جـــامـــعـــة مـحـمـد بـــن زايـــد
للـــذكـاء الاصـــطـــنـــاعـي
MOHAMED BIN ZAYED UNIVERSITY
OF ARTIFICIAL INTELLIGENCE

Components for Arduinos
Servos, LCDs, and Range Sensors

MBZUAI Robotics Club

Workshop Outline

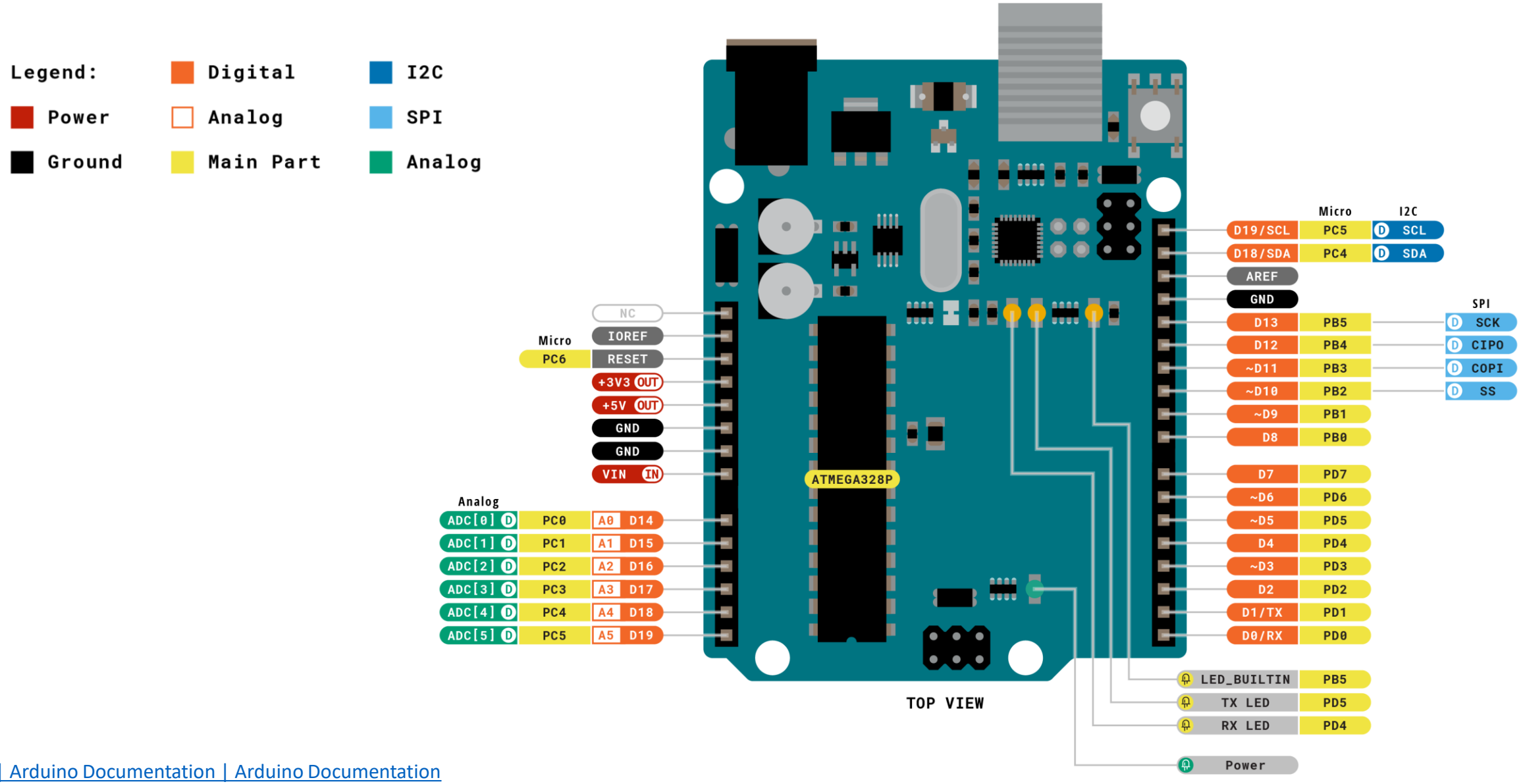
- *Recap:* Arduino GPIO pins.
- *Mini-project:* Liquid Crystal Displays (LCD).
- *Mini-project:* Servo Motor Basics.
- *Mini-project:* Ping Ultrasonic Range Finder.
- *Mini-project:* Joystick.

Workshop Outcomes

By the end of this workshop, you be able to find your way around different components using the published instruction manuals and software libraries and drivers.

- Get familiar with servo motors, LCDs, and ultrasonic sensors.
- Learn to read instruction manuals of new components.
- Learn to use specialized libraries and drivers.

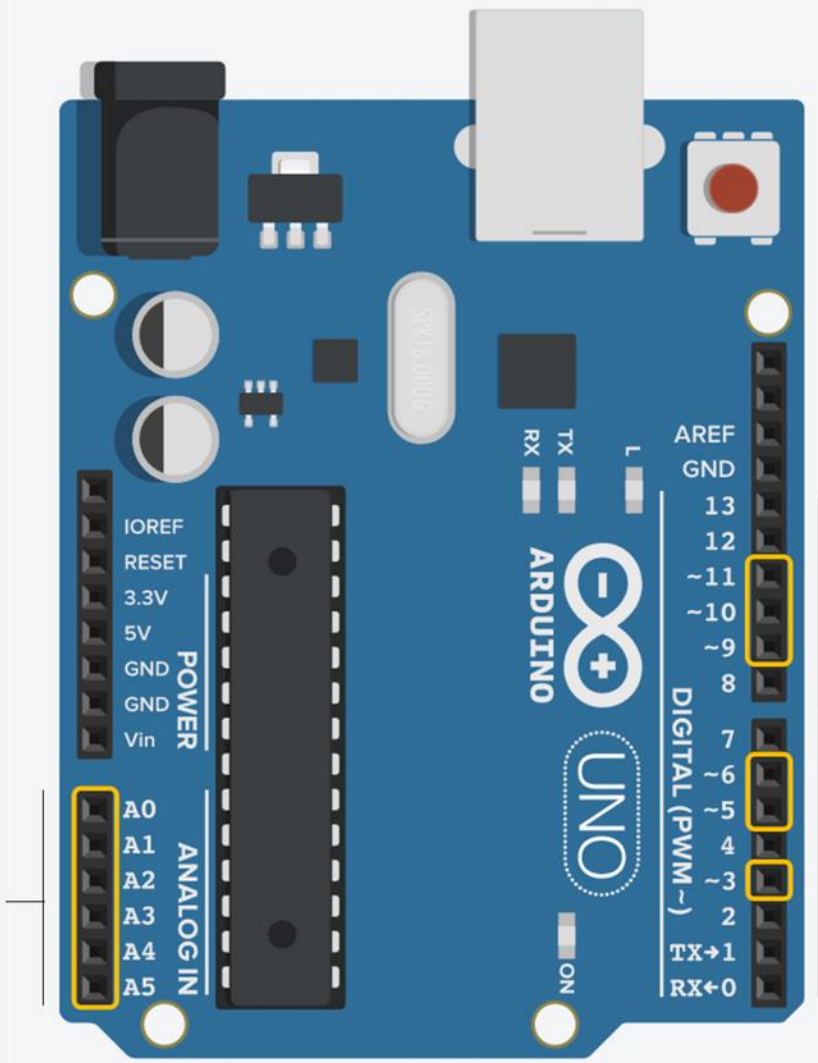
General Purpose Input-Output (GPIO) Pins



[UNO R3 | Arduino Documentation | Arduino Documentation]

General Purpose Input-Output (GPIO) Pins

Six Analog Input Pins
The Arduino Uno has **6** analog **input** pins, which can read a voltage signal between 0-5V using the `analogRead` command



Six Analog Output Pins
The Arduino Uno has **6** analog **output** pins indicated by the tilde ~, which can output a voltage signal between 0 and 5V using PWM via the `analogWrite` command

UNO R3 | Arduino Documentation | Arduino Documentation

Mini-project

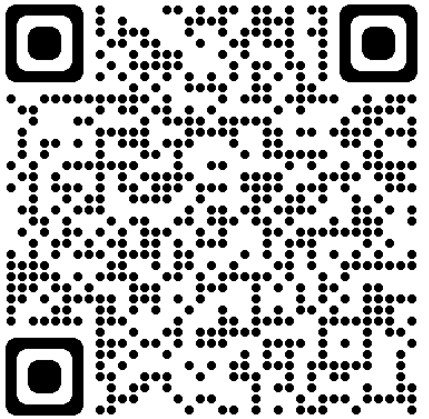
Liquid Crystal Displays (LCD)

LESS EASY

Read the values from the Serial Monitor and show them on an LCD.

Learning outcomes:

- Get familiar with LCDs.
- Learn to display text on an LCD.



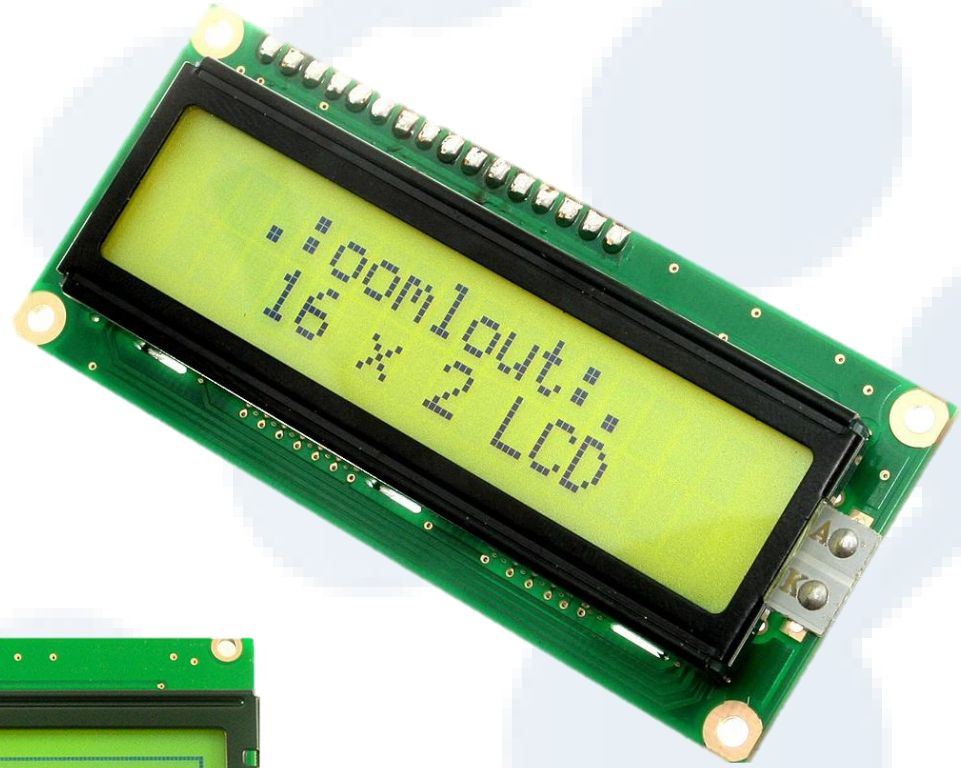
Liquid Crystal Displays (LCD) with Arduino | Arduino Documentation | Arduino Documentation

Liquid Crystal Displays: Hardware Required

- LCD Screen (compatible with Hitachi HD44780 driver)
- Pin headers to solder to the LCD display pins
- 10k Ohm potentiometer
- 220 Ohm resistor
- Breadboard
- Jumper wires

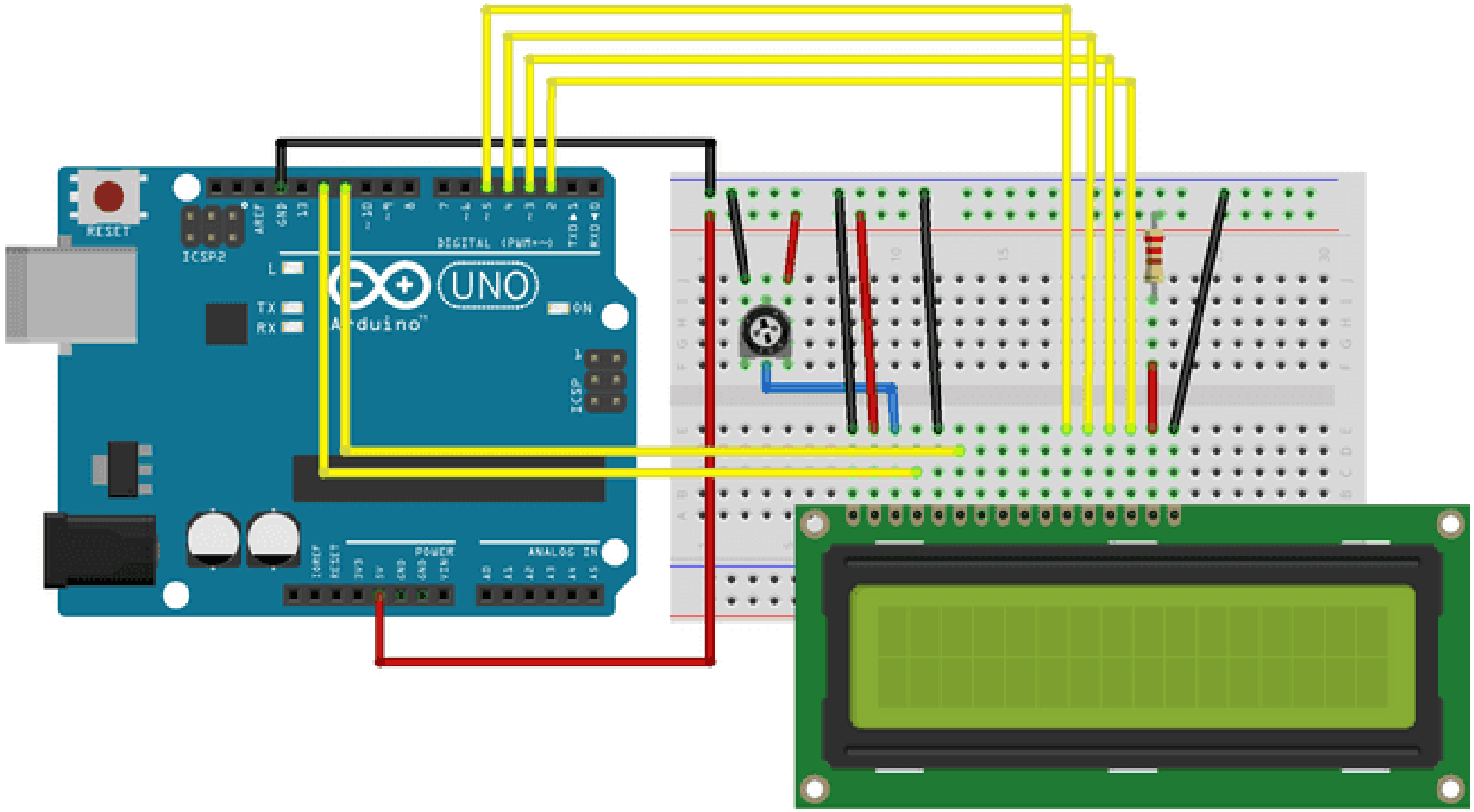
Liquid Crystal Displays

The display consists of a dot matrix of lights or mechanical indicators arranged in a rectangular configuration such that by switching on or off selected lights, text or graphics can be displayed.



HD44780U (LCD-II), (Dot Matrix Liquid Crystal Display Controller/Driver) (sparkfun.com)

Liquid Crystal Displays: Circuit Diagram



Fritzing

Liquid Crystal Displays: The Script

```
#include <LiquidCrystal.h>

// initialize the library by associating any needed LCD interface pin
// with the arduino pin number it is connected to
const int rs = 12, en = 11, d4 = 5, d5 = 4, d6 = 3, d7 = 2;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

void setup() {
  // set up the LCD's number of columns and rows:
  lcd.begin(16, 2);
  Serial.begin(9600);
}

void loop() {
  // when characters arrive over the serial port...
  if (Serial.available()) {
    delay(100); // wait a bit for the entire message to arrive
    lcd.clear(); // clear the screen

    // read all the available characters
    while (Serial.available() > 0) {
      // display each character to the LCD
      lcd.write(Serial.read());
    }
  }
}
```

Liquid Crystal Displays (LCD) with Arduino | Arduino Documentation | Arduino Documentation

Mini-project

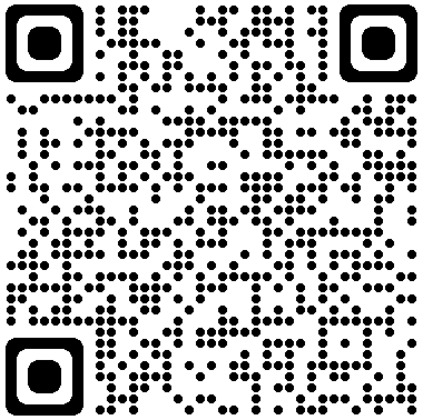
Servo Motor Basics

EASY

Learn to control the angle of a servo motor using input from a potentiometer.

Learning outcomes:

- Get familiar with servo motors.
- Learn how to program servo motors.



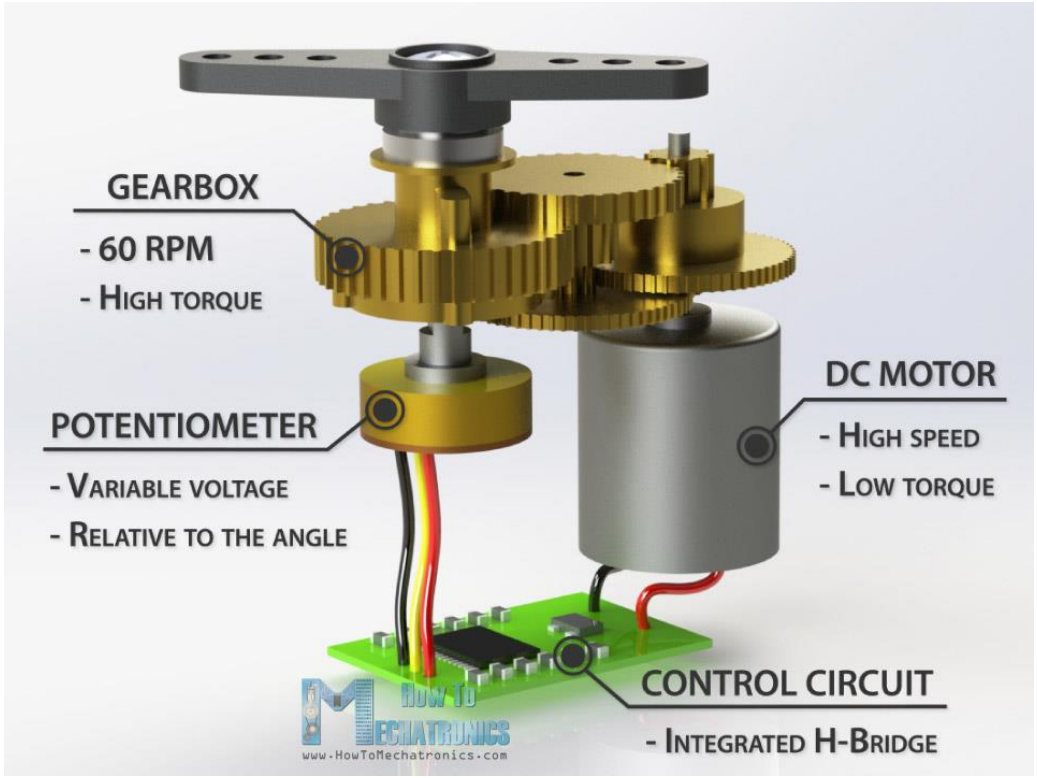
Servo Motor Basics with Arduino | Arduino Documentation | Arduino Documentation

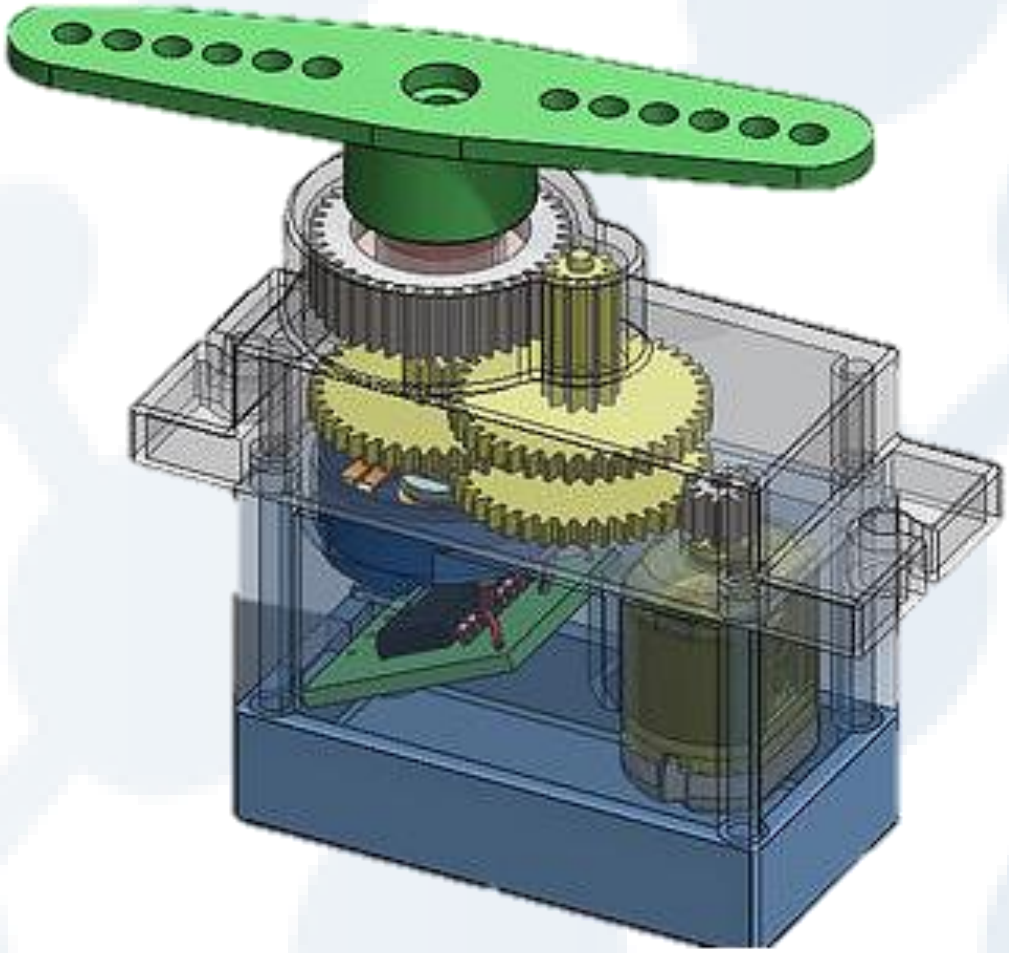
Servo Motor Basics: Hardware Required

- Servo Motor
- 10k Ohm potentiometer
- Breadboard
- Jumper wires

Servo Motors

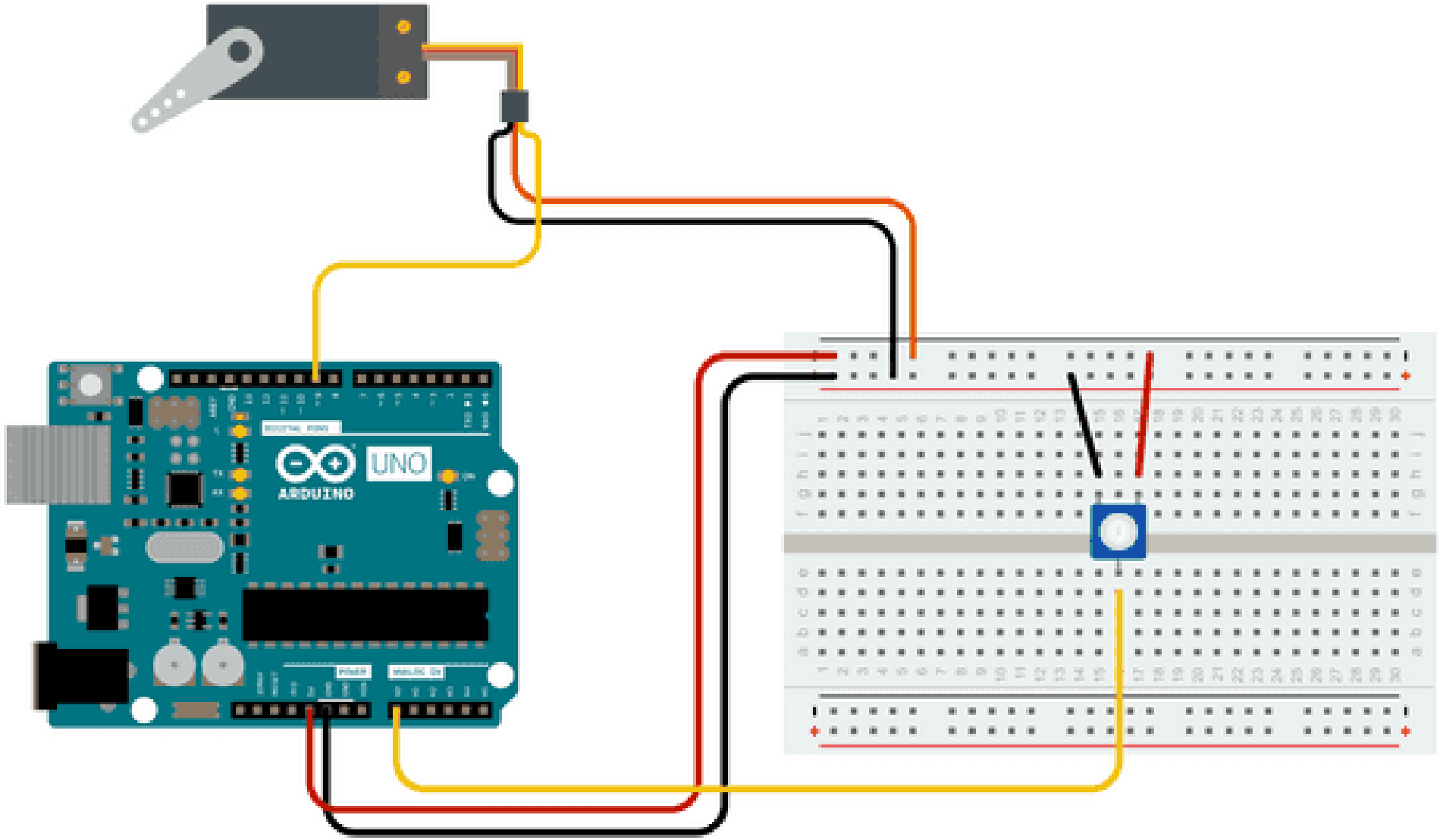
A servo motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision





[How servo motor works - YouTube]

Servo Motor Basics: Circuit Diagram



Fritzing

Servo Motor Basics: The Script

```
#include <Servo.h>

Servo myservo;  // create servo object to control a servo

int potpin = 0;  // analog pin used to connect the potentiometer
int val;    // variable to read the value from the analog pin

void setup() {
  myservo.attach(9);  // attaches the servo on pin 9 to the servo object
}

void loop() {
  val = analogRead(potpin);            // reads the value of the potentiometer (value between 0 and 1023)
  val = map(val, 0, 1023, 0, 180);     // scale it to use it with the servo (value between 0 and 180)
  myservo.write(val);                  // sets the servo position according to the scaled value
  delay(15);                           // waits for the servo to get there
}
```

Servo Motor Basics with Arduino | Arduino Documentation | Arduino Documentation

Mini-project

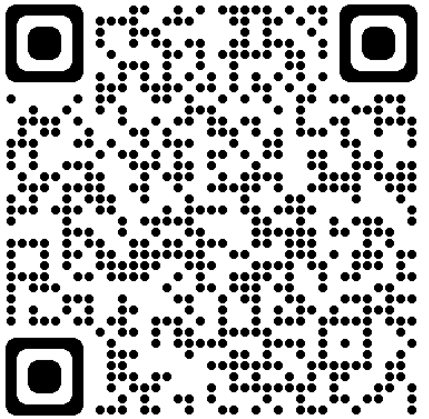
Ping Ultrasonic Range Finder

LESS EASY

Learn to read an Ultrasonic range sensor
to detect objects and measure distances.

Learning outcomes:

- Learn how to read an ultrasonic sensor.
- Learn how to convert the reading to distance.



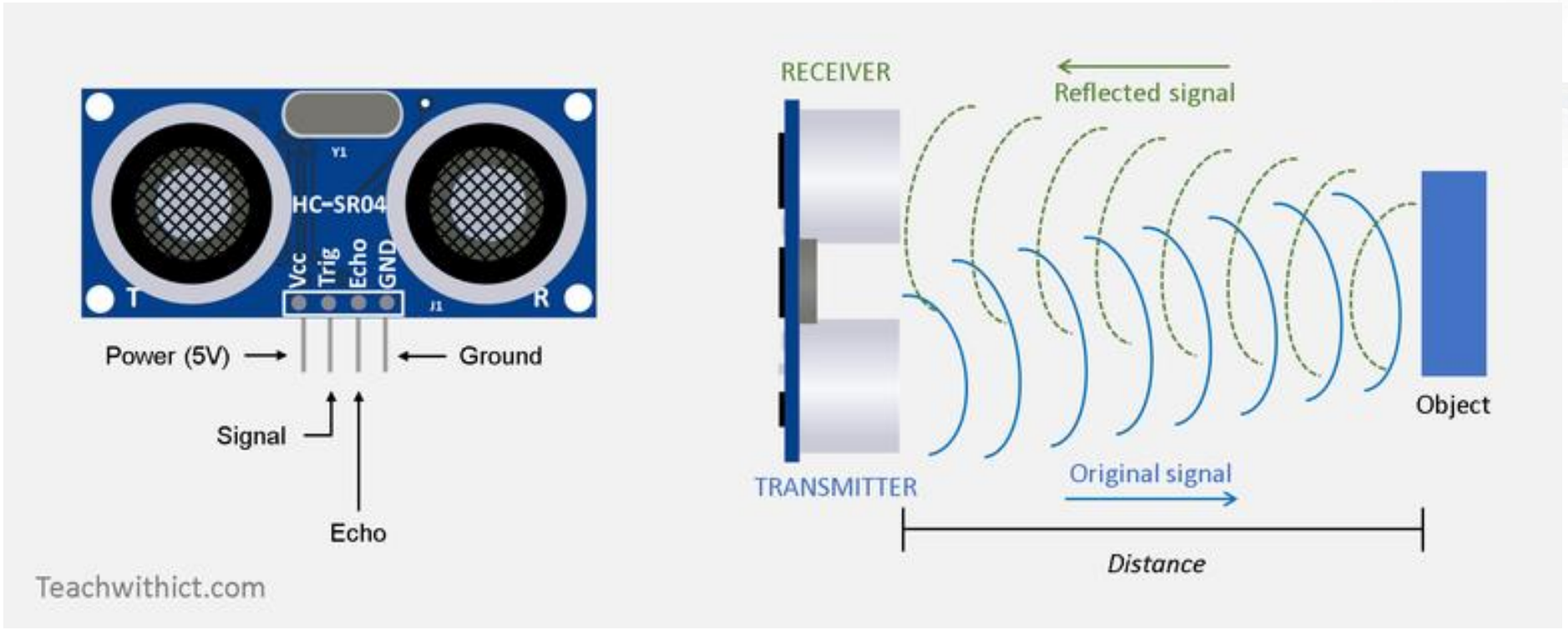
[Ping Ultrasonic Range Finder | Arduino Documentation | Arduino Documentation]

Ping Ultrasonic Range Finder: Hardware Required

- Ultrasonic sensor
- Breadboard
- Jumper wires

Ultrasonic sensors

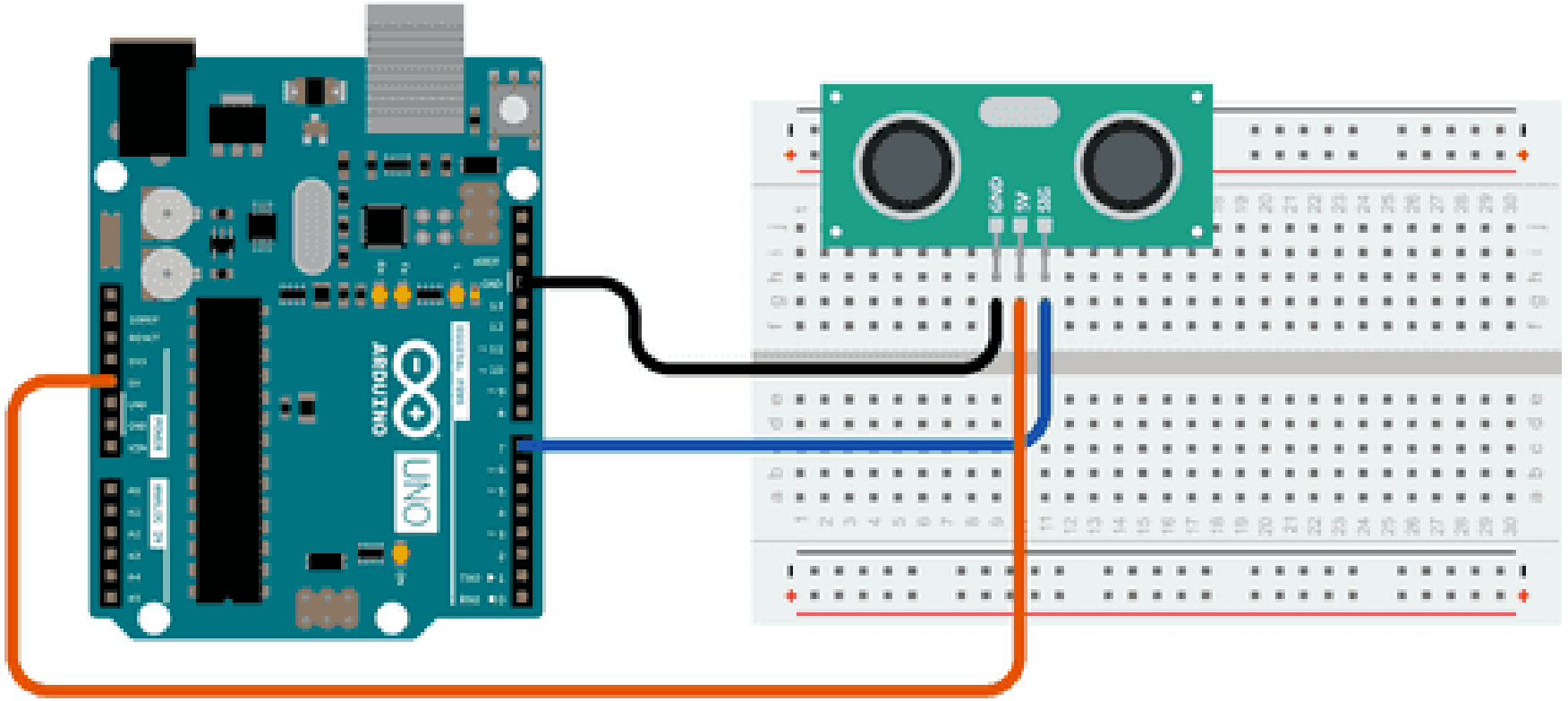
The sensor emits a wave and calculates the distance by the time it takes to reflect in the face of an obstacle.



[HC-SR04 (sparkfun.com)]

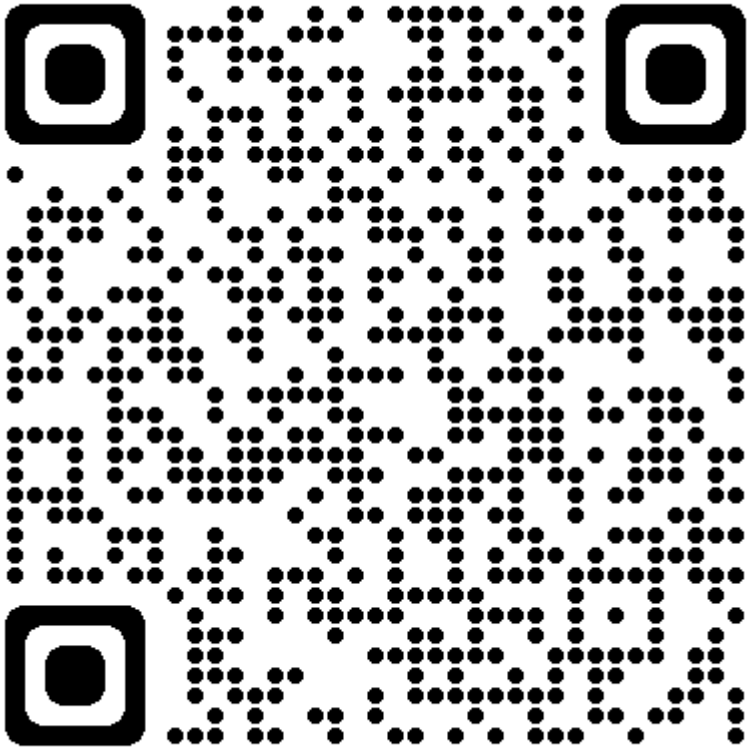
[Ultrasonic sensor with Arduino Nano - How does work Ultrasonic sensor - SriTu Hobby]

Ping Ultrasonic Range Finder: Circuit Diagram



Fritzing

Ping Ultrasonic Range Finder: The Script



Ping Ultrasonic Range Finder | Arduino Documentation | Arduino Documentation

Mini-project

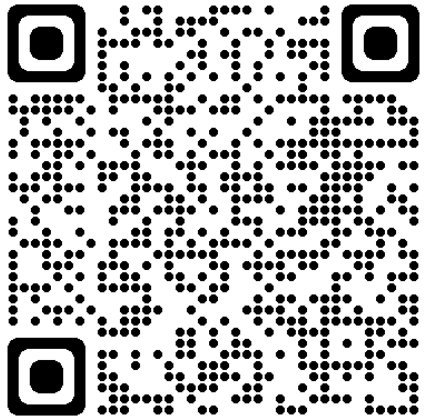
Joystick

LESS EASY

Learn to read an Ultrasonic range sensor
to detect objects and measure distances.

Learning outcomes:

- Learn how to read an ultrasonic sensor.
- Learn how to convert the reading to distance.



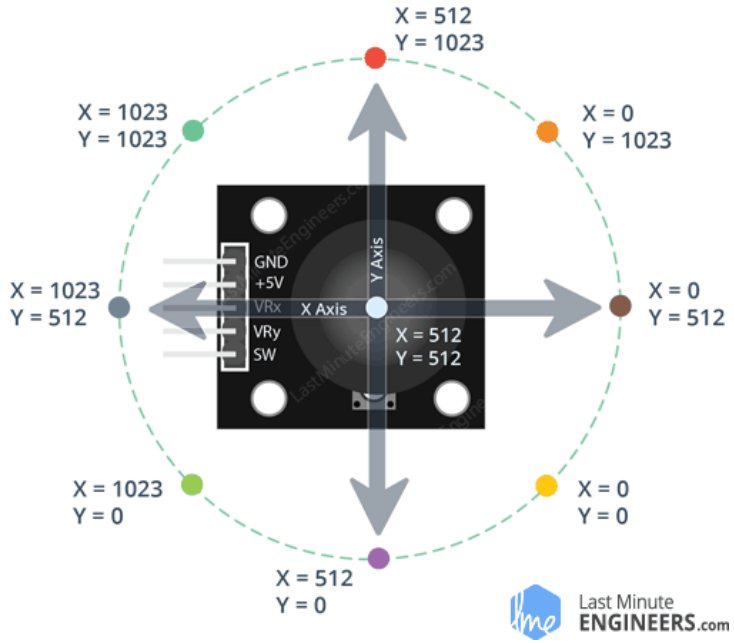
Joystick Controlled Servo Using Arduino: Instructables
Controlling a Servo Motor with Thumb Joystick - Arduino Project Hub

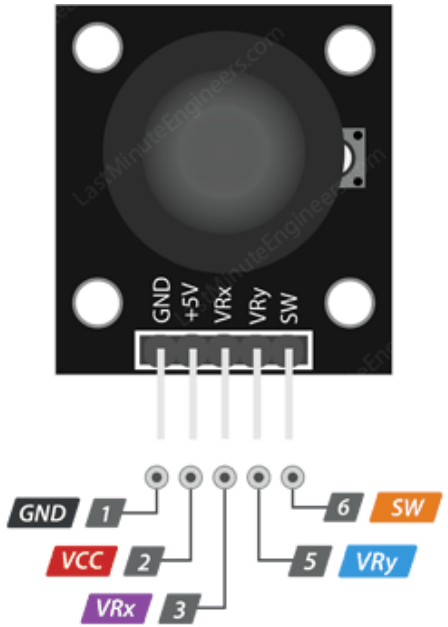
Joystick: Hardware Required

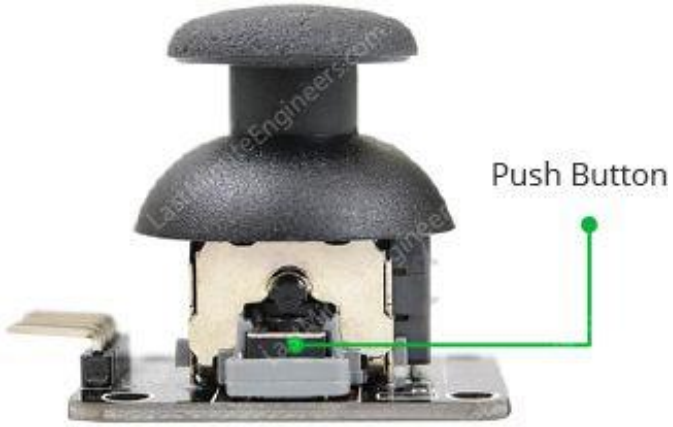
- Joystick
- Servo motor
- Breadboard
- Jumper wires

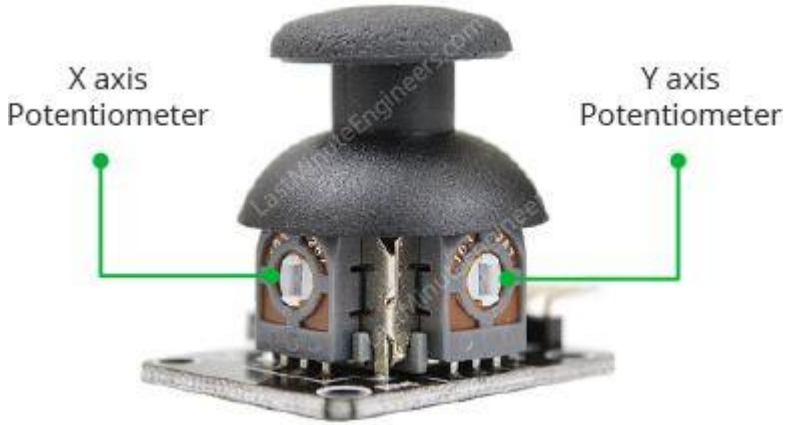
Joysticks

The joystick communicates motion in 2D (2-axis) to an Arduino.



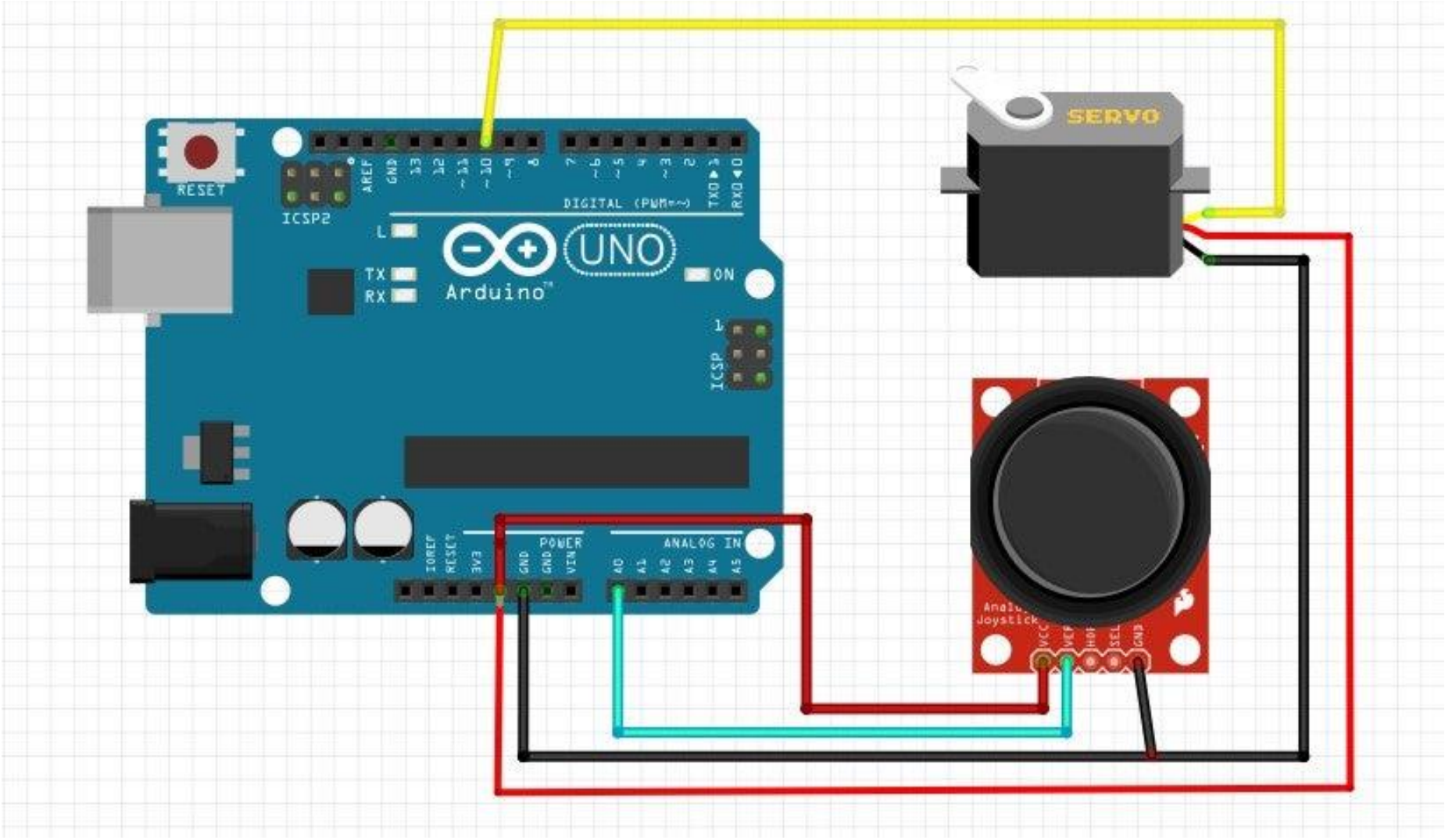






[In-Depth: How 2-Axis Joystick Works? Interface with Arduino & Processing (lastminuteengineers.com)]

Joystick: Circuit Diagram



Fritzing

Joystick: The Script

```
#include<Servo.h>
Servo servo;

int x_axis;
int servo_val;

void setup() {
    pinMode(A0,INPUT);
    servo.attach(10);
}

void loop() {
    x_axis=analogRead(A0);
    servo_val=map(x_axis,0,1023,0,180);
    servo.write(servo_val);
}
```

Thank you