Arduino Lesson ( )

Use of Ultrasonic Sensor & "if … else" structure (coding)

Name: _____ ( ) Class: _____ Date: _____

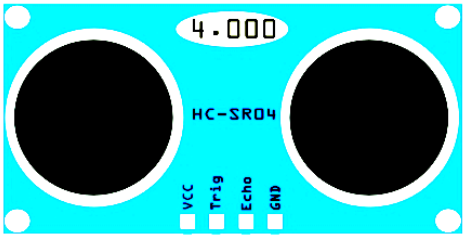
Objectives: At the end of this lesson, you would be able to

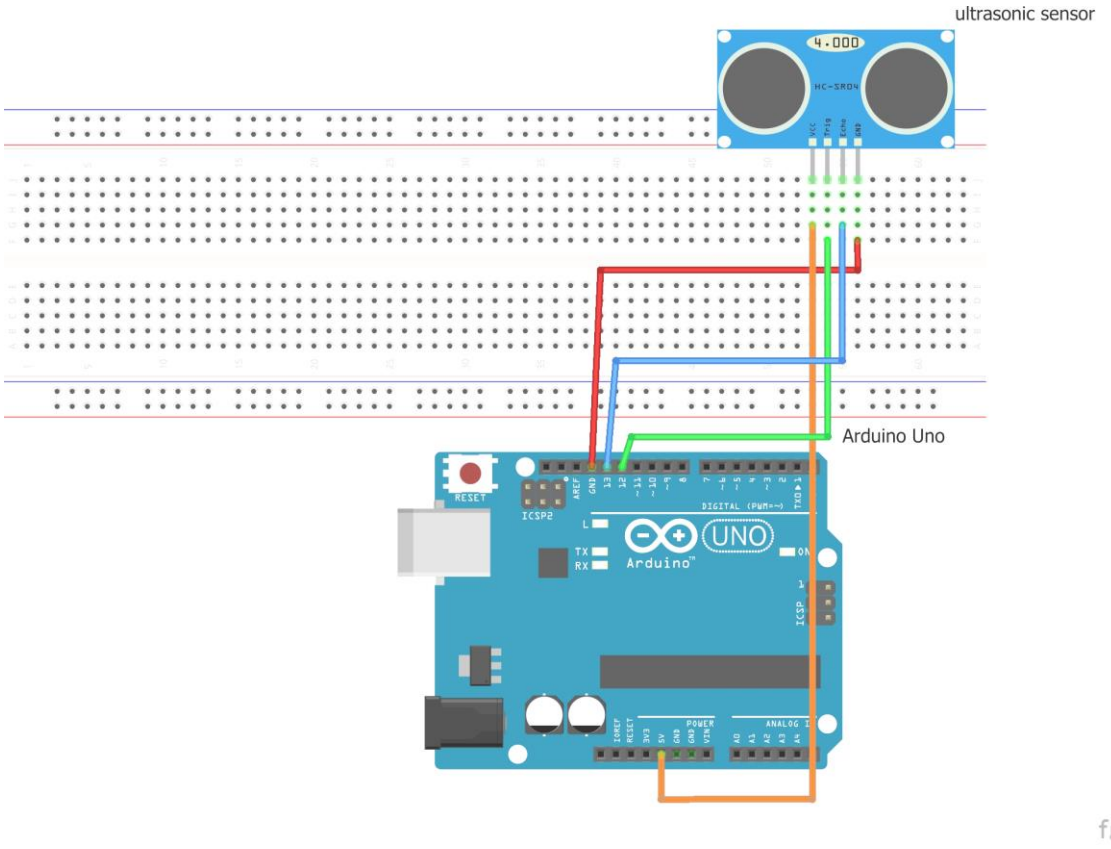
1. Apply basic circuitry to the Arduino microcontroller and other basic hardware
2. Write sketches for ultrasonic sensor circuits
3. Control a blinking LED with "if … else" structure in your sketch to indicate the range of distances detected by the ultrasonic sensor

Apparatus:

- 01 Arduino UNO microcontroller
- 01 USB cable
- 01 LED
- 01 breadboard
- 06 jumper wires
- 01 resistors (1 kΩ)

New item: 01 HC-SR-4 ultrasonic sensor





Above diagram created with fritzing.org software

Assignment 1: Set up and use an ultrasonic sensor

Connect the circuit shown in the diagram on the previous page.

Write a sketch to set up a ultrasonic sensor which provides continuous readings of the distance detected using ultrasonic echoes.

1. Connect ultrasonic sensor to microcontroller:

- GND to GND
- VCC to 5 V
- Trigger pin to digital pin 12
- Echo pin to digital pin 13

2. Write a sketch to include:
- Initialize digital pin 12 as the trigger pin (output) to activate a 40 kHz sound
- Initialize digital pin 13 as the echo pin (input) to detect the returning echo

The ultrasonic sensor produces 8 sonic bursts and detects the returning echo.

The time duration t is measured to calculate distance between the sensor and the obstacle.

Show the calculation used.

t: time duration (in micro seconds) – 1 s = 10^{-6} s

d: distance from sensor to obstacle

distance = speed x time

2d = speed of ultrasound x t

d **=** **(t x 0.034) / 2** **(cm)**

Inside the Sketch: distanceCm = (duration*0.034)/2;

3. Verify and upload the sketch.

4. Click on the "**serial monitor**" icon (top right corner) to open another window.

- Select "9600 baud" (bottom right corner menu).
- View changes in the distance readings by moving the sensor towards/away from a flat hard surface.

Assignment 2: Control an LED with "if … else" structure in your sketch

1. To use a blinking LED to indicate the range of distances detected by the ultrasonic sensor, add an LED in series with a 1 kΩ resistor to the breadboard.

2. Connect this LED circuit to digital pin 10 on the Arduino board in the same way as a simple LED circuit.

3. Modify the original sketch to control the blinking of the LED based on the distance detected by the ultrasonic sensor using "if … else" structure.

- **if** distanceCm >= 100 cm, the LED will blink at 1 s intervals.
- **else** when distanceCm < 100 cm, the LED will blink at 0.5 s intervals (blink faster).
- See sample sketch modifications

Assignment 3: Control an LED with "if … else" structure in your sketch

1. Modify the original sketch to control the blinking of the LED based on the distance detected by the ultrasonic sensor using "if … else" structure.

- **if** distanceCm >= 100 cm, the LED will blink at 1 s intervals.
- **else if** distanceCm >= 20 cm, the LED will blink at 0.5 s intervals (blink faster).
- **else** when distanceCm < 20 cm, the LED will blink at 0.1 s intervals (blink very fast).

Note: A buzzer can be added or used to replace the LED with a beeping sound.

Questions? Alternatives? Uses?

Assignment 1: Sample sketch

```
const int TRIG_PIN = 12;
const int ECHO_PIN = 13;

void setup() {
  // put your setup code here, to run once:
Serial.begin(9600);
pinMode(TRIG_PIN, OUTPUT);    //trigger pin activates the 40 kHz sound (very high frequency)
pinMode(ECHO_PIN, INPUT);     //echo pin detects the returning echo
}

void loop() {
  // put your main code here, to run repeatedly:
long duration, distanceCm;
digitalWrite(TRIG_PIN, LOW);
delayMicroseconds(2);
digitalWrite(TRIG_PIN, HIGH);
delayMicroseconds(10);
digitalWrite(TRIG_PIN, LOW);
duration = pulseIn(ECHO_PIN,HIGH);   //duration of pulse from High to Low, pulseIn returns
                                      a value in microseconds
distanceCm = (duration*0.034)/2;      //formula to find a distance in cm
Serial.print(distanceCm);
Serial.print(" cm");
Serial.println();
delay(500);
}
```

Assignment 2: Sample sketch modifications

Add to

void setup() {

```
// initialize digital pin 10 as an output.
  pinMode(10, OUTPUT);
```

Add to

void loop() {

```
// using if ... else structure
if (distanceCm >= 100){
  digitalWrite(10, HIGH);          // turn the LED on (HIGH is the voltage level)
  delay(1000);                     // wait for a second
  digitalWrite(10, LOW);           // turn the LED off by making the voltage LOW
  delay(1000);                     // wait for a second (or 1000 ms)
}
else {                             // too close
  digitalWrite(10, HIGH);          // turn the LED on (HIGH is the voltage level)
  delay(500);                      // wait for 0.5 second
  digitalWrite(10, LOW);           // turn the LED off by making the voltage LOW
  delay(500);                      // wait for 0.5 second
}
```