Building Arduino Applications

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Assoc. Prof. Computer Engineering

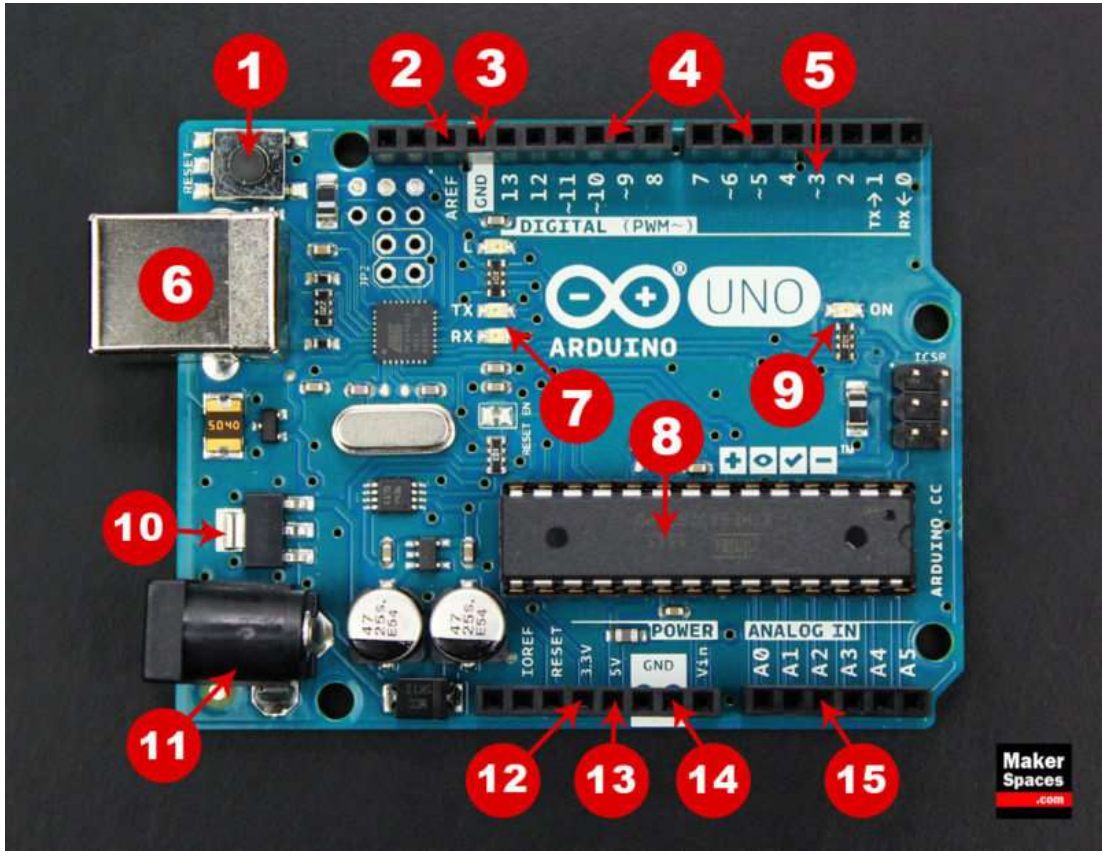
Day 1

Welcome to the course!

During Day 1,

- We are going to introduce you to the course.
- How to assemble a circuit on a breadboard circuit?
- Let us get acquainted with Arduino
- Development tools for Arduino IDE
- First glance at a program
- First coded material
- Macro definitions, variables, counting loops.

Arduino Uno


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
RESET
AREF
GND
DIGITAL (PWM~)
TX
RX
ON
ARDUINO
UNO
ICSP
POWER
ANALOG IN
IOREF
RESET
3.3V
5V
GND
Vin
A0
A1
A2
A3
A4
A5
ARDUINO.CC
Maker Spaces .com

Board Breakdown

Here are the components that make up an Arduino board and what each of their functions are:

1. **Reset Button** – This will restart any code that is loaded to the Arduino board.
2. **AREF** – Stands for “Analog Reference” and is used to set an external reference voltage
3. **Ground Pin** – There are a few ground pins on the Arduino and they all work the same
4. **Digital Input/Output** – Pins 0-13 can be used for digital input or output
5. **PWM** – The pins marked with the (~) symbol can simulate analog output
6. **USB Connection** – Used for powering up your Arduino and uploading sketches
7. **TX/RX** – Transmit and receive data indication LEDs

Board Breakdown

8. ATmega Microcontroller – This is the brains and is where the programs are stored

9. Power LED Indicator – This LED lights up anytime the board is plugged in a power source

10. Voltage Regulator – This controls the amount of voltage going into the Arduino board

11. DC Power Barrel Jack – This is used for powering your Arduino with a power supply

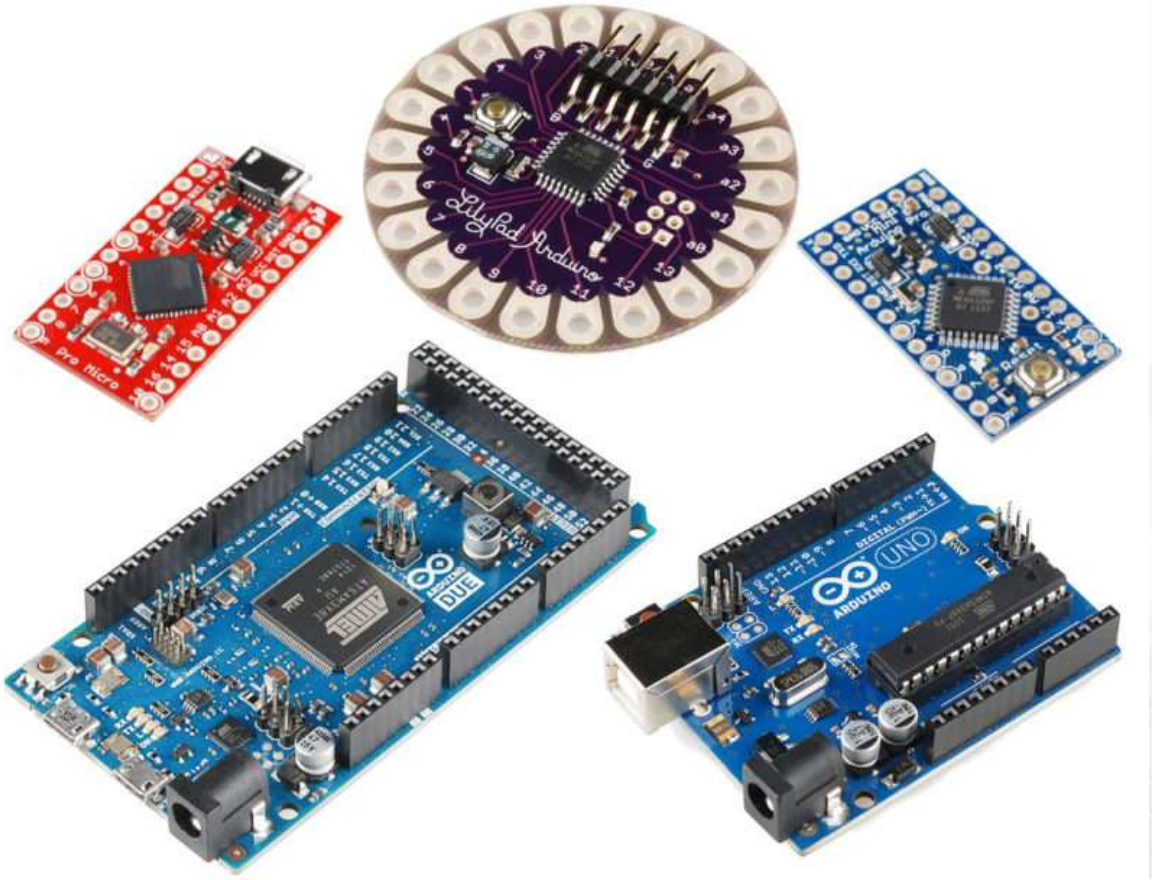
12. 3.3V Pin – This pin supplies 3.3 volts of power to your projects

13. 5V Pin – This pin supplies 5 volts of power to your projects

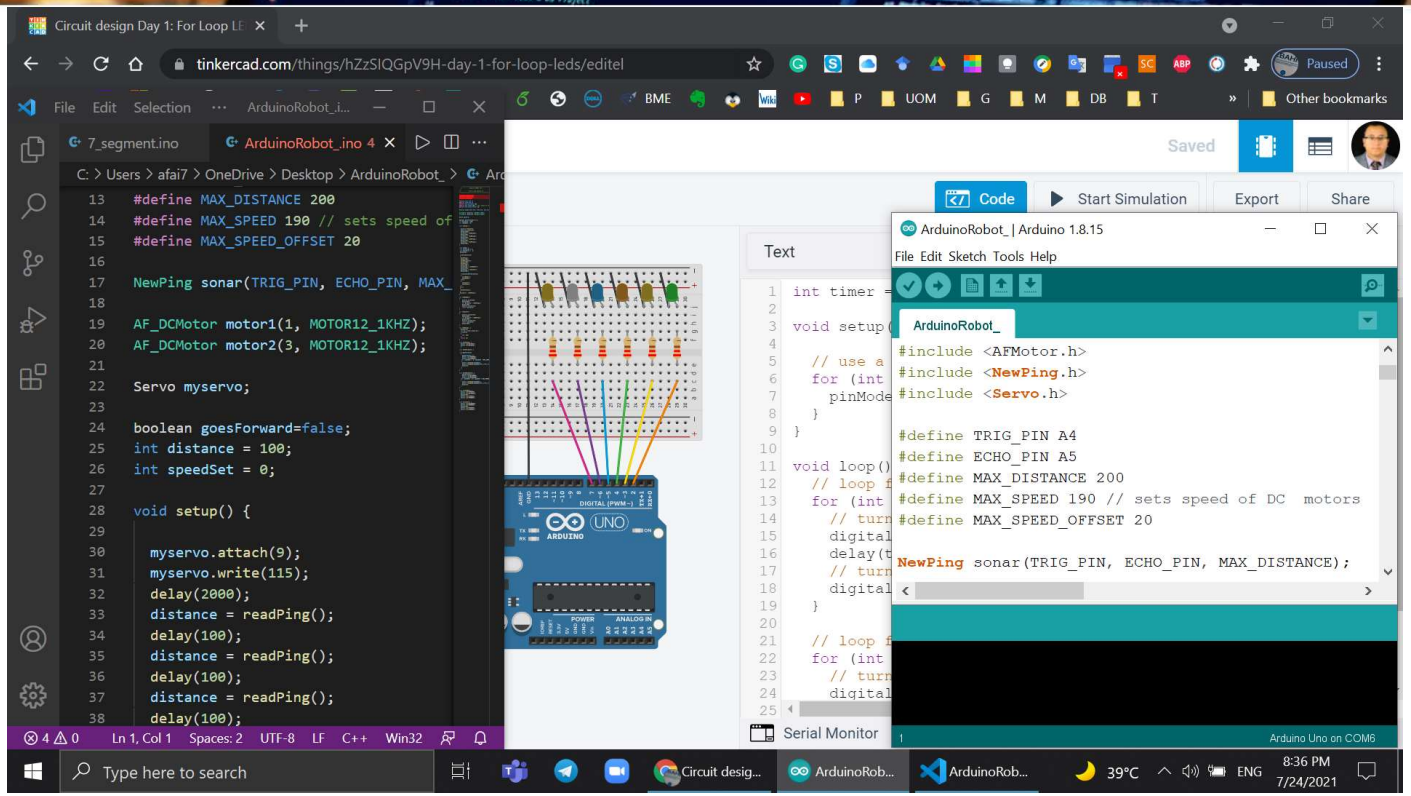
14. Ground Pins – There are a few ground pins on the Arduino

15. Analog Pins – These pins can read the signal from an analog sensor and convert it to digital

Types of Arduino Boards



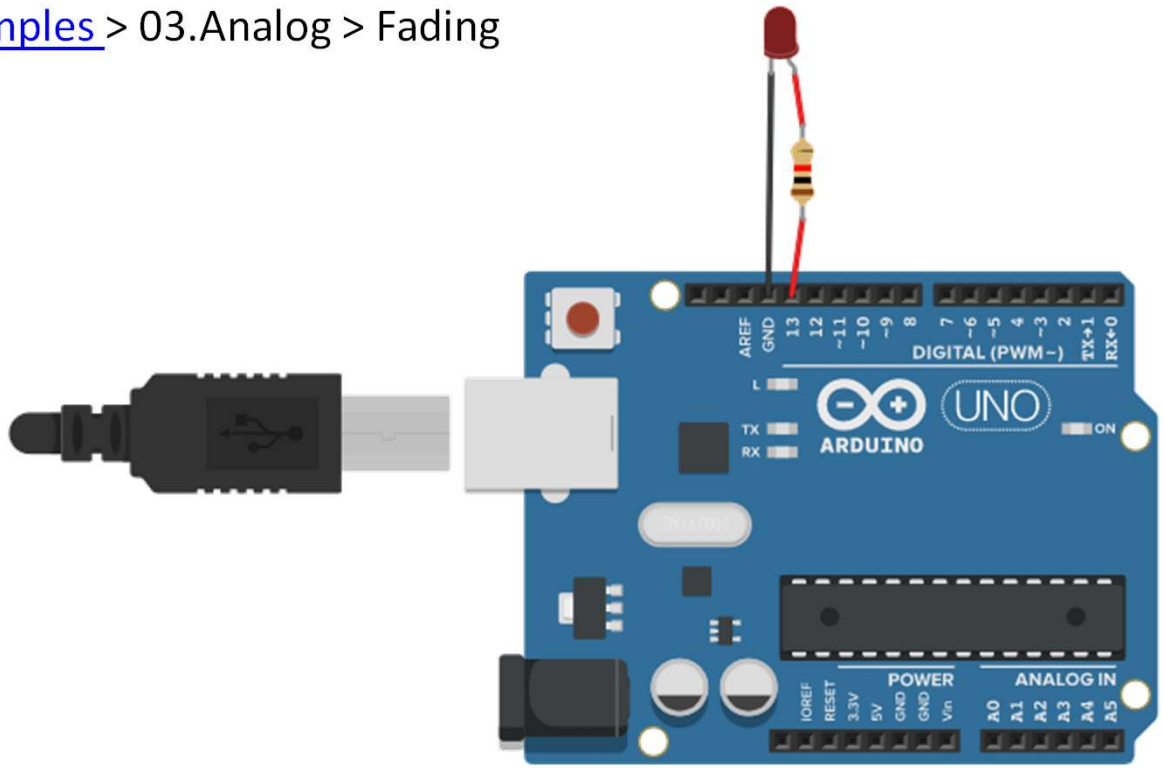
How To Program Arduino



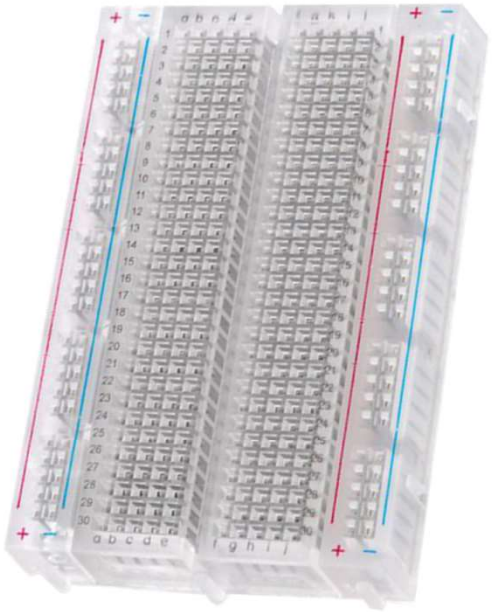
https://www.arduino.cc/
https://www.tinkercad.com/dashboard
https://code.visualstudio.com/

List of experiments

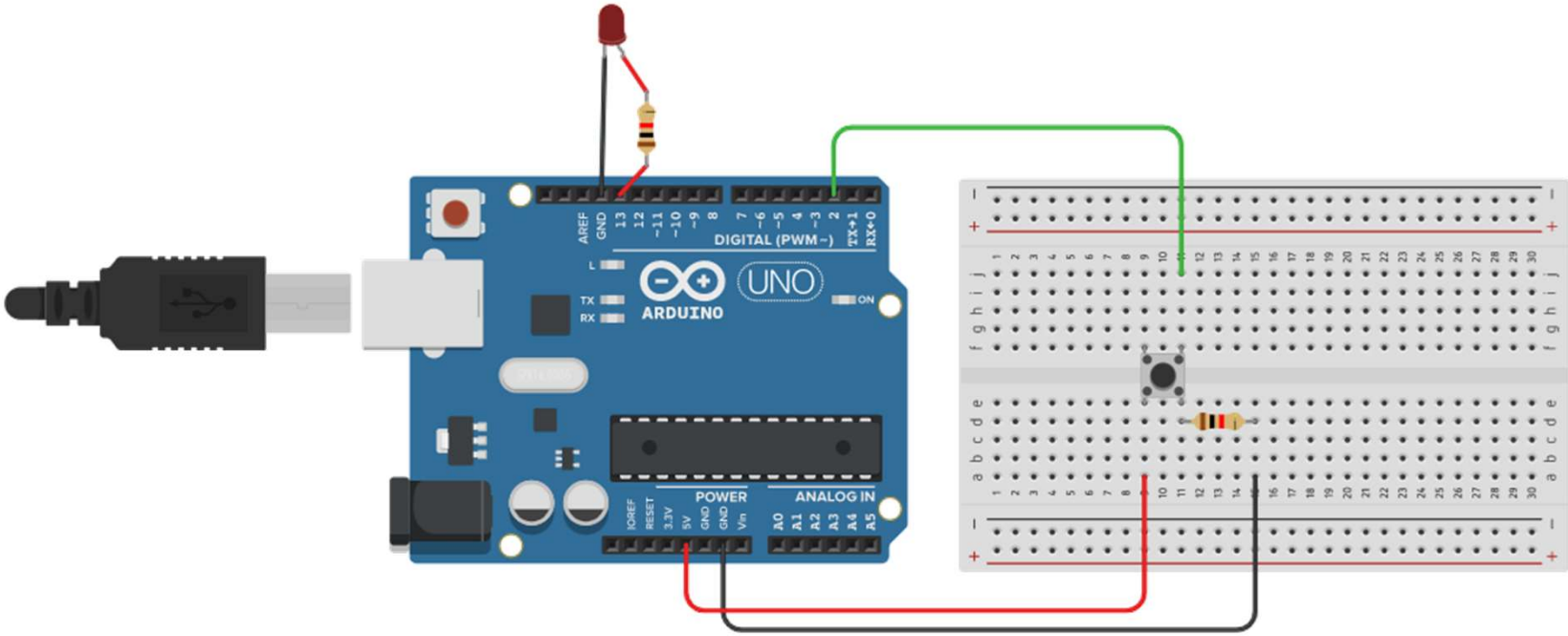
- TUTORIALS > Built-In Examples > 01.Basics > Blink
- TUTORIALS > Built-In Examples > 03.Analog > Fading



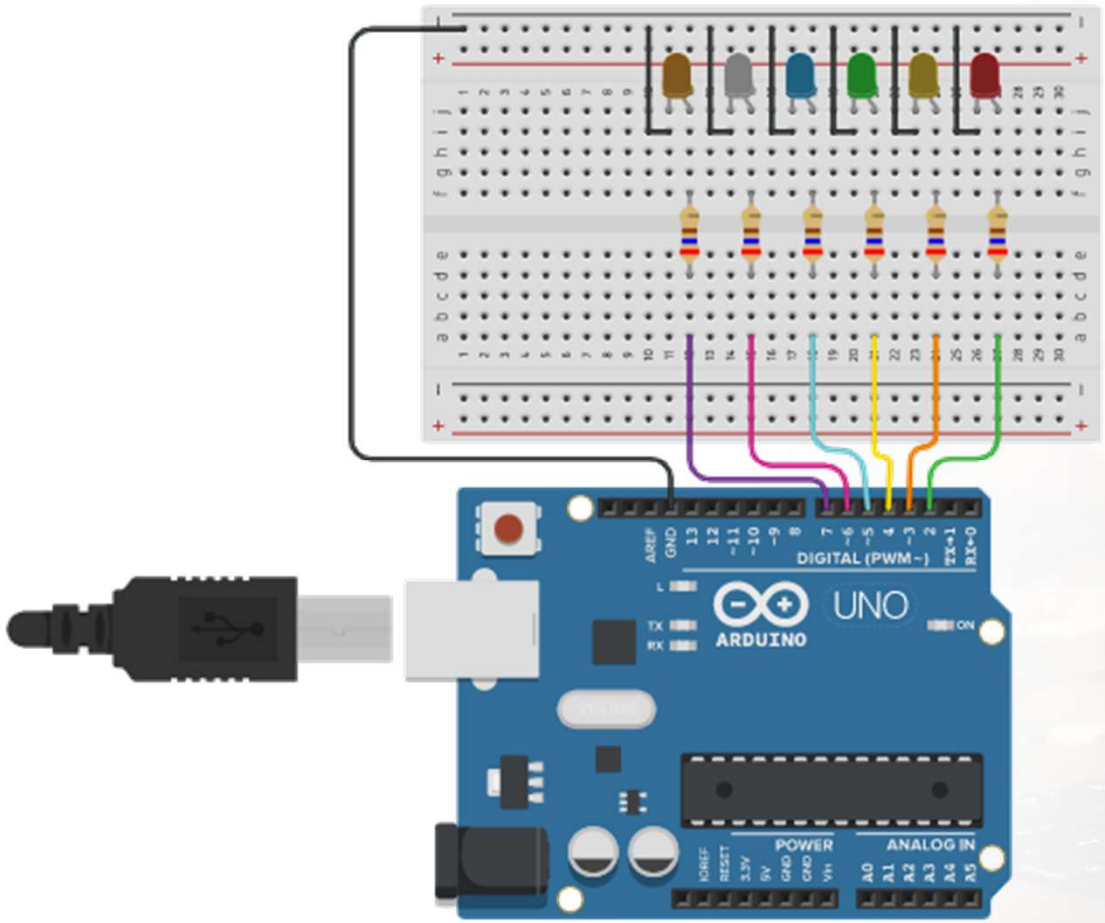
What’s a Breadboard?



- TUTORIALS > Built-In Examples > 02.Digital > Button
- TUTORIALS > Built-In Examples > 02.Digital > StateChangeDetection



- TUTORIALS > Built-In Examples > 05.Control > ForLoopIteration



Day 2

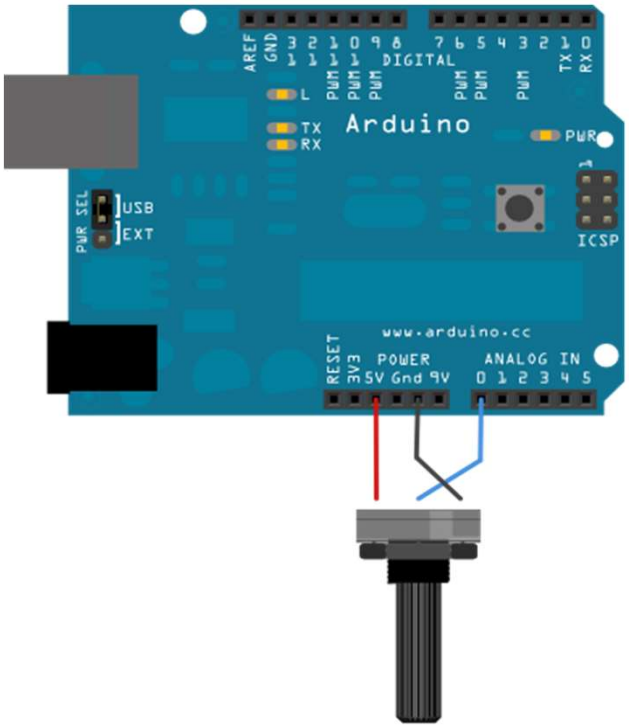
It’s time to learn how to receive data with the help of sensors.

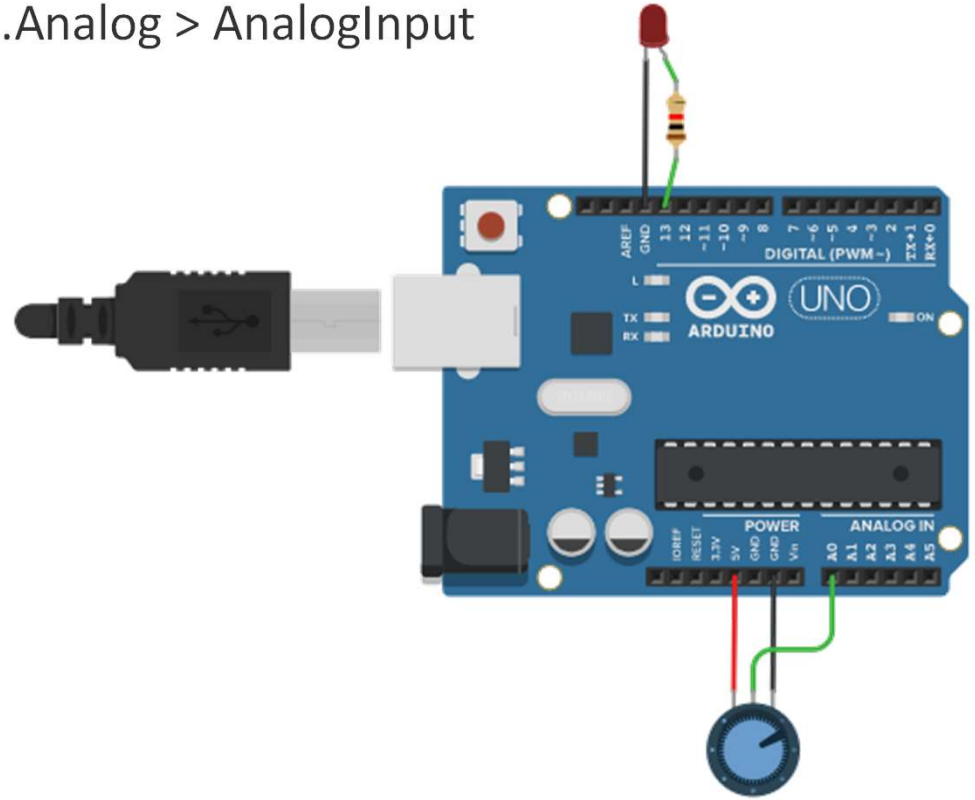
During Day 2,

- First sensor
- How to read off analog signals
- Reading off digital signals
- Boolean expressions and program branching
- Seven-segment display
- Usage of modules and RGB sensor
- Joystick app and testing

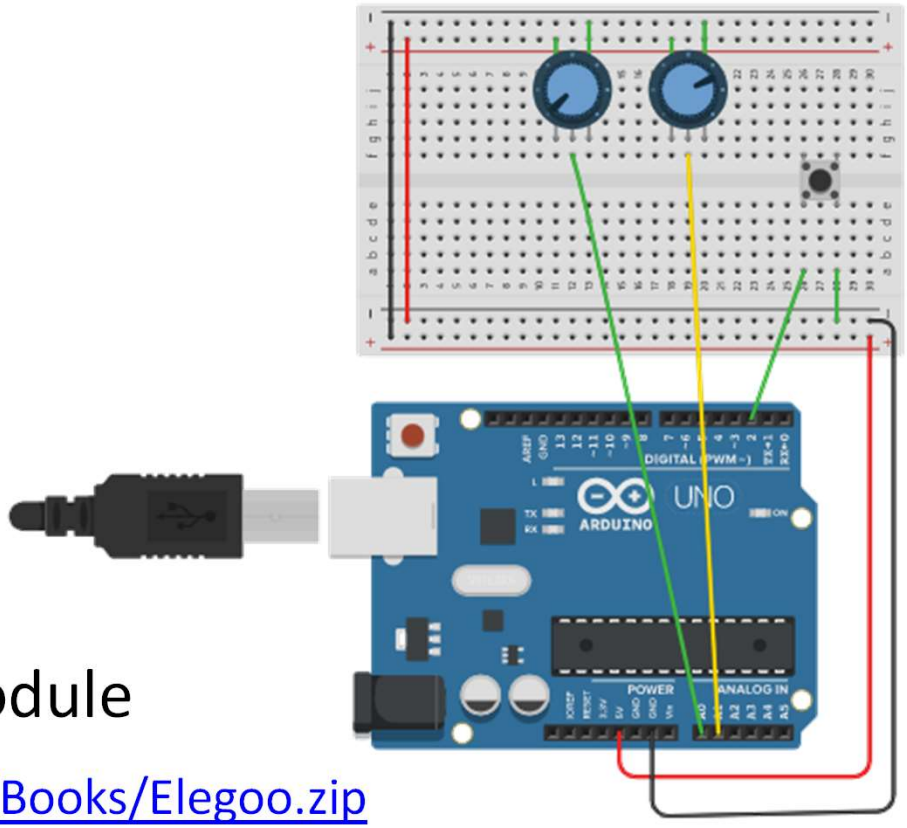
List of experiments

- TUTORIALS > Built-In Examples > 03.Analog > AnalogInput





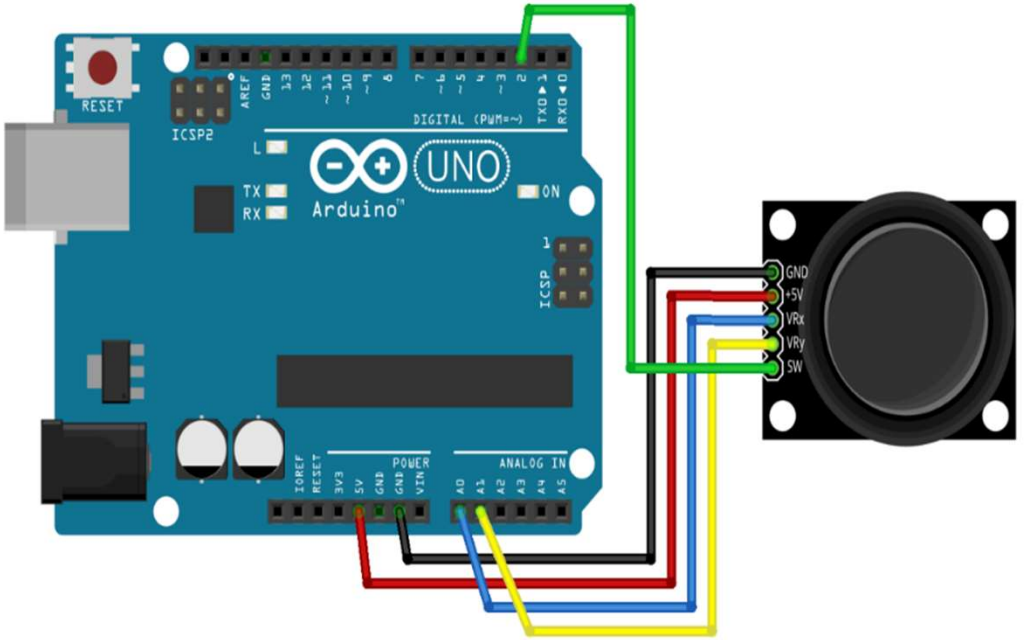
- JOYSTICK CONTROL



Code: Lesson 12 Analog Joystick Module

https://github.com/afai79/Arduino/blob/main/Books/Elegoo.zip

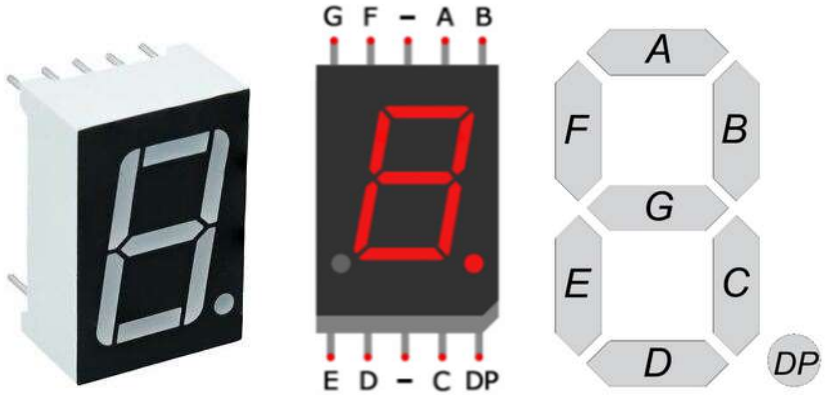
- JOYSTICK CONTROL

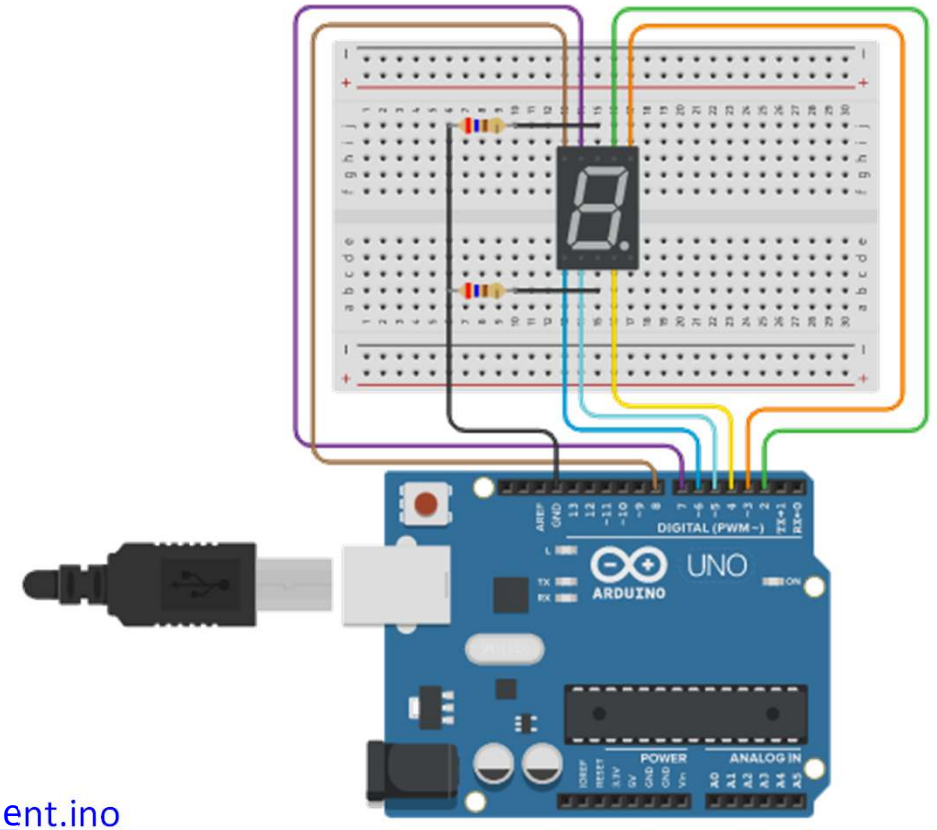


Code: Lesson 12 Analog Joystick Module

https://github.com/afai79/Arduino/blob/main/Books/Elegoo.zip

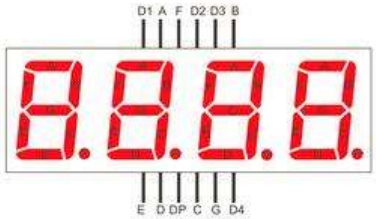
- 7 SEGMENT

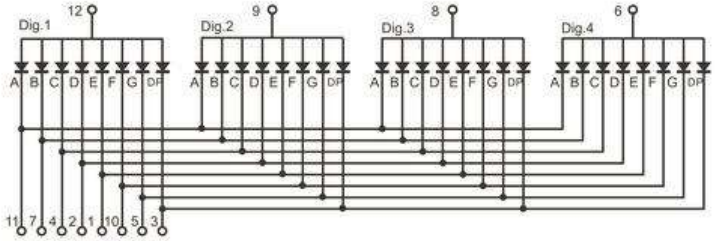


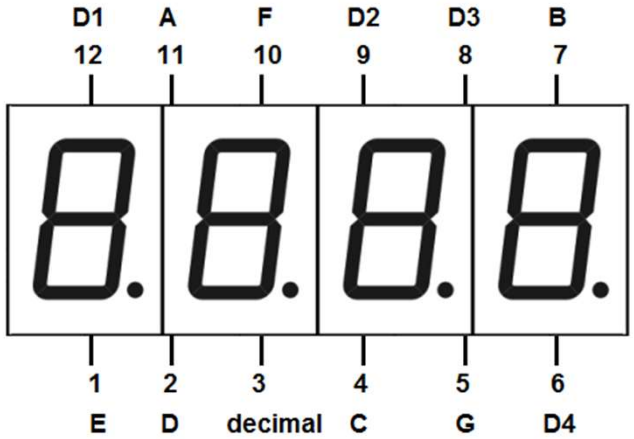


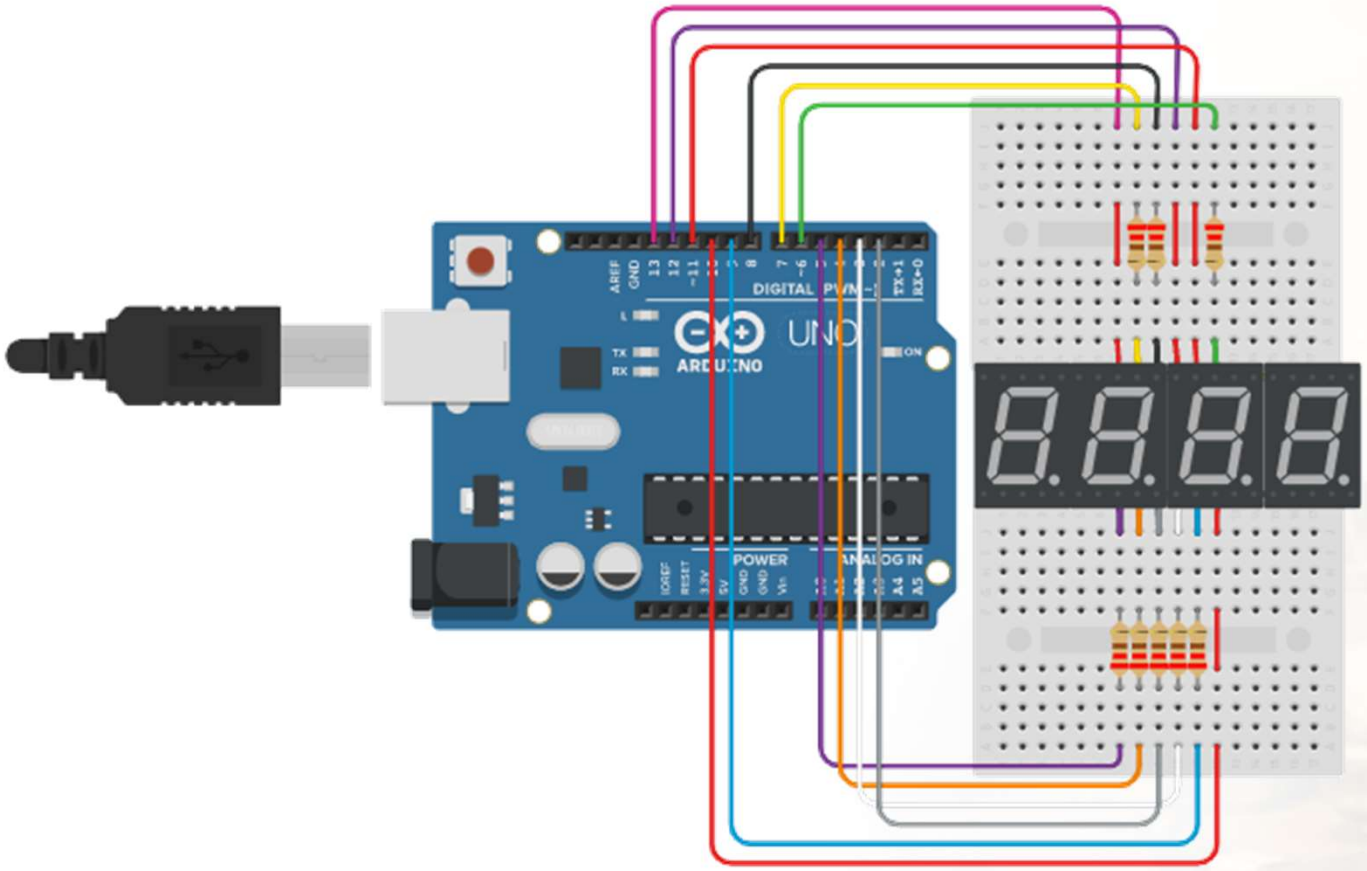
https://github.com/afai79/Arduino/blob/main/7_segment.ino

- Four Digital Seven Segment Display



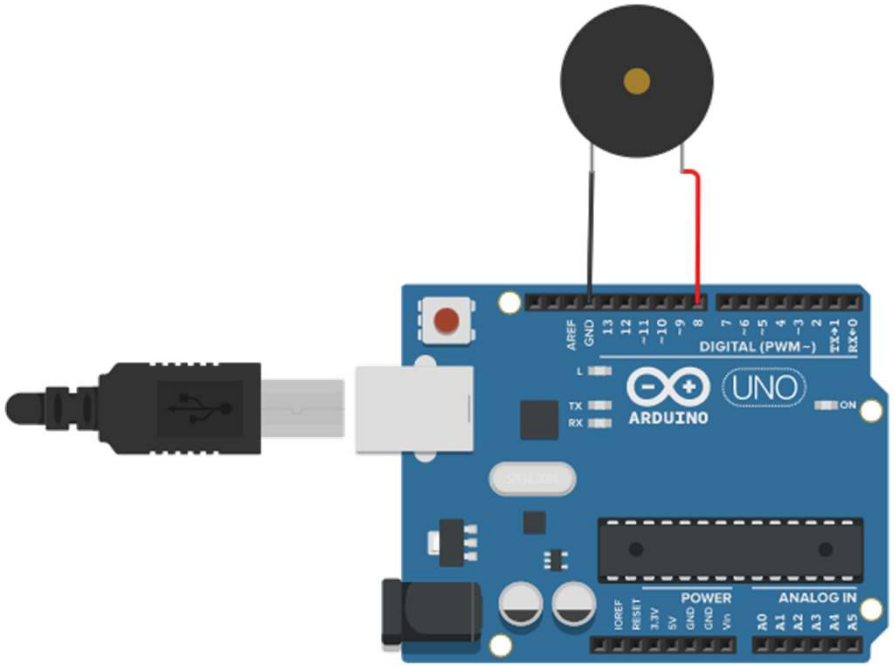






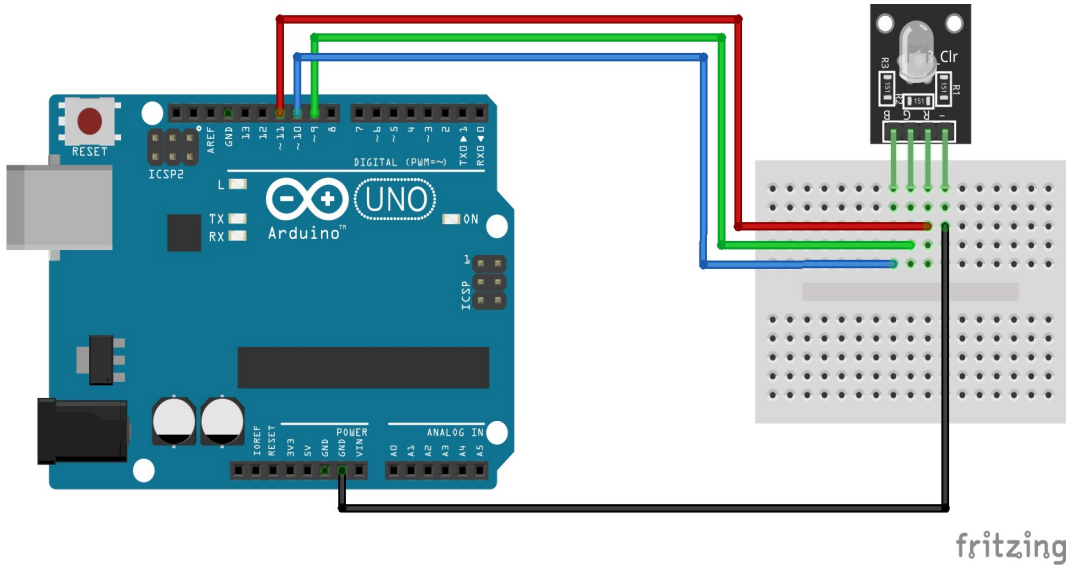
https://github.com/afai79/Arduino/blob/main/4_digit_7_segment.ino

- Tone Melody



https://www.arduino.cc/en/Tutorial/BuiltInExamples/toneMelody
https://github.com/afai79/Arduino/blob/main/Lib/pitches.zip

- RGB sensor



Code: Lesson 4 RGB LED

https://github.com/afai79/Arduino/blob/main/Books/Elegoo.zip

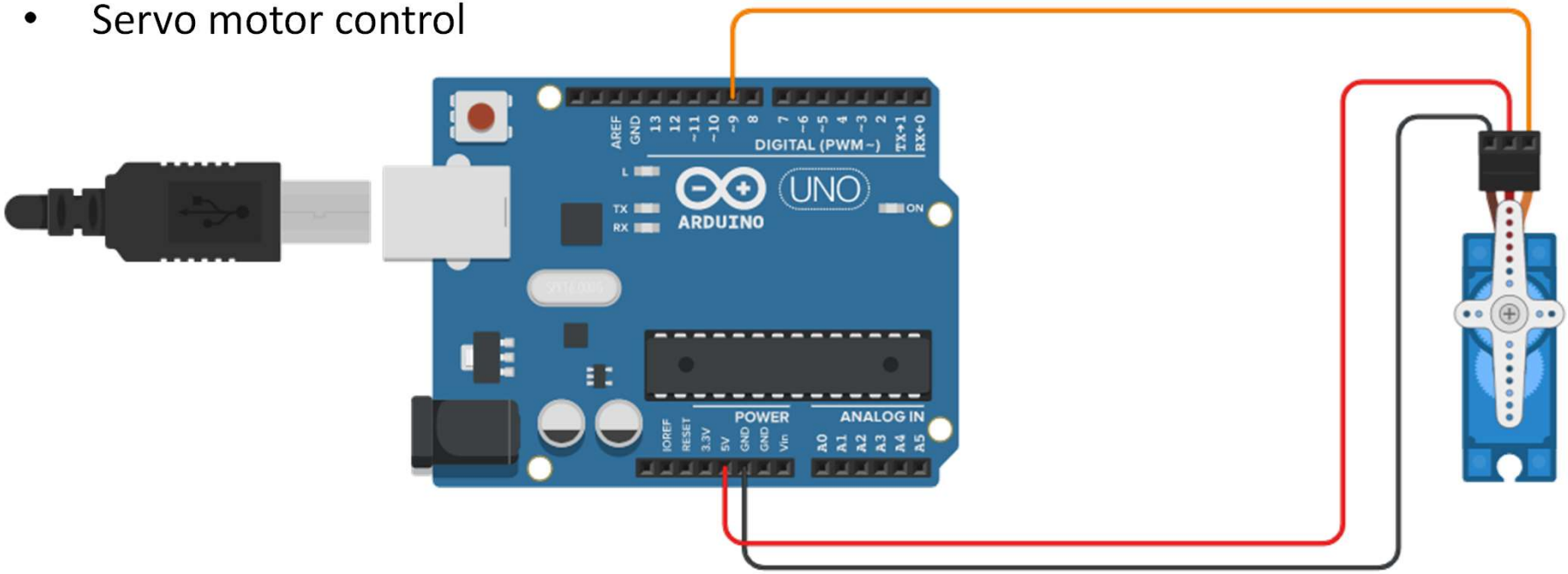
Day 3

Having learnt to create a step motor, you can create devices which can perform very precise actions. It could as well be just messing with your hand with which you are trying to control it.

During Day 3,

- Servo and the library
- Ultrasonic Sensor
- LCD
- Temperature and humidity sensor
- Water level Sensor
- Step motor
- Motor control expansion board
- LCD with I2C

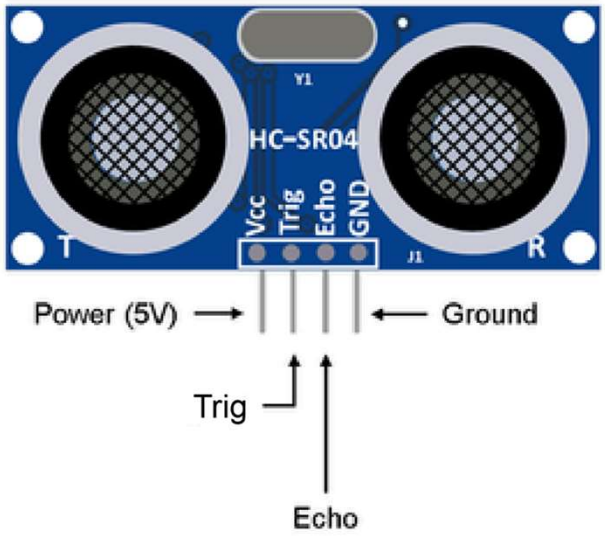
- Servo motor control

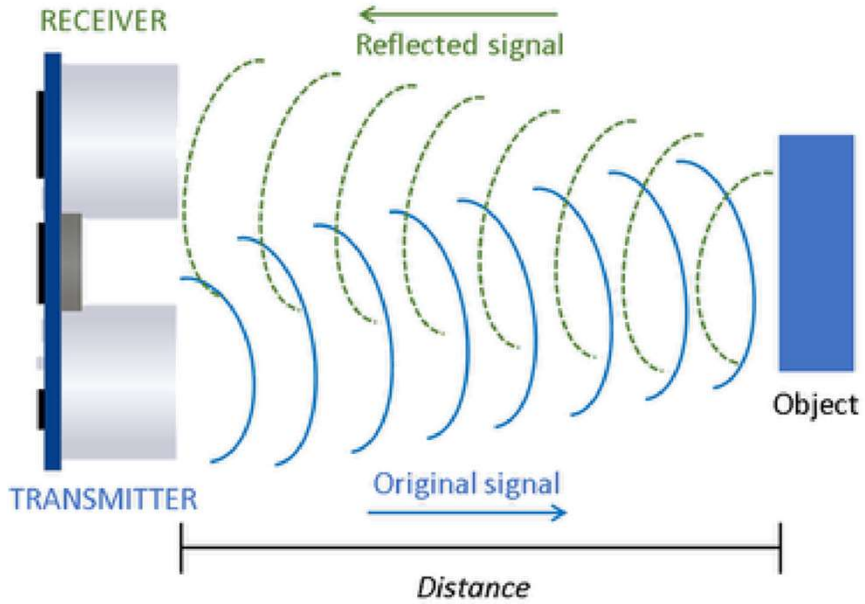


Code: Lesson 9 Servo

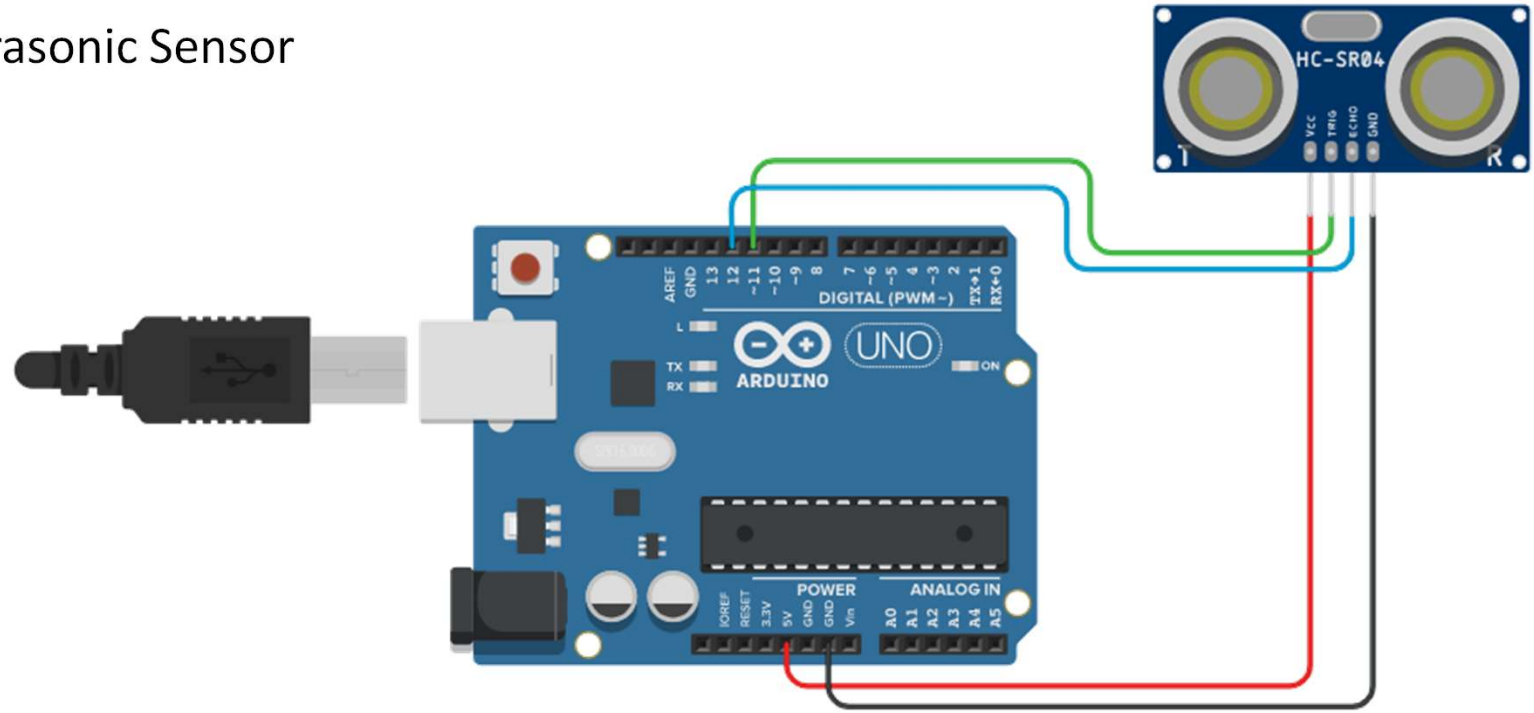
https://github.com/afai79/Arduino/blob/main/Books/Elegoo.zip

- Ultrasonic Sensor



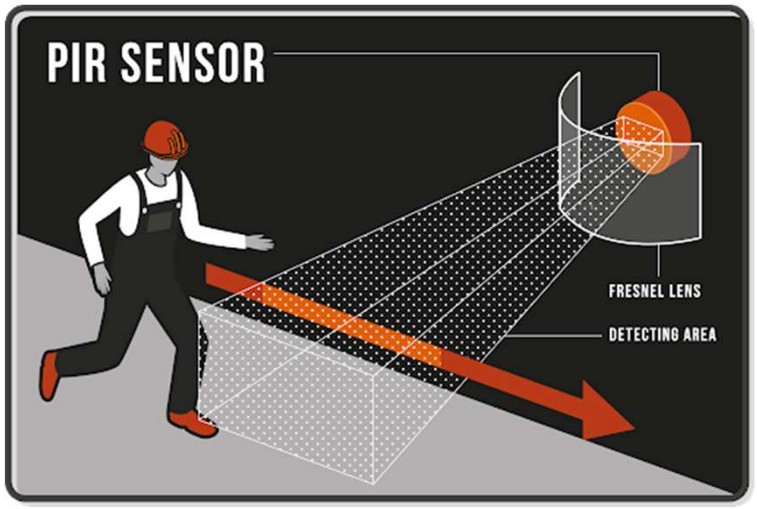


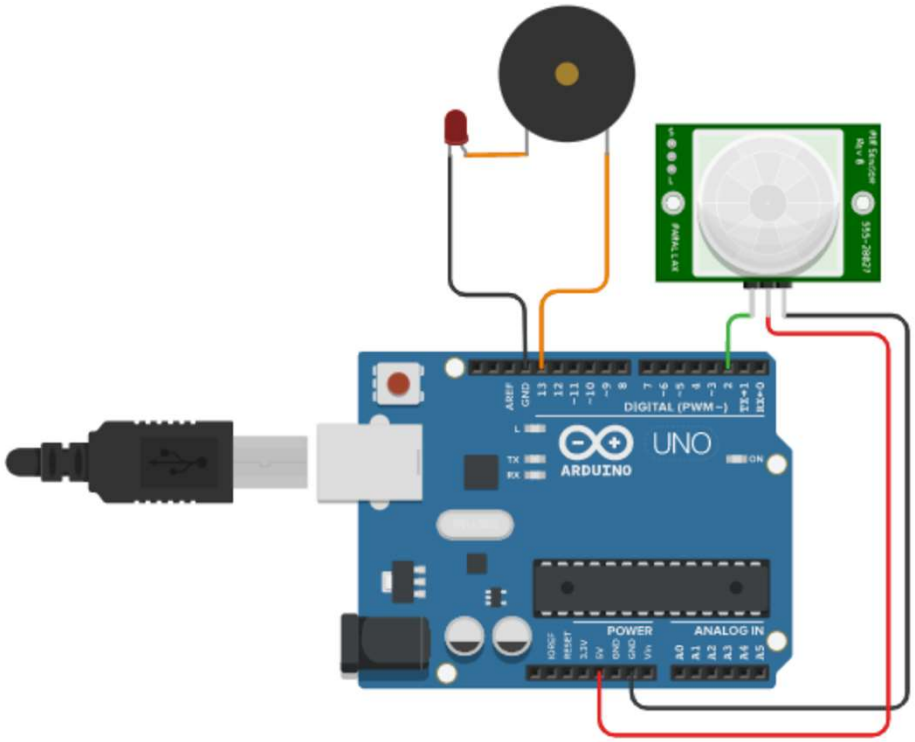
- Ultrasonic Sensor



https://github.com/afai79/Arduino/blob/main/Ultrasonic.ino

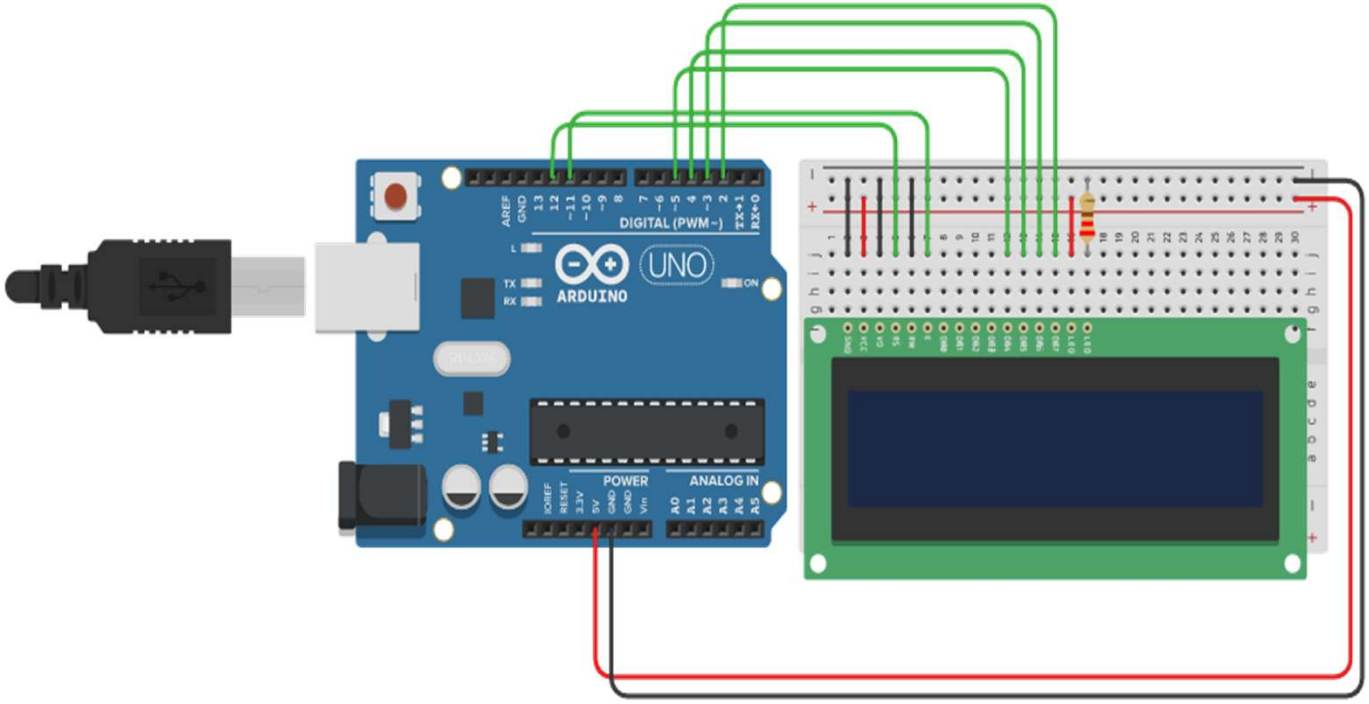
- PIR Sensor





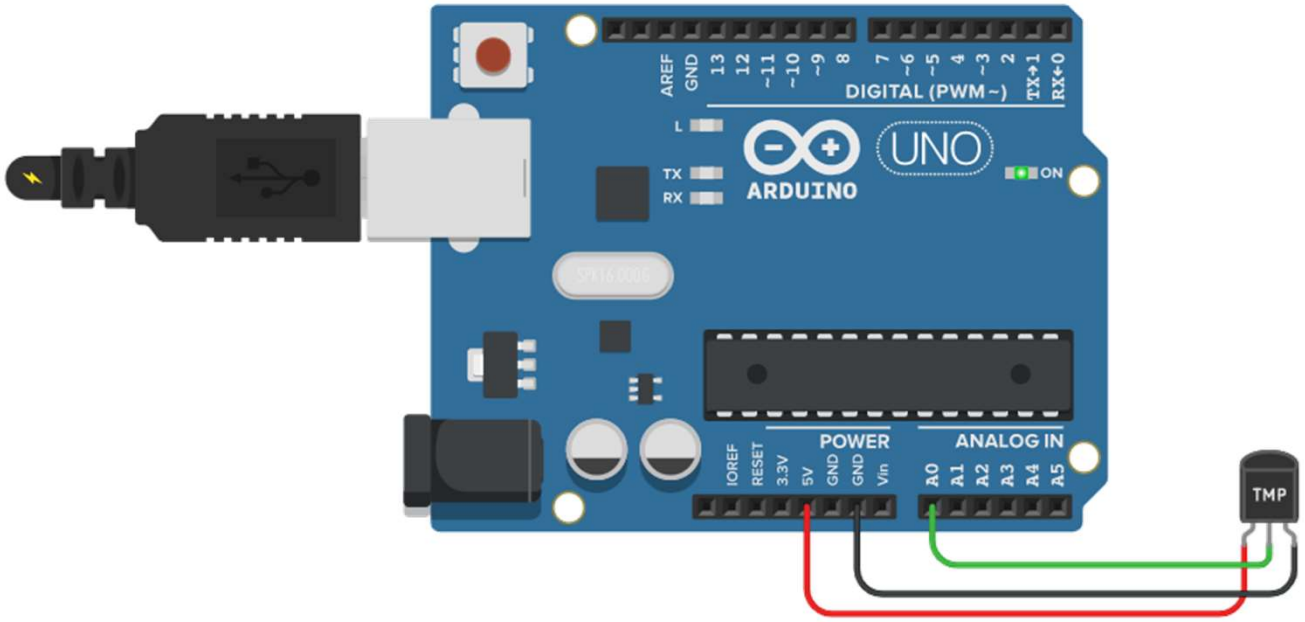
https://github.com/afai79/Arduino/blob/main/PIR_Sensor.ino

- LCD



https://github.com/afai79/Arduino/blob/main/LCD.ino

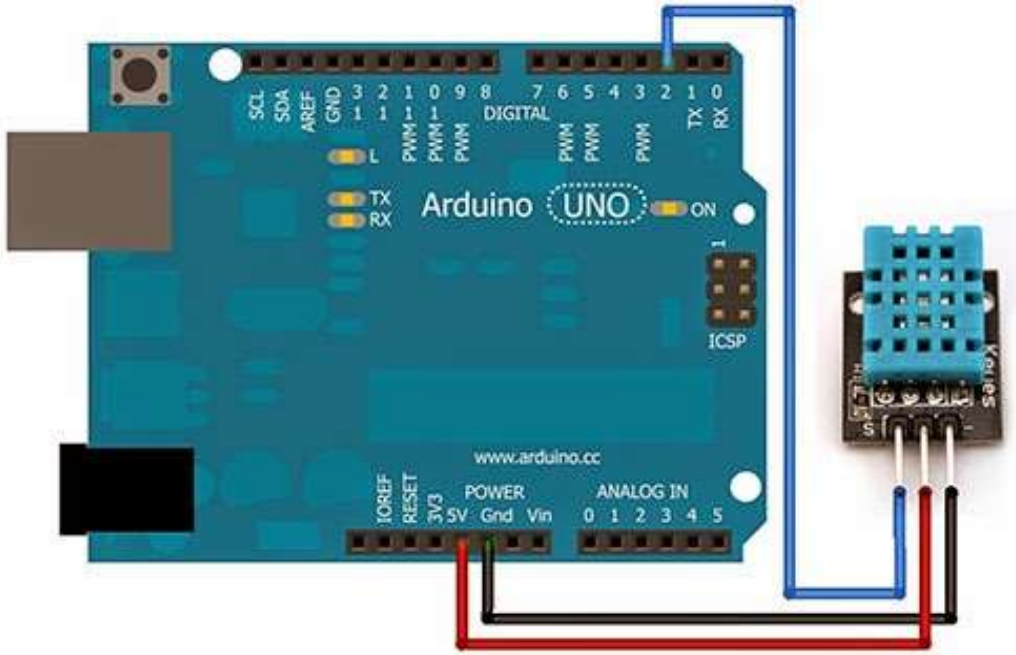
- Temperature sensor.



https://github.com/afai79/Arduino/blob/main/Temperature.ino

List of experiments

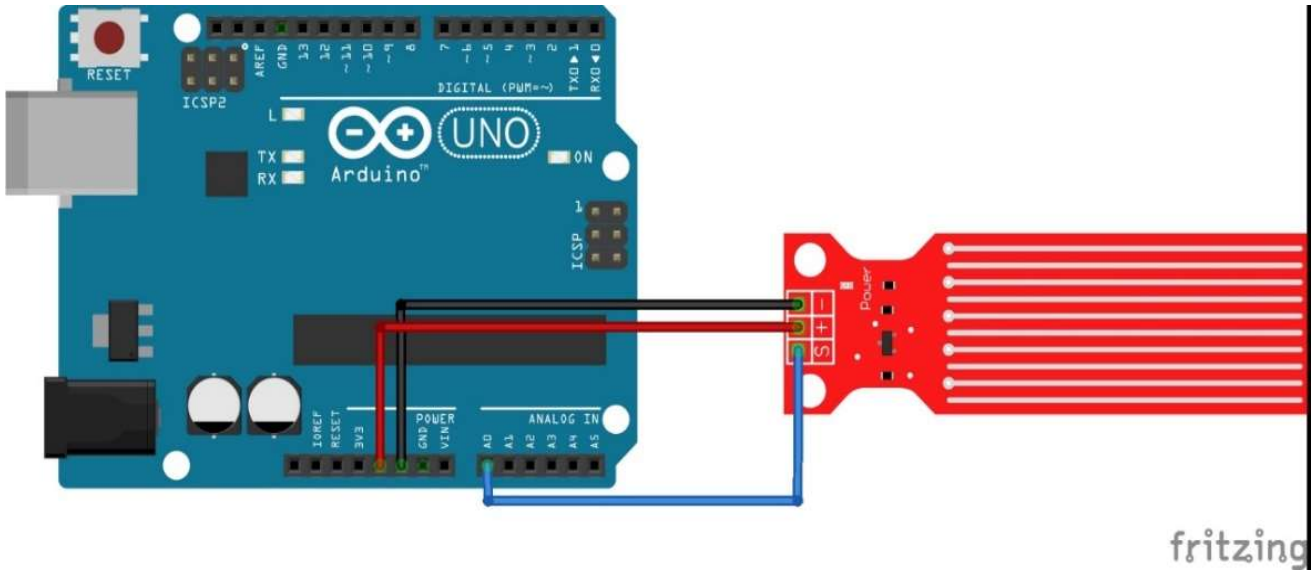
- Temperature and humidity sensor.



Code: **Lesson 11 DHT11 Temperature and Humidity Sensor**

https://github.com/afai79/Arduino/blob/main/Books/Elegoo.zip

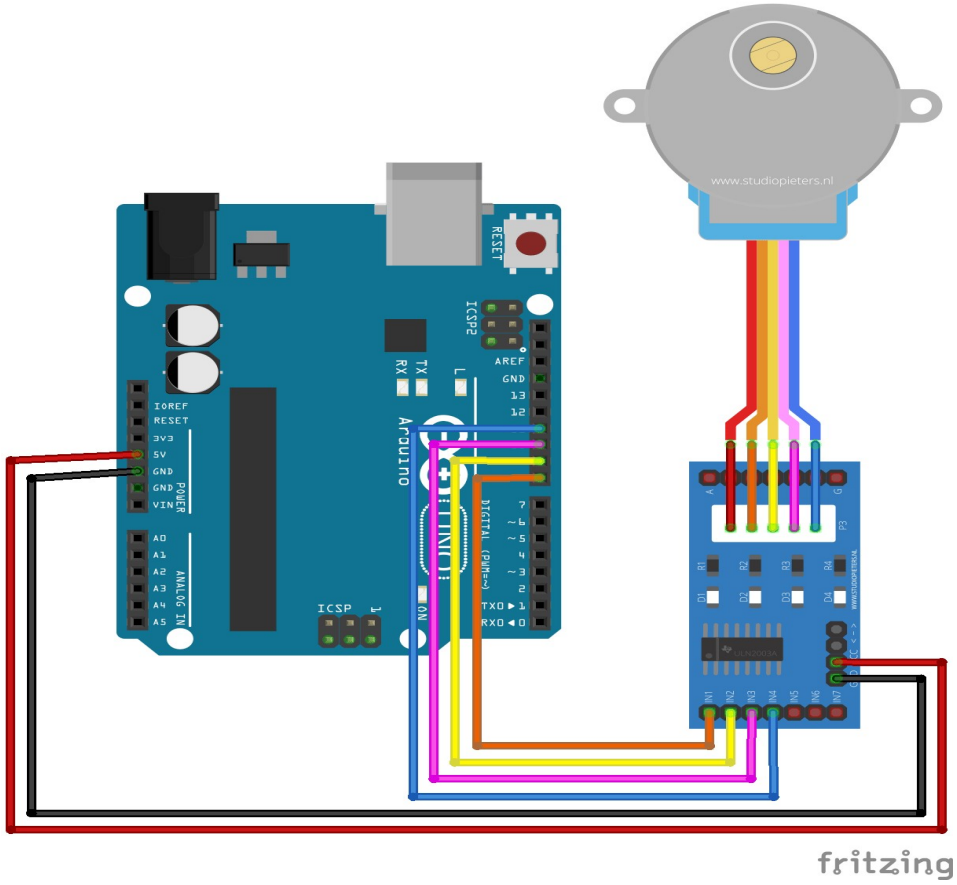
- Water level Sensor



https://www.thegeekpub.com/236571/arduino-water-level-sensor-tutorial/

https://github.com/afai79/Arduino/blob/main/water_level.ino

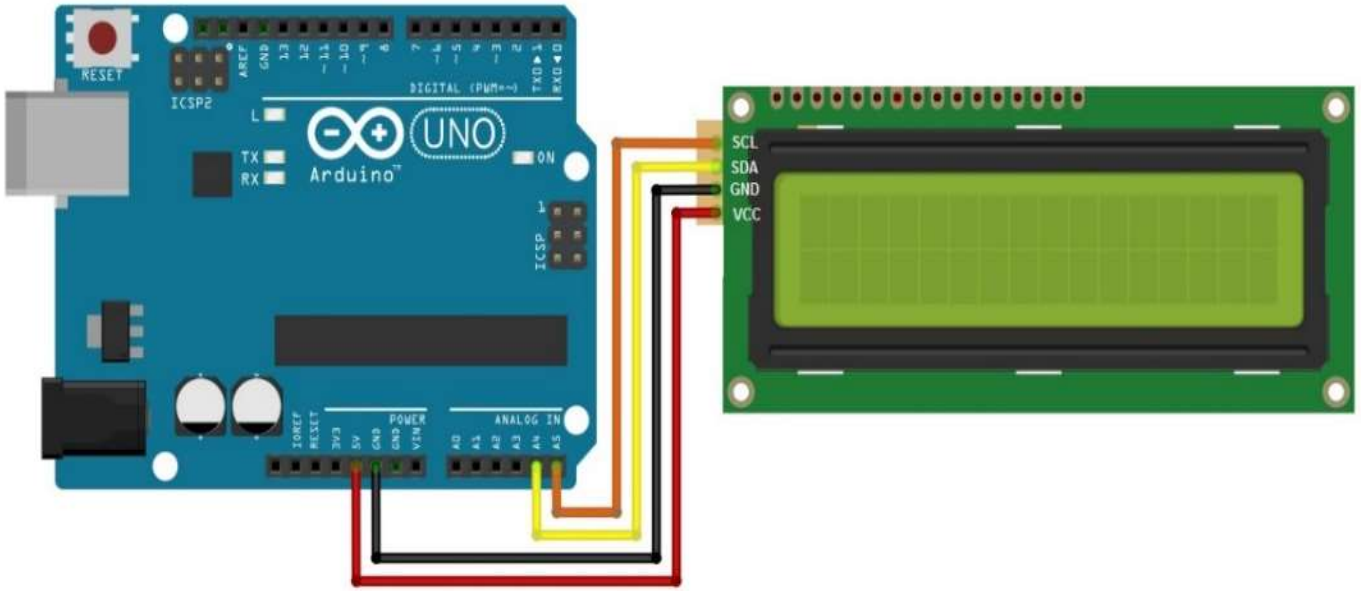
- Stepper motor



Code: Lesson 23 Stepper Motor

https://github.com/afai79/Arduino/blob/main/Books/Elegoo.zip

- LCD with I2C



https://github.com/afai79/Arduino/blob/main/LCD_I2C.ino

Day 4

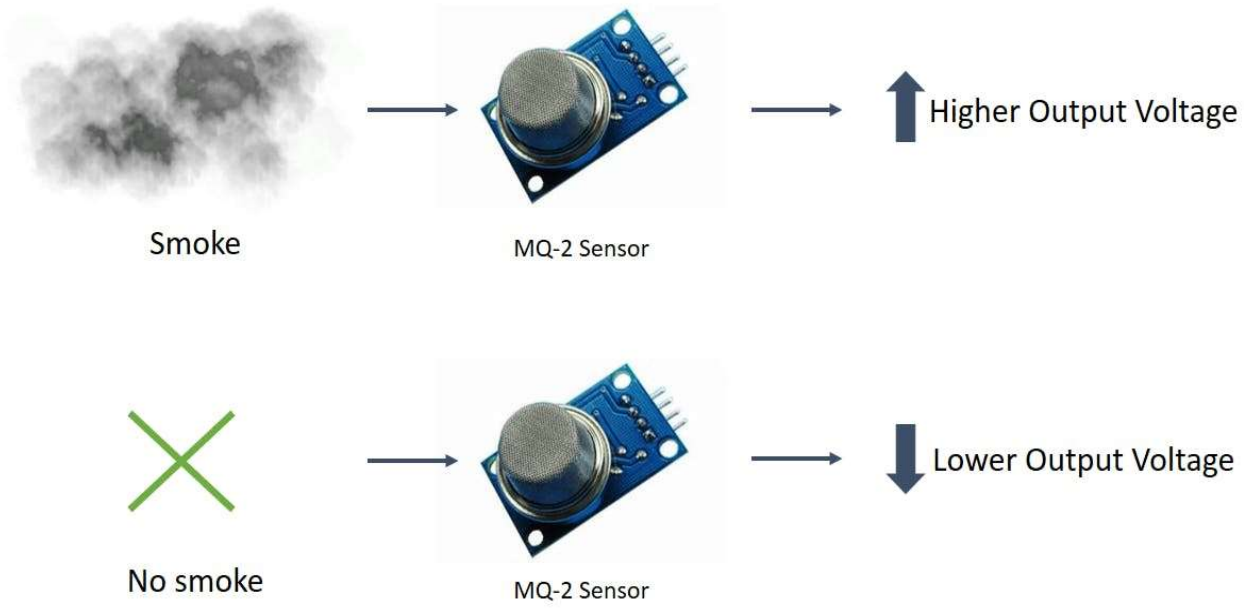
Having learnt to use a lot of sensors and devices with Arduino

During Day 4, you are ready to make various small projects based on your skills.

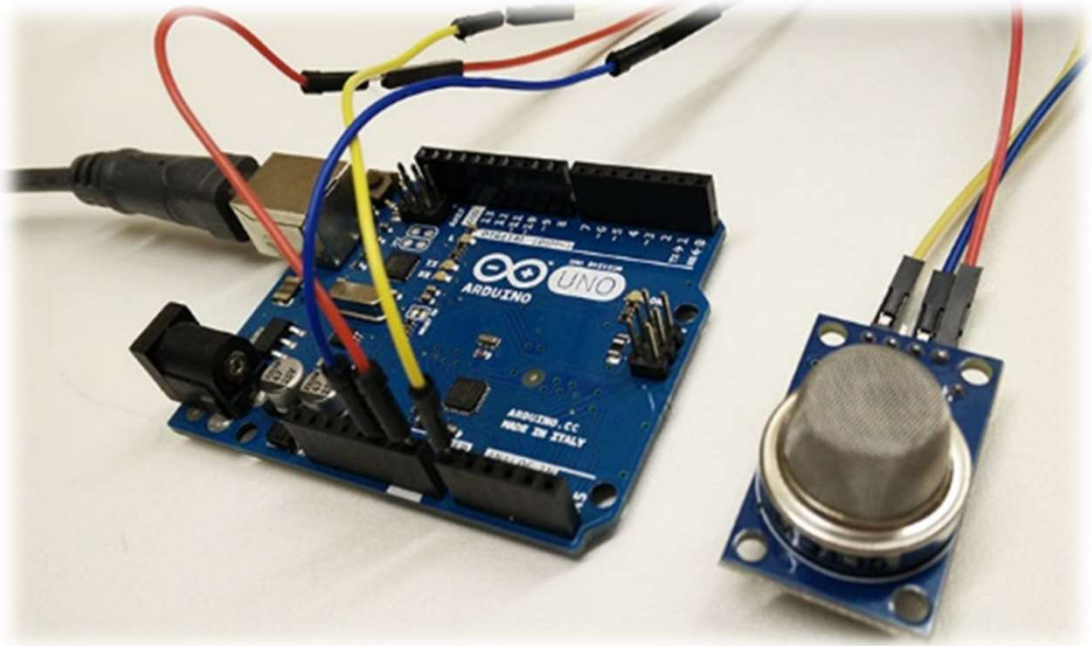
- Small Project **1**: Air Quality Detector
- Small Project **2**: Control servo motor by RGB sensor
- Small Project **3**: Smart House

Small Project 1: Air Quality Detector

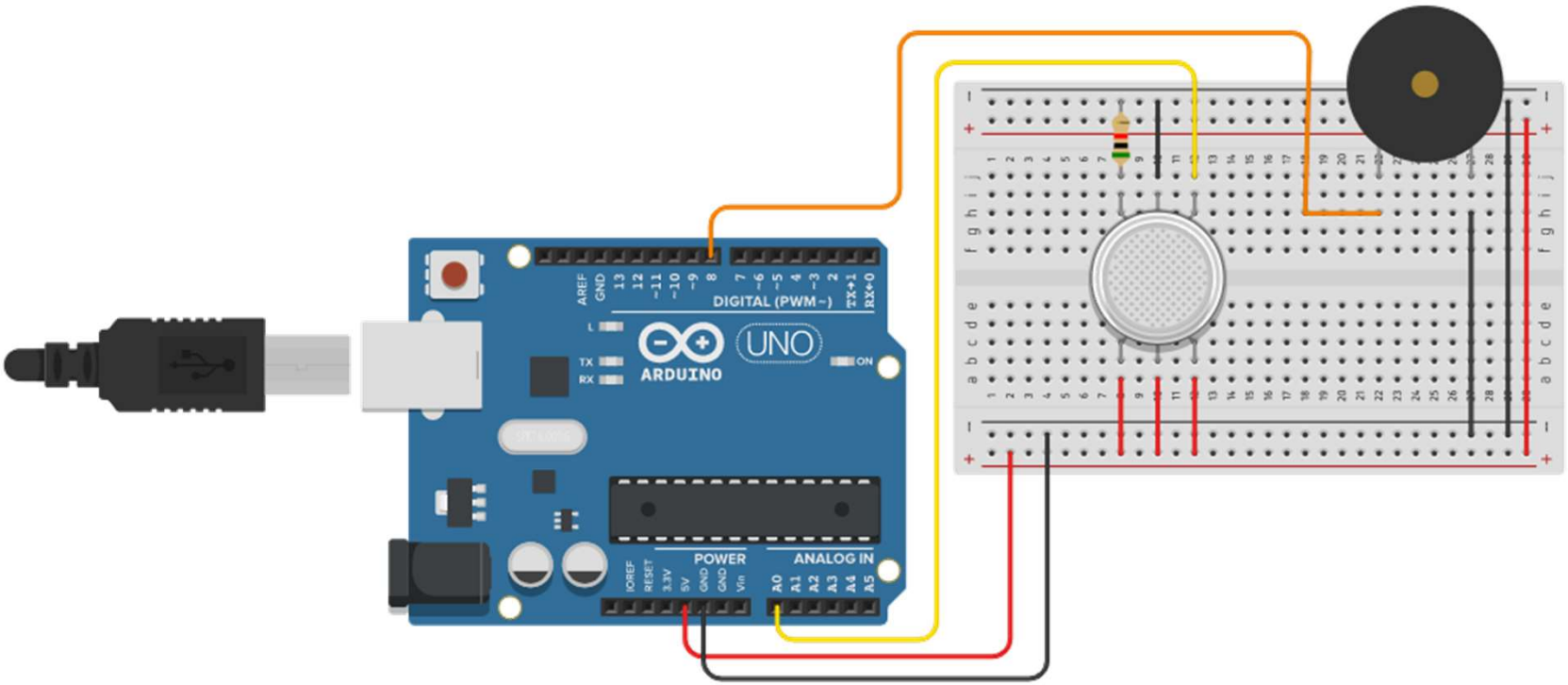
- **Gas Sensor**



Model	Gas Detection
MQ2	flammable gas/smoke
MQ3	alcohol steam
MQ4	Natural gas/Methane
MQ5	Liquefied gas/Methane/Coal gas /LPG
MQ6	Liquefied gas/Isobutane/Propane/LPG
MQ7	Carbon monoxide
MQ8	hydrogen
MQ9	Carbon monoxide flammable gas
MQ131	Ozone Concentration
MQ135	Ammonia/sulfide/benzene vapor
A set of MQ	

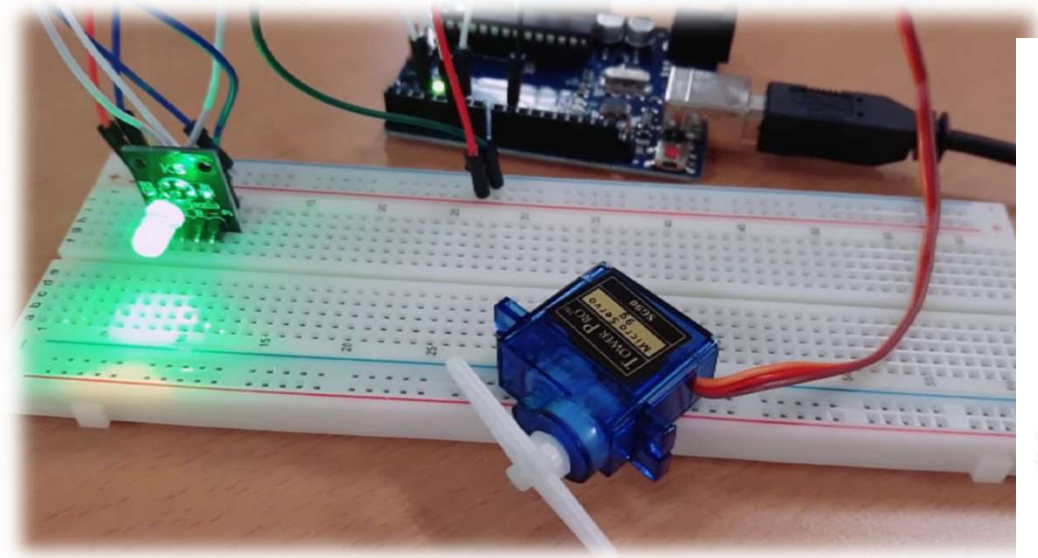


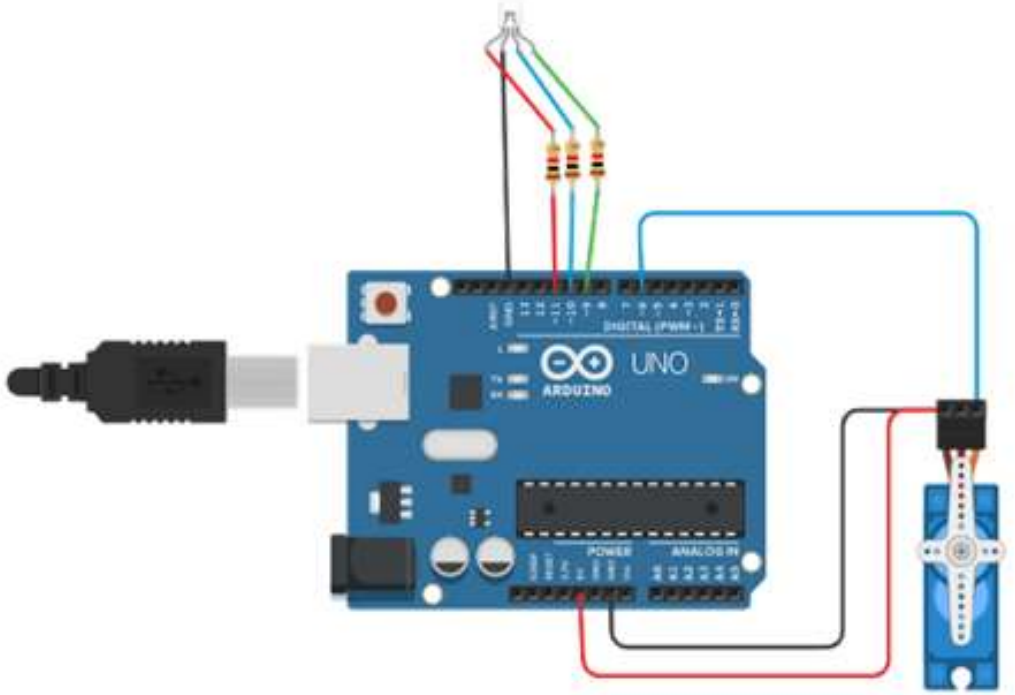
https://github.com/afai79/Arduino/blob/main/Gas_sensor.ino
https://github.com/afai79/Arduino/blob/main/Gas_sensor-LED-Motor.ino



https://github.com/afai79/Arduino/blob/main/Gas_Piezo.ino

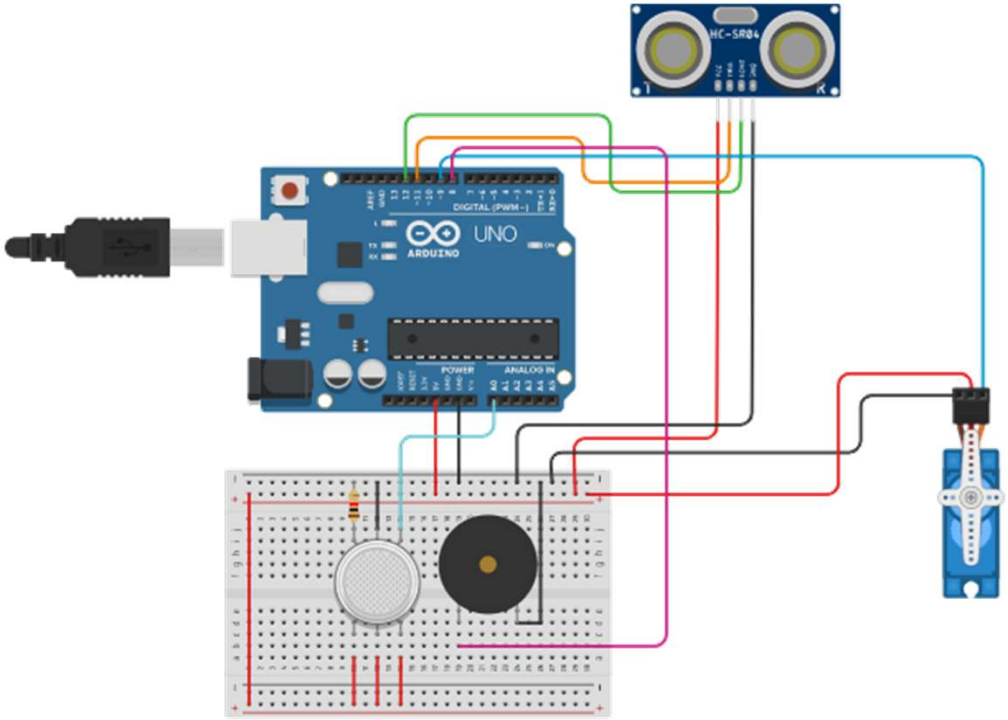
Small Project 2: Control servo motor by RGB sensor





https://github.com/afai79/Arduino/blob/main/RGB_LED-motor.ino

Small Project 3: Smart House



https://github.com/afai79/Arduino/blob/main/Ultrasonic_Servo_Gas_P.ino

Day 5

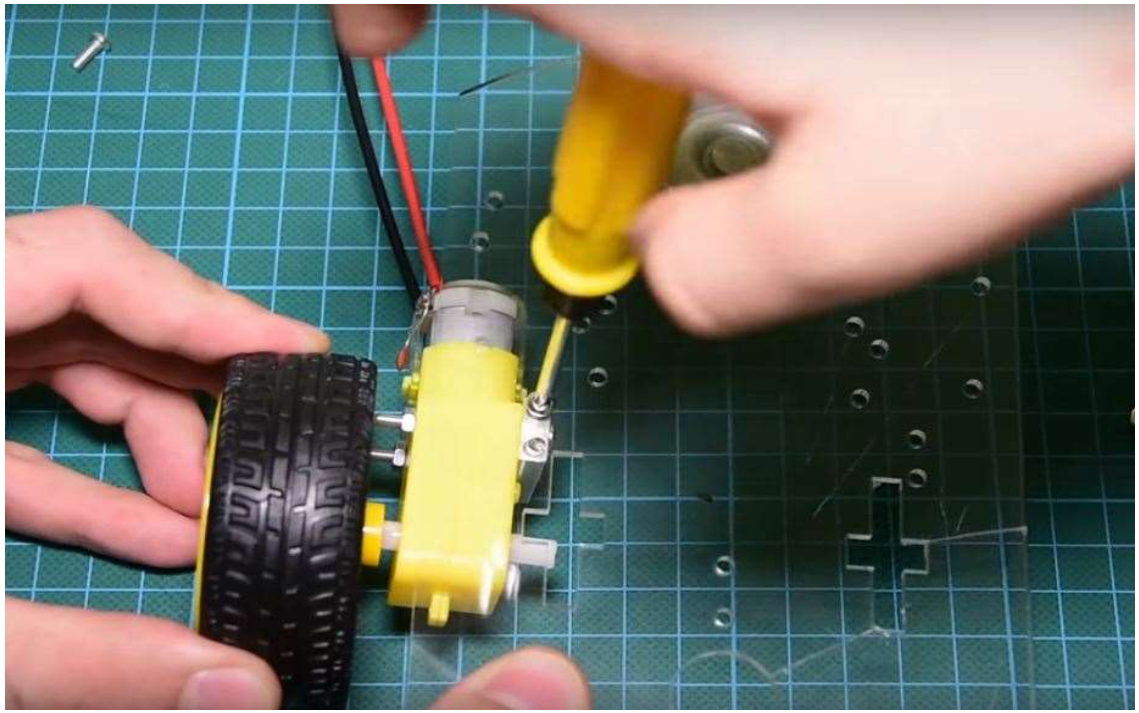
- **Arduino Robot – An easy DIY project**
  - We are going to build an Arduino based robot capable of avoiding obstacles in its path.
  - It is a fun project and a great learning experience, so without any further delay, let us get started!

https://educ8s.tv/arduino-robot-easy-diy-project/

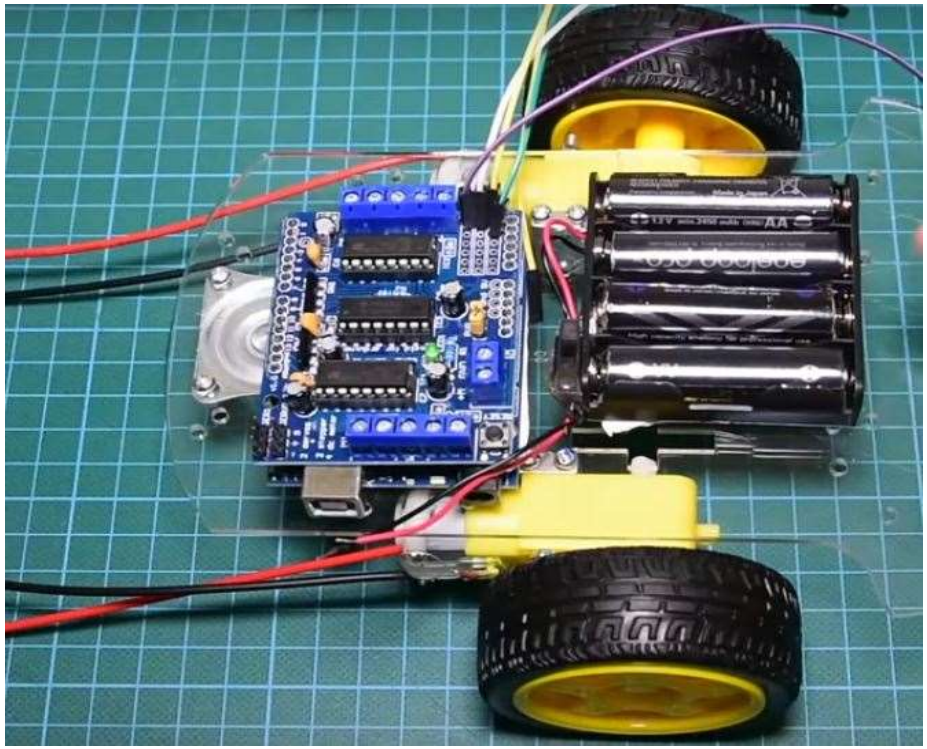
https://github.com/afai79/Arduino/tree/main/ArduinoRobot

Building the Robot

- **Step 1. Connect the motor and wheels to the chassis.**

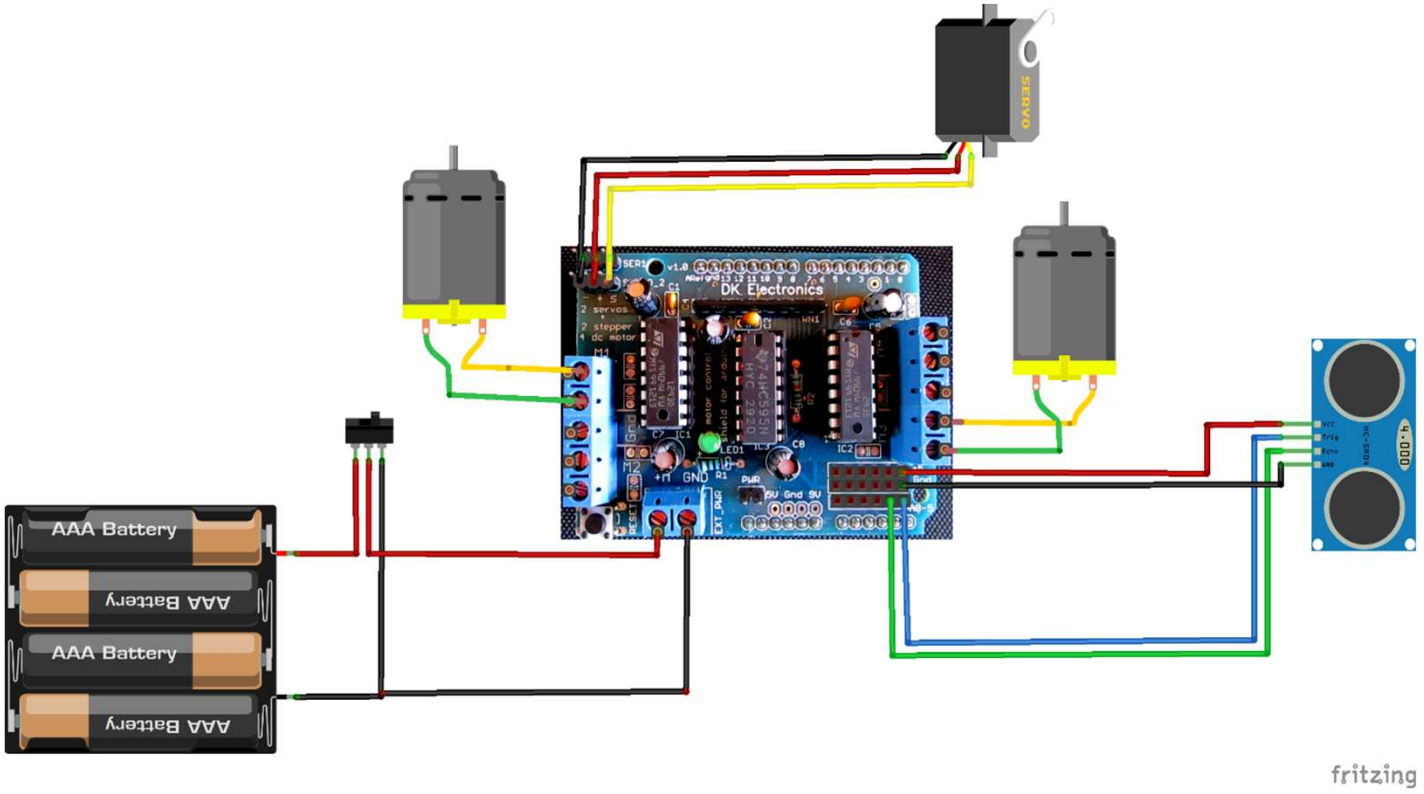


- **Step 2: Prepare the Switch and connect the Power Source**
- **Step 3: Mount other Parts on the chassis.**



Schematics

- Wire up the components together as shown in the image below.



Code

- The code uses three libraries.
  - Two of them must be downloaded for the program to compile.
  - The first one is the motor shield driver from Adafruit.
  - The second library is the NewPing library for the supersonic distance sensor.

https://github.com/afai79/Arduino/blob/main/ArduinoRobot/ArduinoRobot_.ino

LIBRARIES

- **Motor Shield Library:**

https://github.com/afai79/Arduino/blob/main/ArduinoRobot/Adafruit-Motor-Shield-library-master.zip

- **New Ping Library:**

https://github.com/afai79/Arduino/blob/main/ArduinoRobot/NewPing_v1.9.1.zip

End of Training!