Embedded System I

Lecture 5

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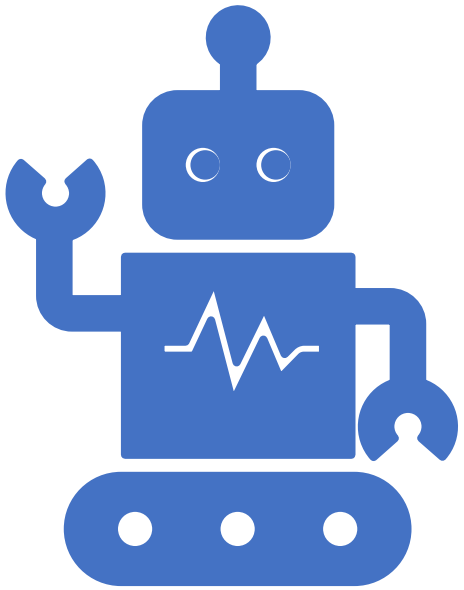
Outline

- Sensors
- Types of Sensors
- Sensors Classifications
- Ultrasonic Sensor
- How Does An Ultrasonic Sensor Work?
- Example

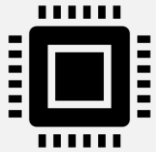


Sensors

Embedded devices in general, have sets of Sensors. Sensors are the inputs to your device. So, Sensors are how the device perceives the outside world. It allows the microcontroller to receive information from the outside world, about the environment.

Sensors

For example: suppose you wanted to detect the humidity. Maybe you want to do something if it's very humid out. So, you receive the humidity, and you have some codes that say if humidity is above whatever the thresholds, then do some operations.



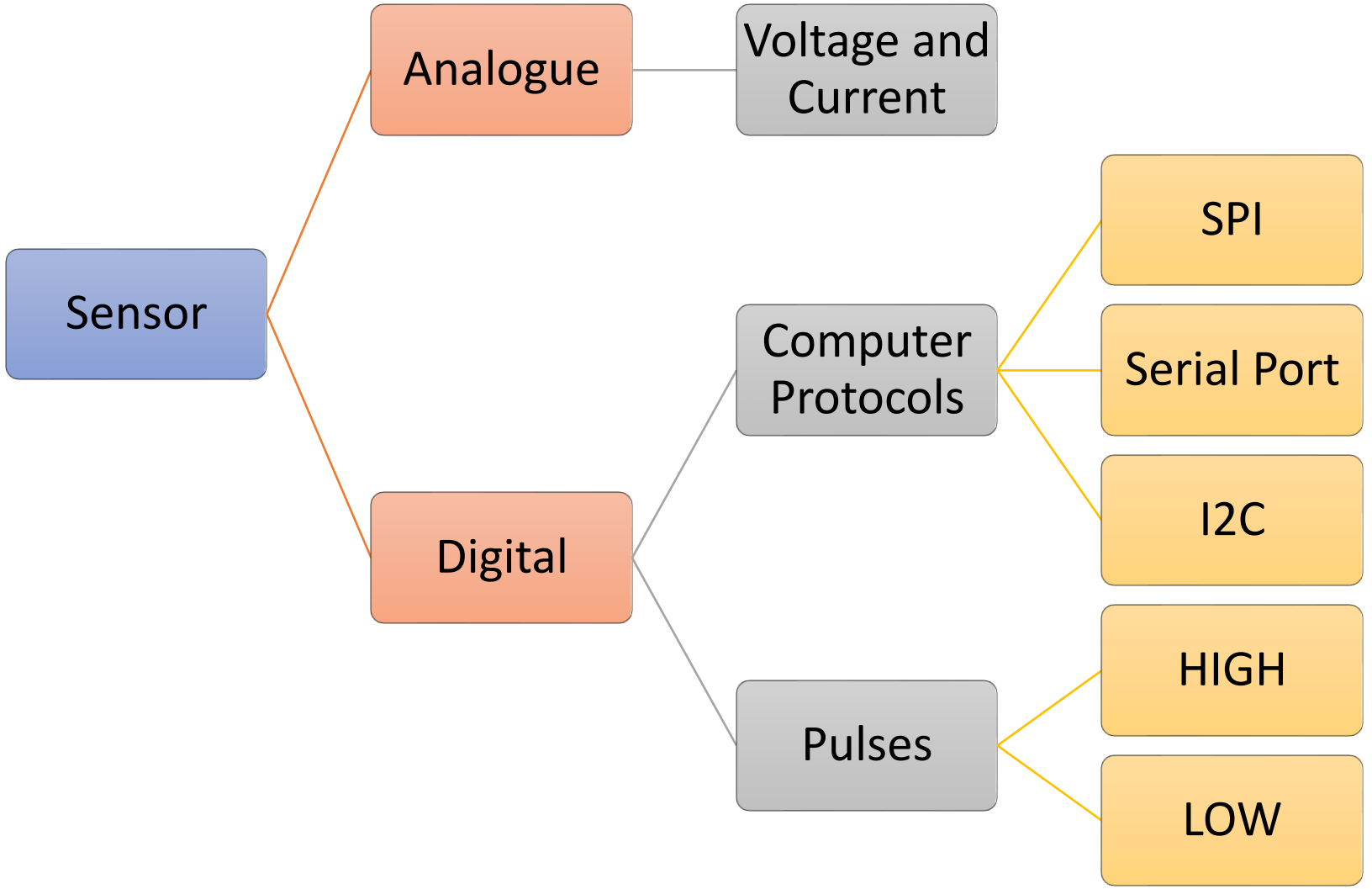
There are lots of Sensors. But somehow, how do we know the microcontroller has received data from the Sensors?

So, when it comes to sensing the environment, eventually all this data must come into the microcontroller, and then the code has to interpret it.

Types of Sensors

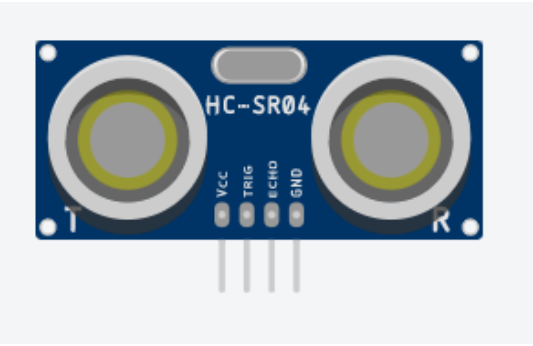
- Position Sensors.
- Pressure Sensors.
- Temperature Sensors.
- Force Sensors.
- Vibration Sensors.
- Piezo Sensors.
- Fluid Property Sensors.
- Humidity Sensors.

Sensors Classifications



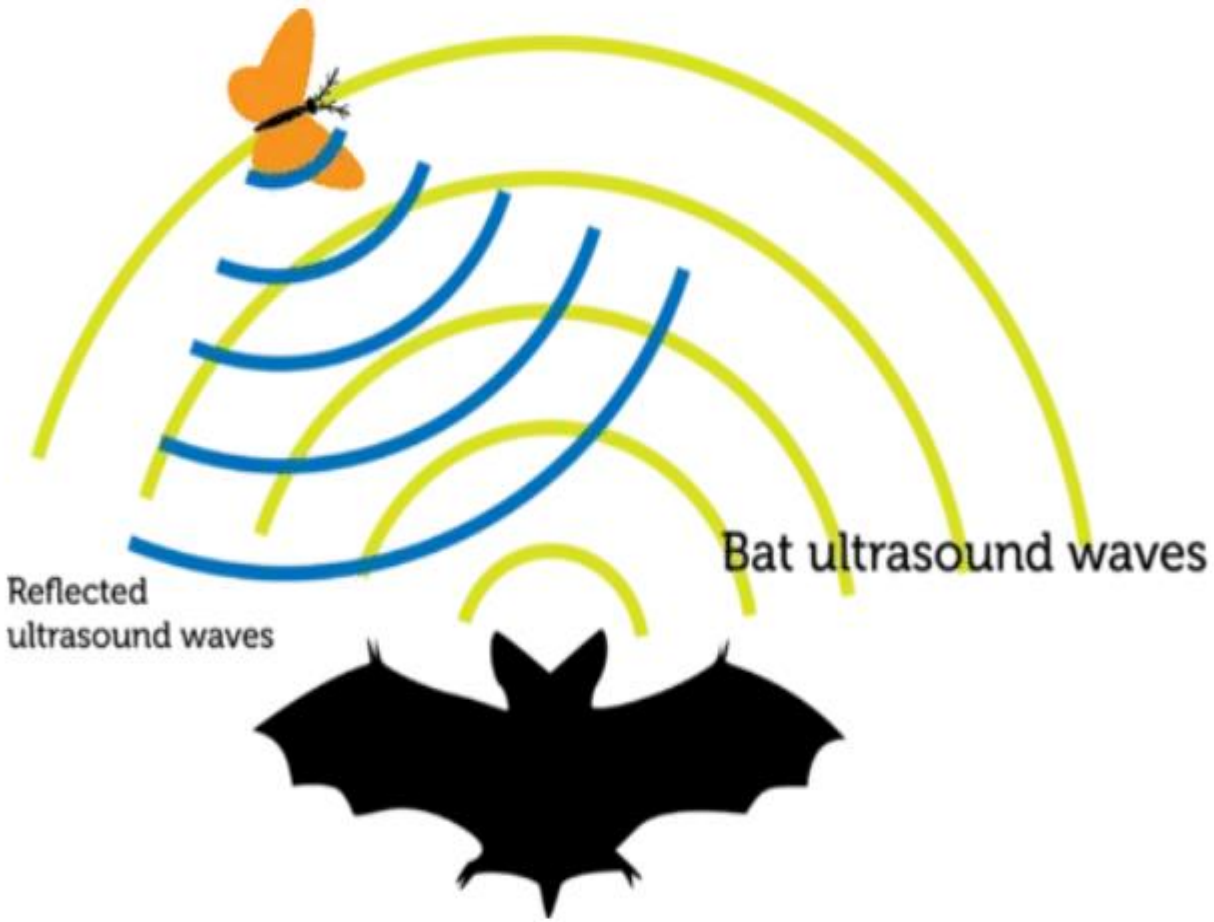
Ultrasonic Sensor

An ultrasonic sensor is an electronic device that is typically used for distance measurement and/or object detection. This sort of sensors is very common in the makers' community as well as industrial applications. Ultrasonic sensors are usually used for embedded systems projects/applications.

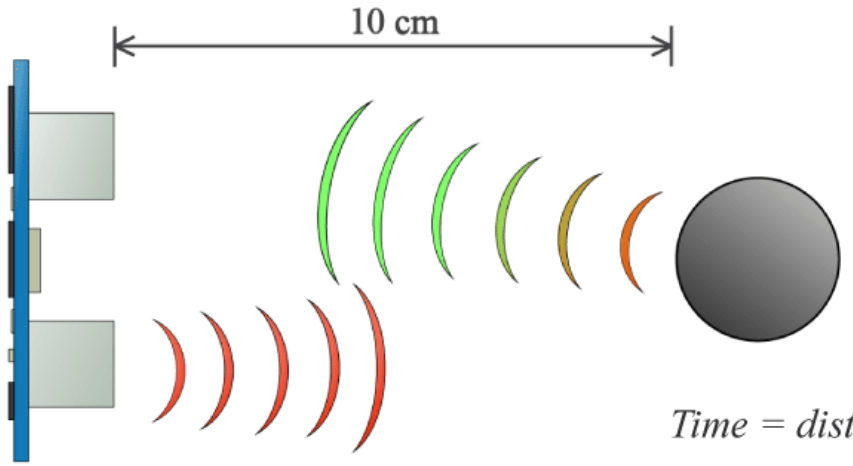


How Does An Ultrasonic Sensor Work?

As the name suggests, the ultrasonic sensor's operation is mainly dependent on ultra-sound waves. This is typically the way that Bats are used for vision and navigating around. They send some sound waves in the air, which will reflect to them to tell how close an object is to the source of the sound wave. You should also know that the ultrasound waves are not detected by the human ears which hear low-frequency tones up to 20kHz.



How Does An Ultrasonic Sensor Work?



speed of sound:

$v = 340\ m/s$

$v = 0{,}034\ cm/\mu s$

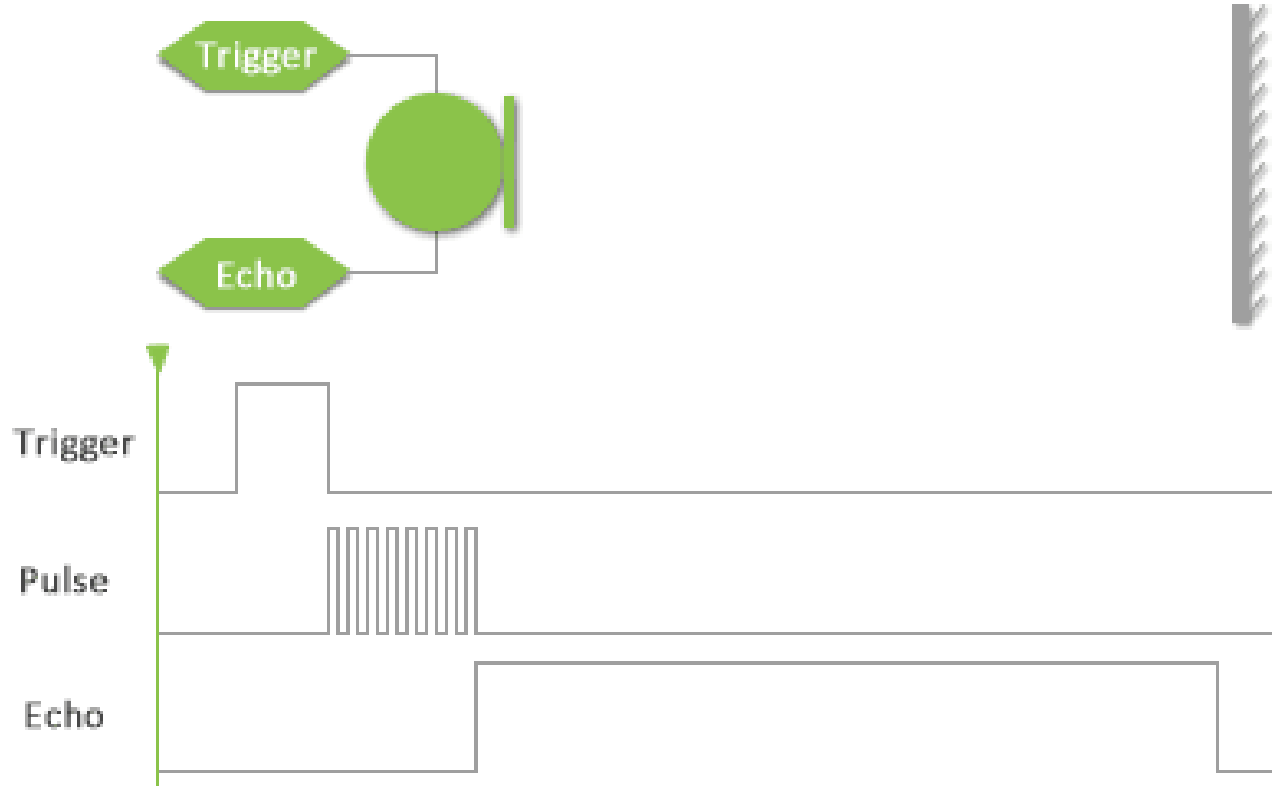
Time = distance / speed:

$t = s / v = 10 / 0{,}034 = 294\ \mu s$

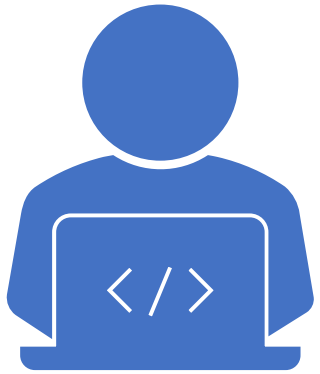
Distance:

$s = t \cdot 0{,}034 / 2$

How Does An Ultrasonic Sensor Work?



Example



firebase | Arduino 1.8.13

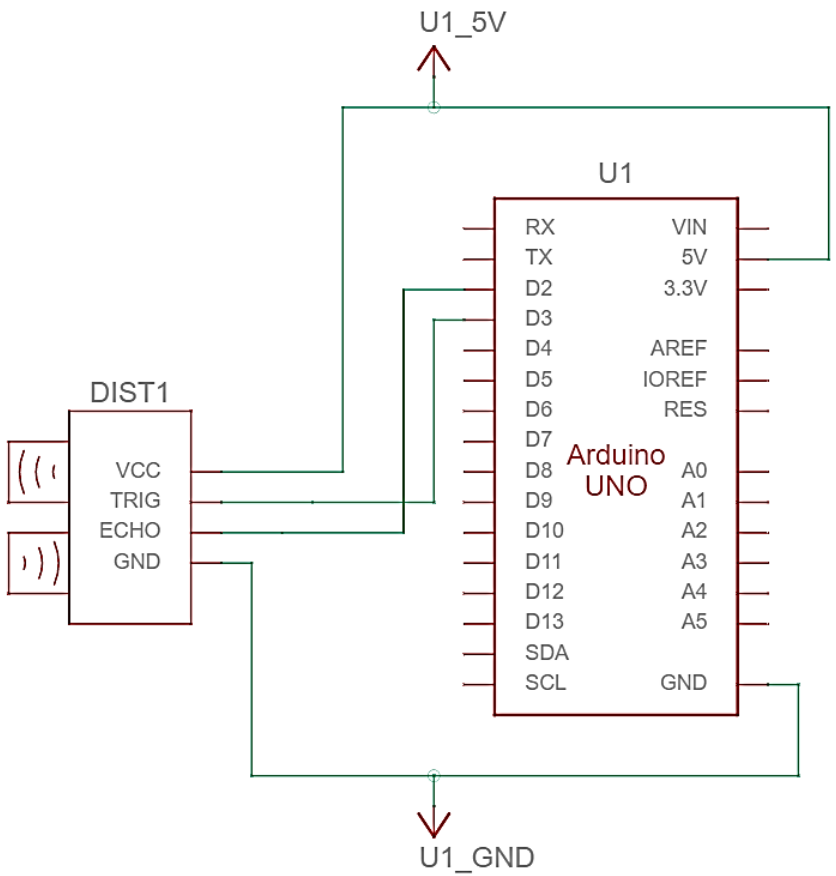
File Edit Sketch Tools Help

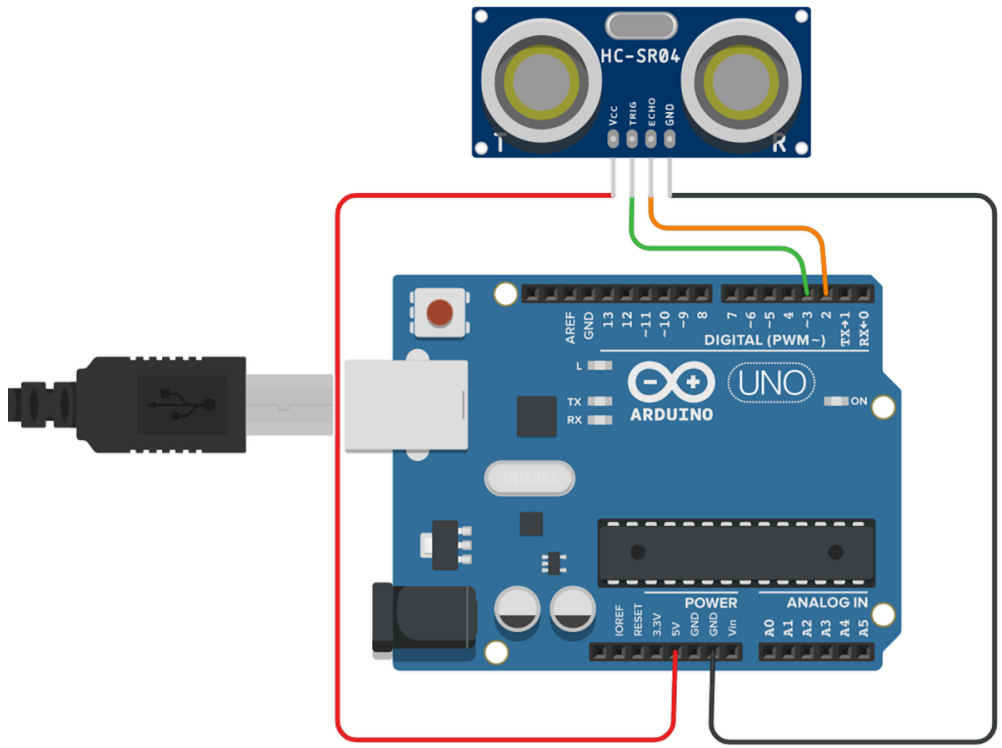
firebase §

```
int cm = 0;
byte triggerPin = 3, echoPin = 2;

void setup()
{
  Serial.begin(9600);
  pinMode(triggerPin, OUTPUT);
  pinMode(echoPin, INPUT);
}

void loop()
{
  cm = 0.017 * readUltrasonicDistance();
  Serial.print(cm);
  Serial.println("cm");
  delay(100);
}
```

```
long readUltrasonicDistance()
{
  digitalWrite(triggerPin, LOW);
  delayMicroseconds(2);
  digitalWrite(triggerPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(triggerPin, LOW);
  return pulseIn(echoPin, HIGH);
}
```

Example


U1_5V
U1
RX
TX
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
SDA
SCL
VIN
5V
3.3V
AREF
IOREF
RES
A0
A1
A2
A3
A4
A5
GND
Arduino
UNO
DIST1
VCC
TRIG
ECHO
GND
U1_GND


HC-SR04
Vcc
TRIG
ECHO
GND
DIGITAL (PWM~)
ARDUINO
UNO
POWER
ANALOG IN