the echo pin and for the second one you can write either HIGH or LOW. In this case, HIGH means that the pulseIn() function will wait for the pin to go HIGH caused by the bounced sound wave and it will start timing, then it will wait for the pin to go LOW when the sound wave will end which will stop the timing. At the end the function will return the length of the pulse in microseconds.

For example, if the object is 20 cm away from the sensor, and the speed of the sound is 340 m/s or 0.034 cm/µs the sound wave will need to travel about 588 microseconds. But what you will get from the Echo pin will be double that number because the sound wave needs to travel forward and bounce backward. So in order to get the distance in cm we need to multiply the received travel time value from the echo pin by 0.034 and divide it by 2.

20 CM
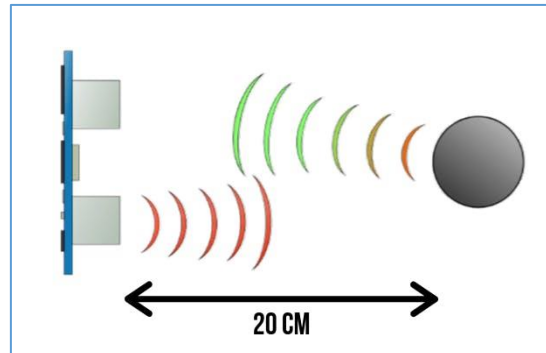
LAB TASKS

Q1) Develop the program to read the data from ultrasonic sensor and display it on serial monitor. Capture it using snipping tool and add this image in your lab report.

Q2) Develop a digital measuring device which displays data in cm and m based on the time you calculated in question 1. Use basic velocity formula with consistent units. Capture it using snipping tool and add this image in your lab report.

Q3) Develop a vehicle reverse car parking device that will assist the driver while reversing the car. (Capture the results using snipping tool and add in your lab report.) The device must consist of an ultrasonic sensor which would sense the data between rear bumper and an obstacle. Write the program such that

- if the distance is between 30 and 45 cm, it prints "SLOW!!",
- if the distance is between 15 and 30 cm, it prints "WATCH OUT!!",
- if the distance is between 0 and 15 cm, it prints "STOP!!".

POST LAB TASKS

Q1) Write down the model number of your sensor and list the pins with their usage.

Q2) What is the speed and frequency of sound waves emitted by Sonar sensor?

Q3) Why time is divided by 2 in the distance formula?

Q4) What will be the return value of pulseIn() if no wave is detected?

Q5) Suggest any process that can made using Arduino and Ultrasonic Sensor which can be used in any industry for automation.