

C0Ding Workshop Wk03:Yuta Nakayama

Quick Review: Week 02

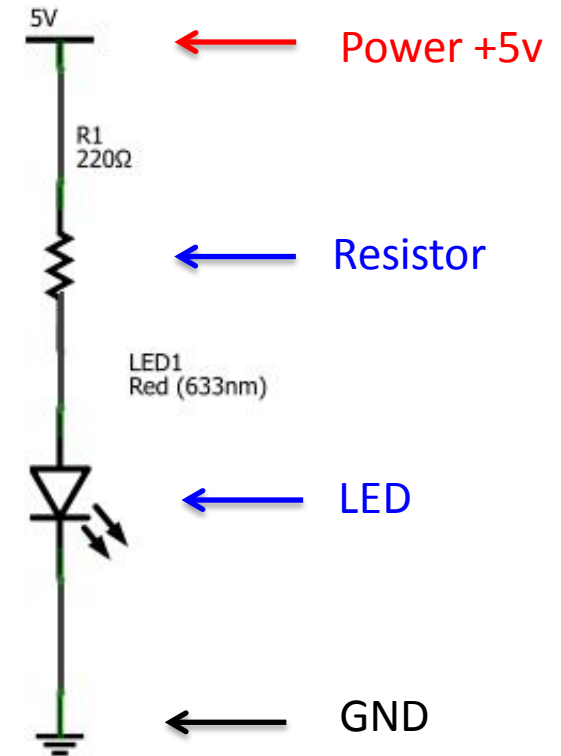
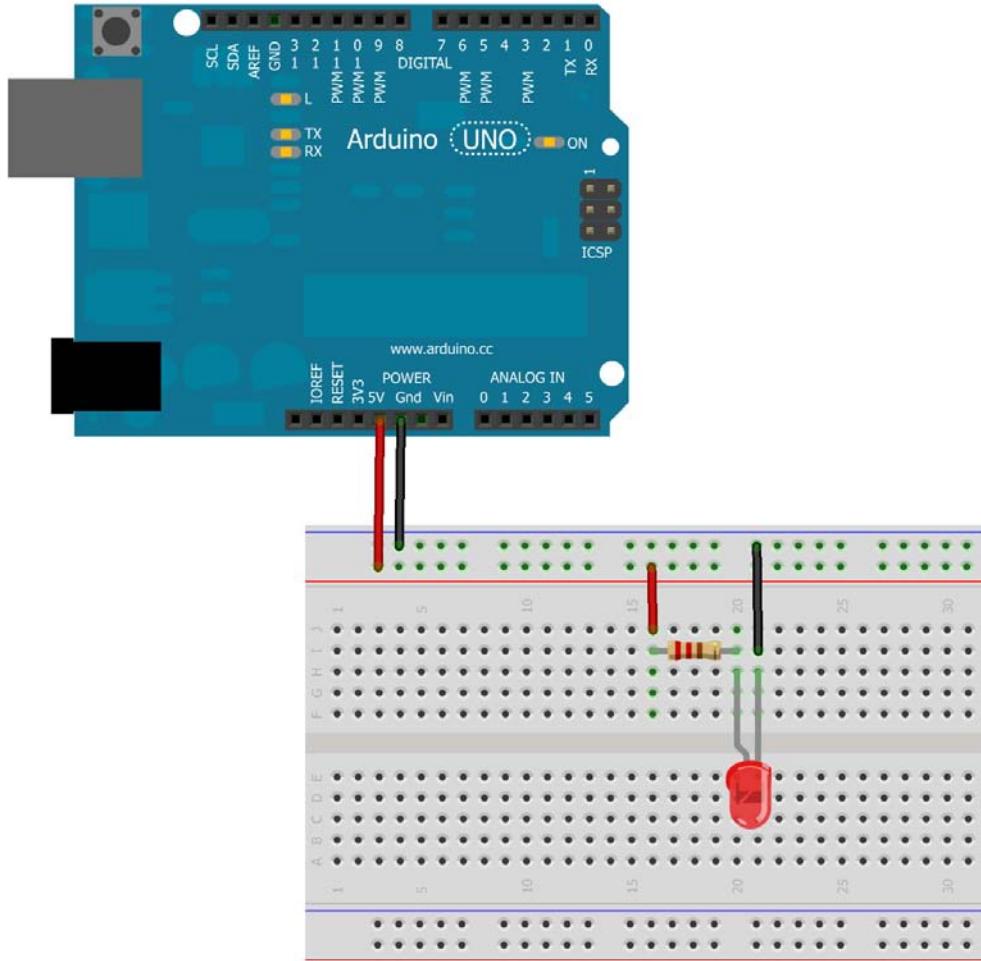
- **Introduction to Electronics/Arduino Programming**

- Digital Input / Output
digitalRead(); | digitalWrite();

- **Analog Input / Output**
analogRead(); | analogWrite();

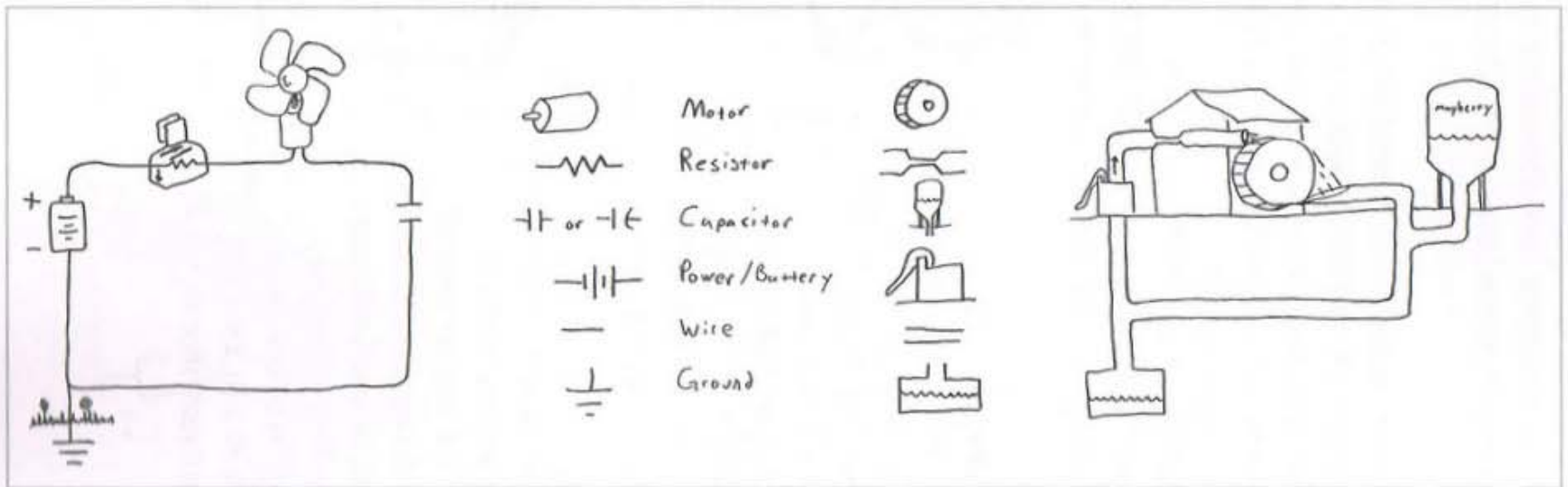
- Sensor Input
map();
Serial.begin();
Serial.print();/ Serial.println();

LED1:: My 1st LED Circuit



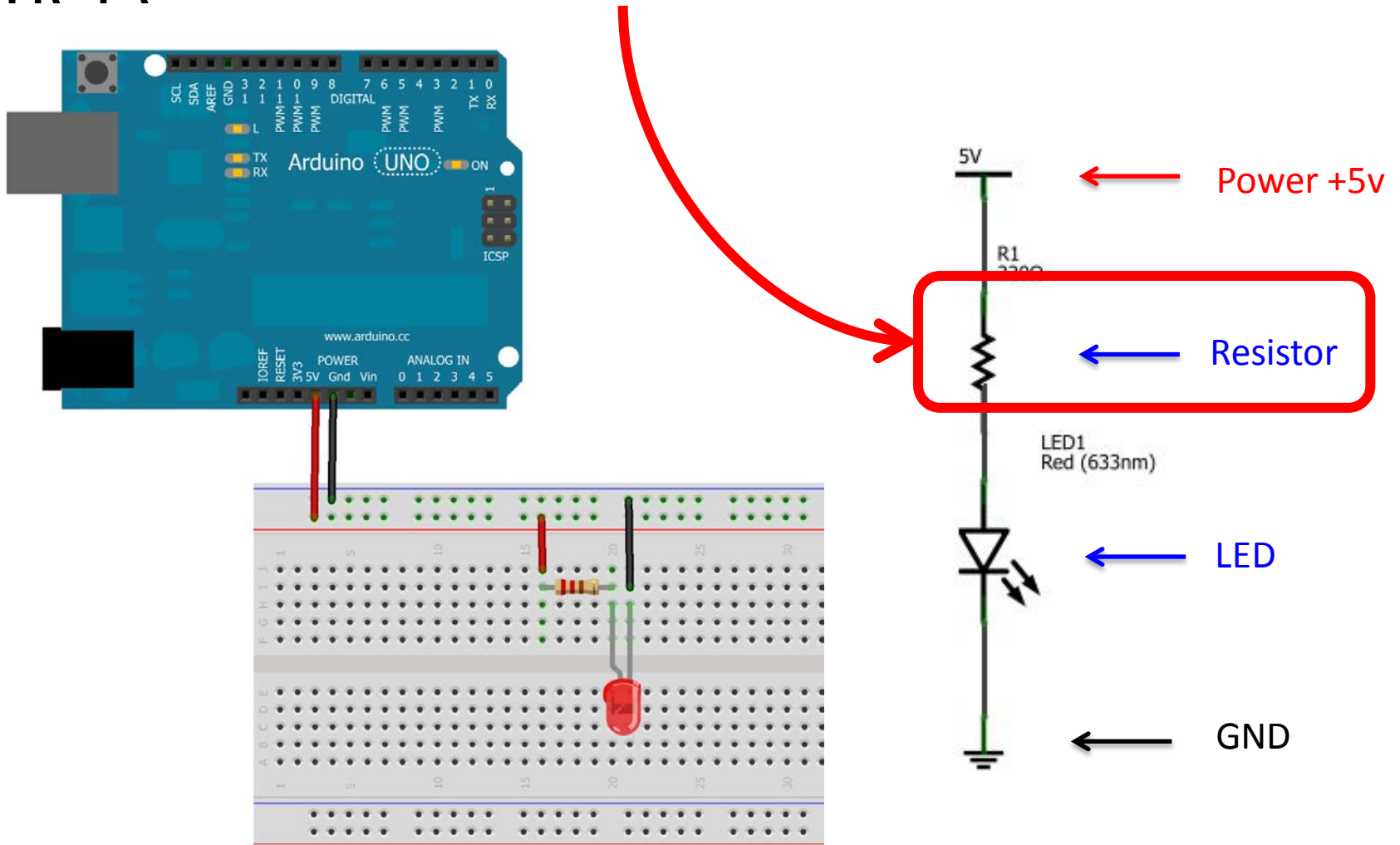
Water Analogy of Electrical Circuit

FIGURE 5-4 Water analogy ecosystem representing electricity flow through electronic components

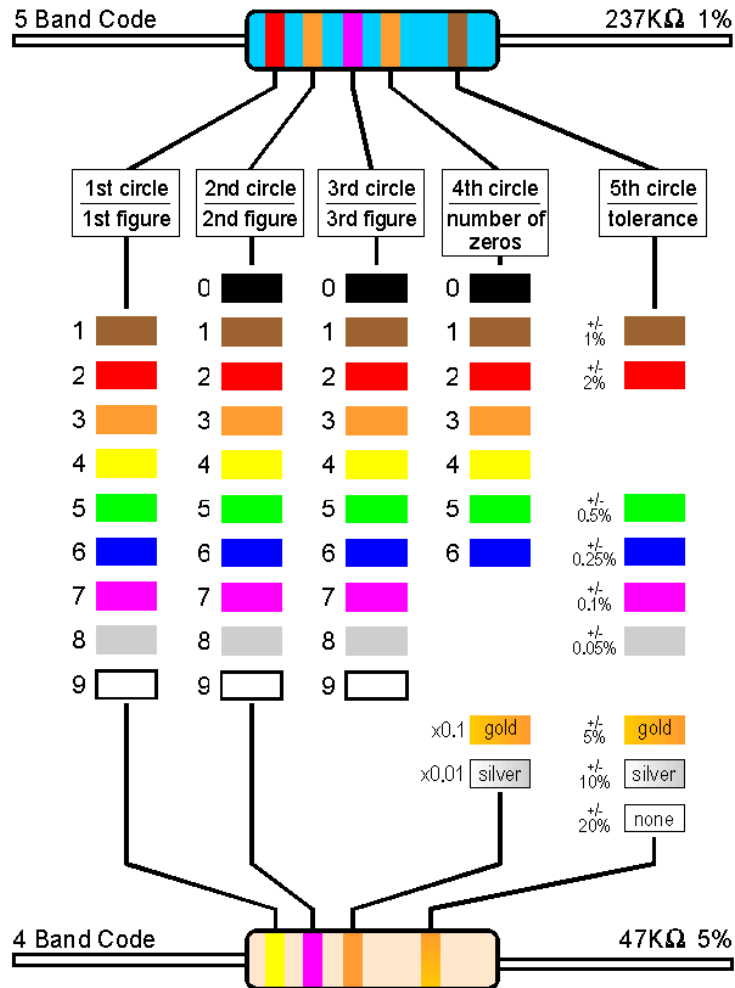


Making Things Move

Q1: Why do you need a resistor here?



Resistor ColorCode



1 : Brown

2 : Red

3 : Orange

4 : Yellow

5 : Green

6 : Blue

7 : Purple

8 : Gray

9 : White

0 : Black

Tolerance

+/- 5% : Gold

+/- 10% : Silver

Reading Resistor Color Code



Brown Black Red Gold

$$1 \quad 0 \quad \times \quad 100 \quad \pm 5\% = 1000 = 1k \text{ Ohm}$$



Yellow Purple Orange Gold

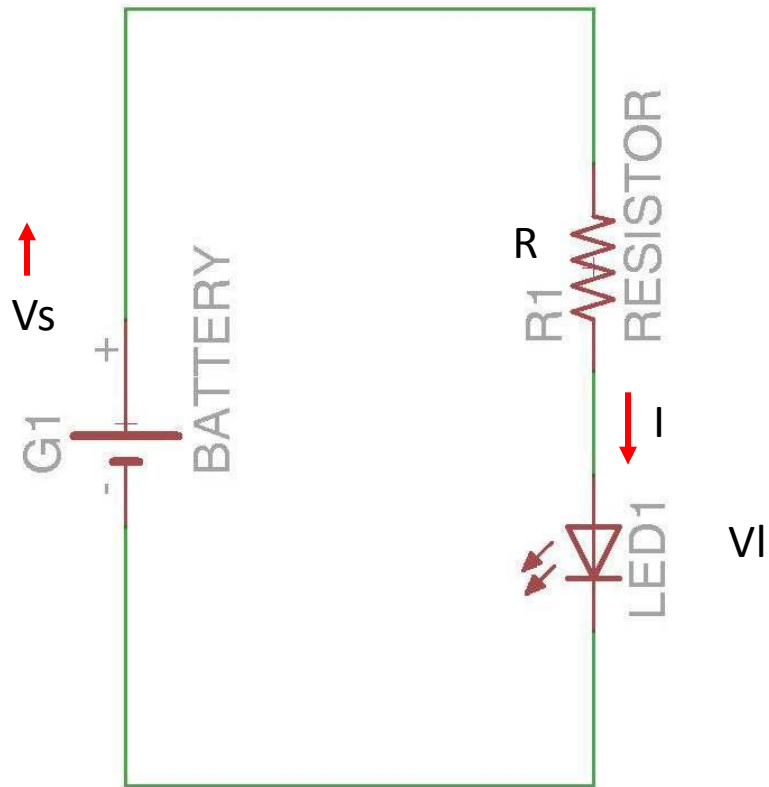
$$4 \quad 7 \quad \times \quad 1000 \quad \pm 5\% = 47000 = 47k$$



Brown Black Orange Gold

$$? \quad ? \quad \times \quad 1? \quad ? = ???$$

How to lit a LED?



- V_s = Battery Voltage
- V_I = LED forward voltage
- R = Resistance
- I = LED Current

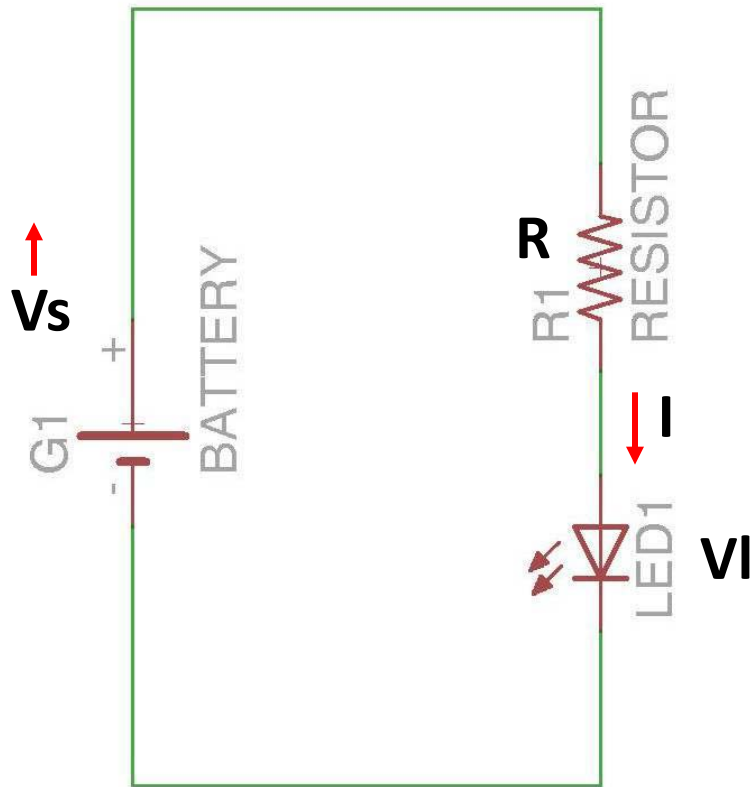
LED Brightness = I = LED current. Usually 10mA ~ 30mA

Ohm's Law

- $V = IR$:
 - Voltage = Current x Resistance
- $I = V / R$:
 - Current = Voltage / Resistance
- $R = V / I$:
 - Resistance = Voltage / Current

How to lit a LED?

= How to choose resistor value?



- $R = (V_s - V_f) / I$

$$V_s = 5v$$

$$V_f = 1.5$$

$$I = 20mA(0.02A)$$

$$R = (5 - 1.5) / 0.02$$
$$= 375 \text{ ohm}$$

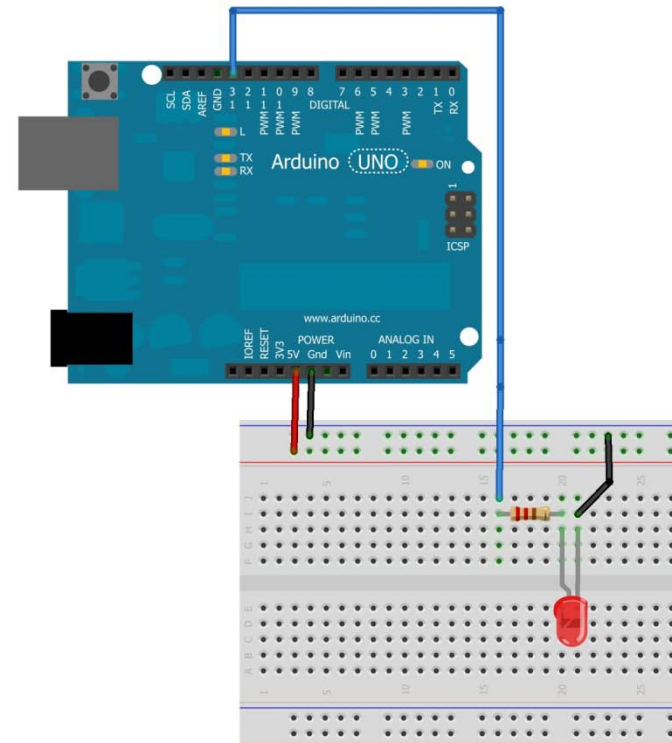
Cable Color Convention

Power Line = RED

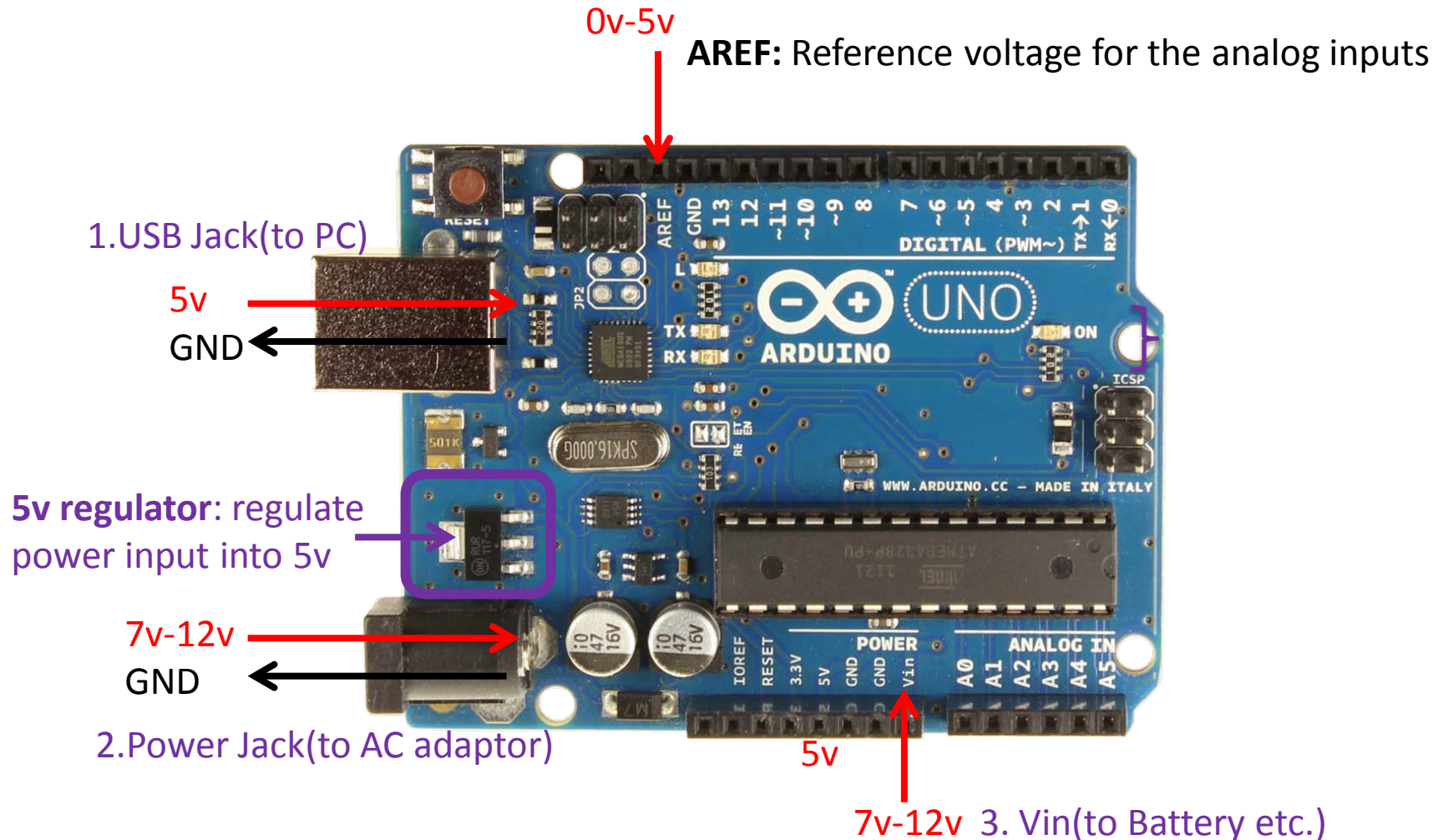
Ground Line = Black

Signal Line = Blue

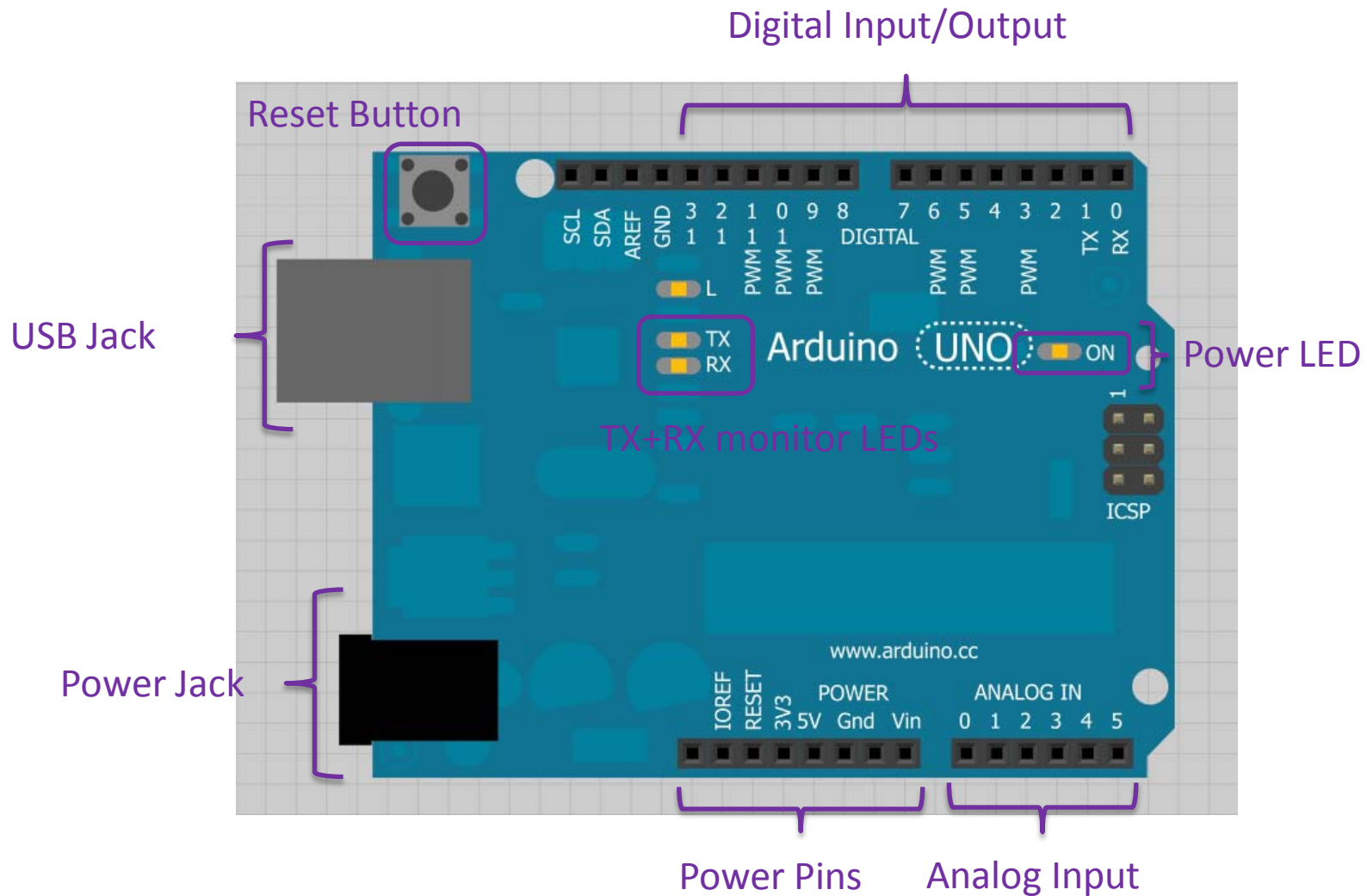
Helps you to find out
Short circuit/Power failure



Arduino Board(Power Signal)

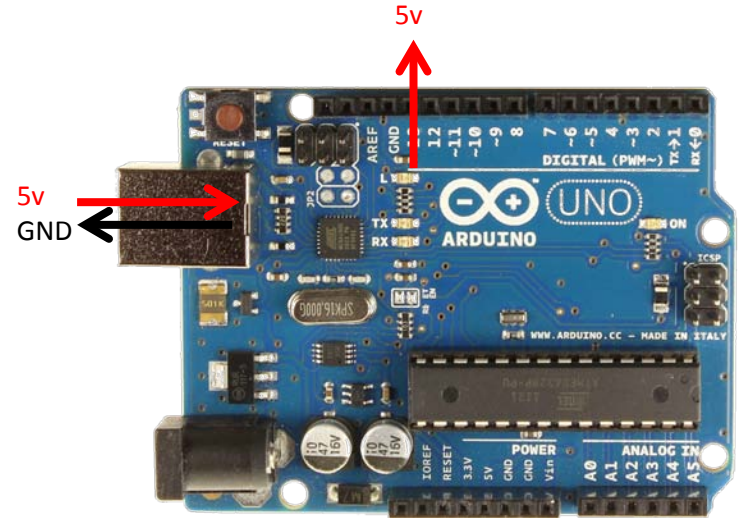


Arduino Board

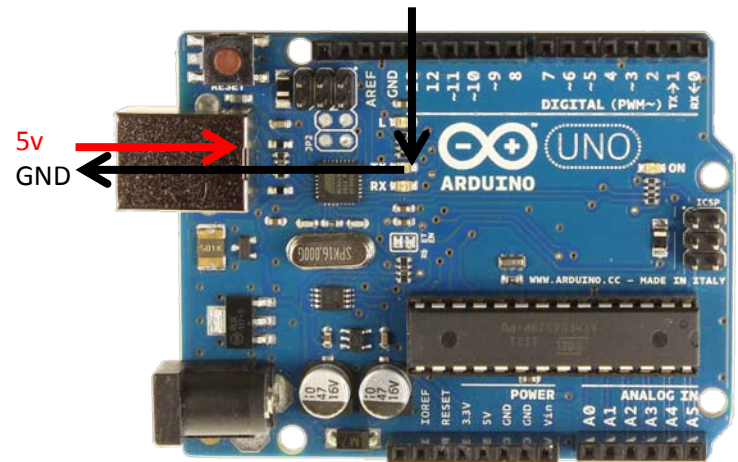


digitalWrite(pin,value)

```
digitalWrite(11,HIGH);
```

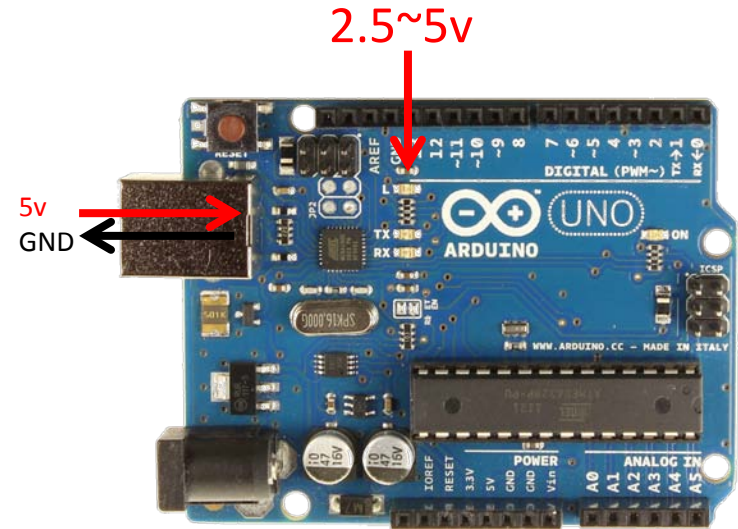


```
digitalWrite(11,LOW);
```

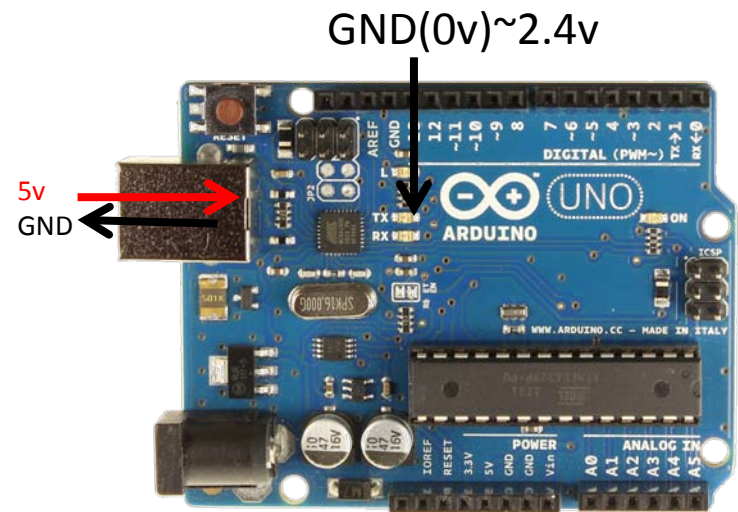


`digitalRead(pin)`

HIGH

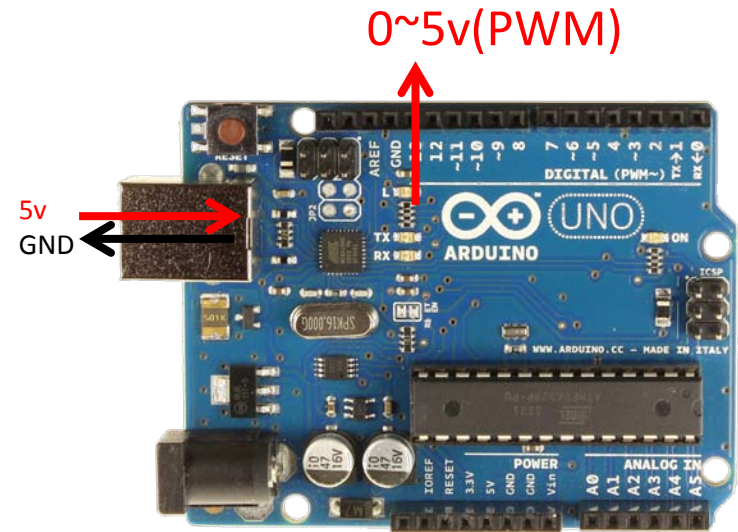


LOW

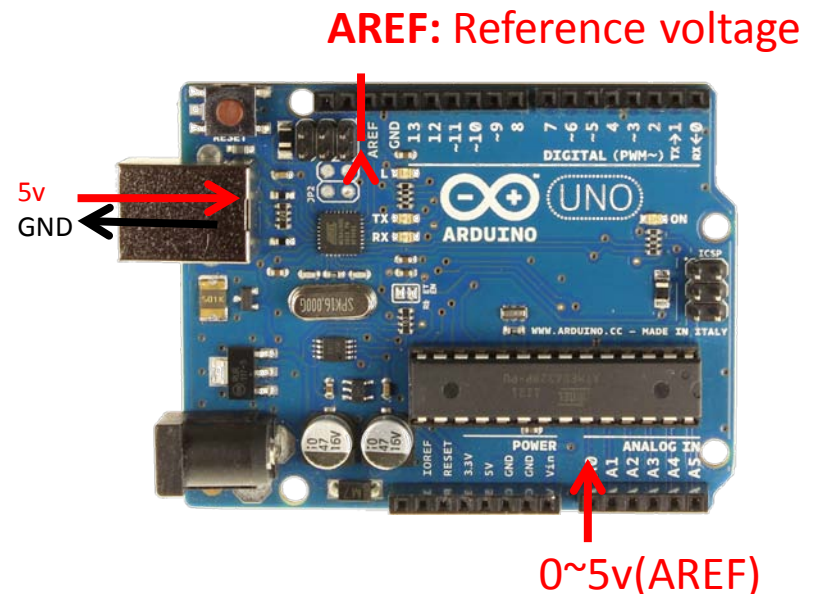


`analogWrite(pin, val), /analogRead(p
in)`

Output analog-signal(PWM):
value : 0 ~ 255
voltage: 0 ~ 5v



Read analog-signal:
voltage : 0 ~ 5v(**AREF**)
value: 0 ~ 1023



Power Sources



dry-cell battery
(1.2 ~ 1.5v)



Li-poly battery
(3v ~ 3.7v)



ACAdaptor
(5v ~ 24v)

Battery Types



Round
1.2v-1.5v
600-2800mAh



Lithium cells
3v
30-1000mAh



Lithium-polymer
3v~3.7
30-3000mAh

Battery Capacity



+

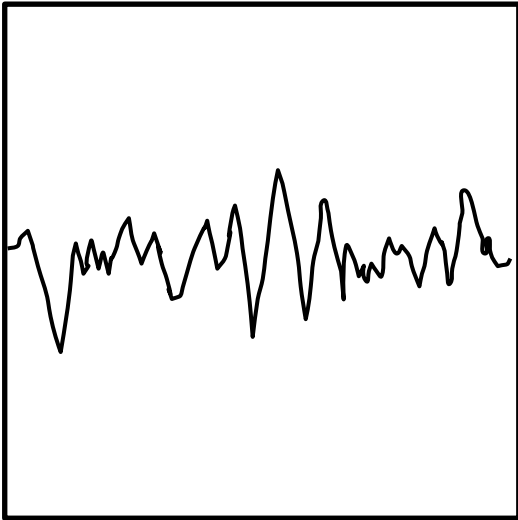


Lithium cell battery
1000mAh

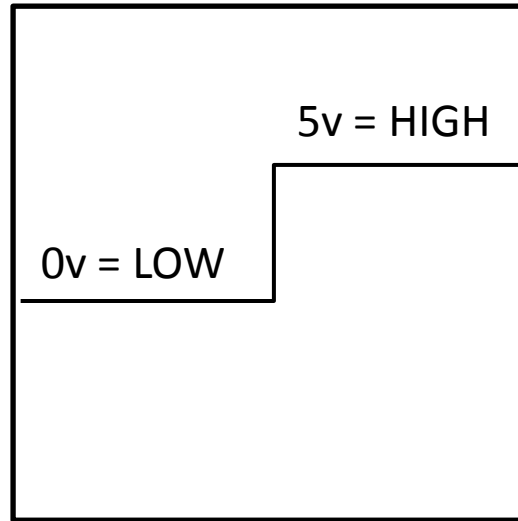
LED at 20mA

$$= \frac{1000\text{mAh}}{20\text{mA}} = 5\text{hr}$$

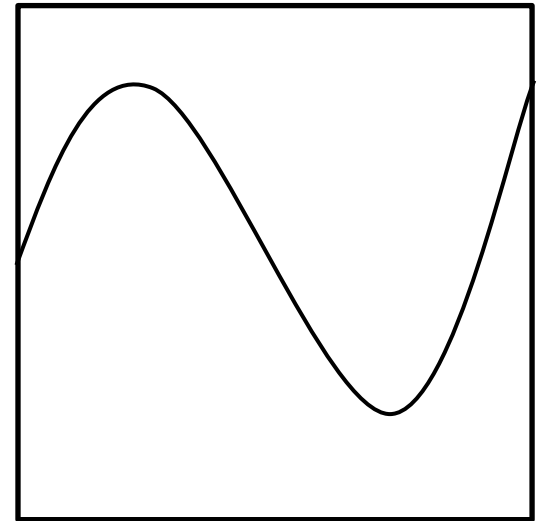
Electrical Signals



Analog



Digital Signal
TTL(5v)/LVTTTL3.3



AC Power Signal
(245v 50hz)

Quick Overview: Week 03

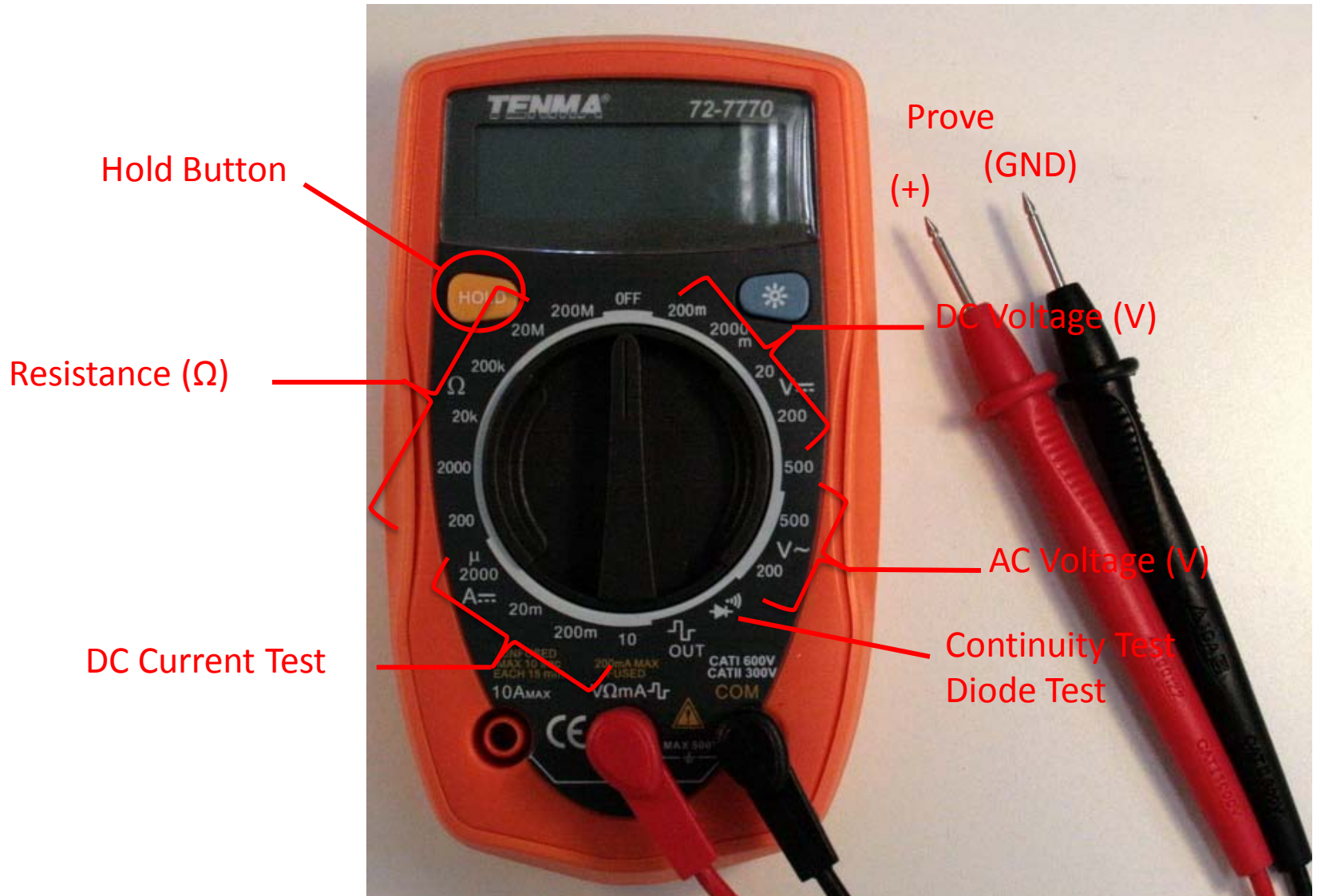
- **Introduction to Sensor/Actuator Modules**
- ***3-1 Sensor modules (1hr)***
 - Touch Sensor/ Sound Sensor/Pressure Sensor/
- ***3-2 Actuators and Basic Mechatronics (1hr)***
 - DC motor/Servo motor/Stepper motor/Solenoid
 - *Lever/Pulley/Gear*
- **Circuit Bending Exercise (2hr)**

Multimeter

- Resistance (Ω)
- DC Voltage (V)
- AC Voltage (V)
- DC Current (A)
- Continuity Test
- Diode Test



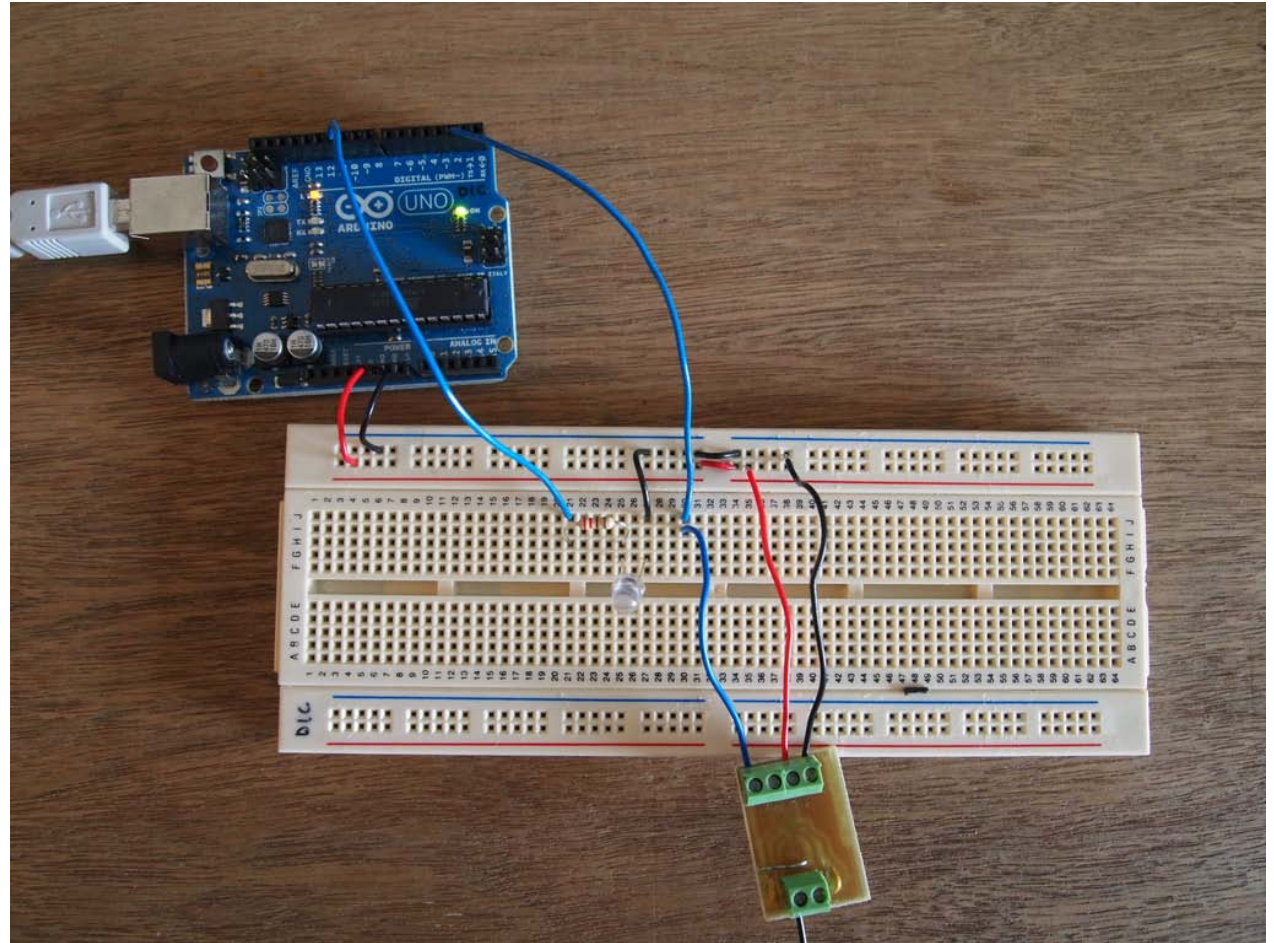
Multimeter



3-1 Sensor modules (1hr)

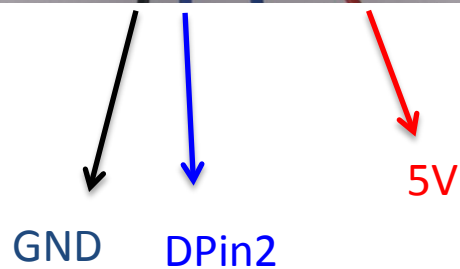
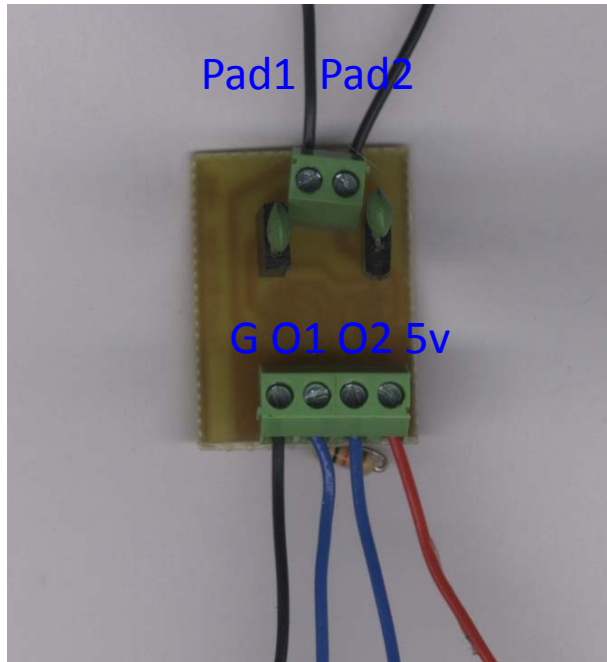
- Light Sensor
- Touch sensor
- Sound sensor
- Pressure Sensor

Touch Sensor/

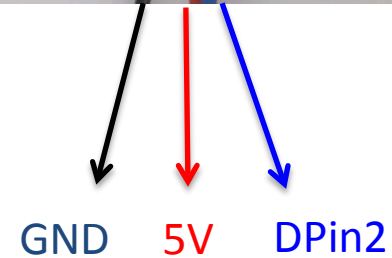


Touch Sensor

2ch Touch Sensor Module



1ch Touch Sensor Module

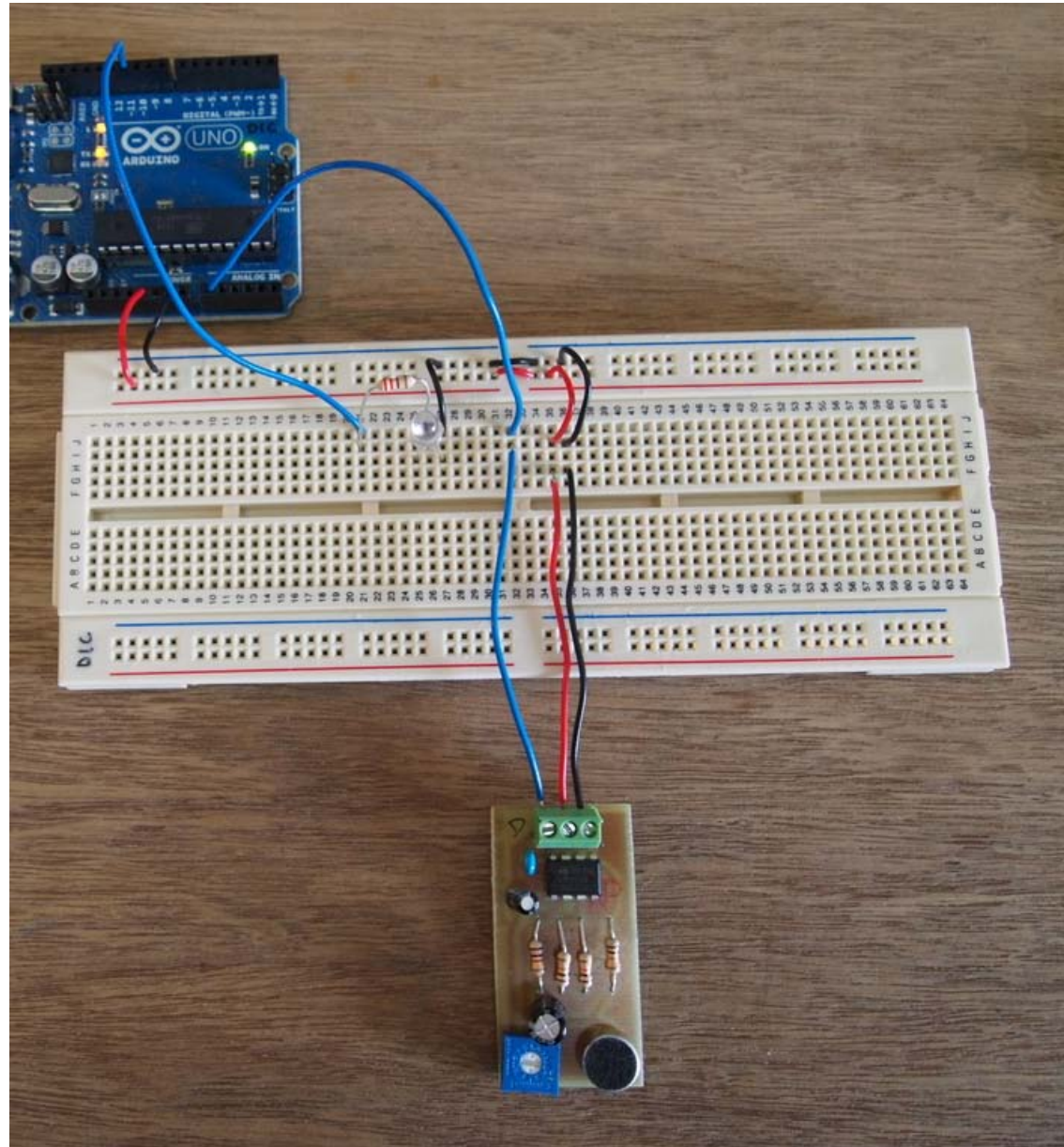


Sound Sensor/

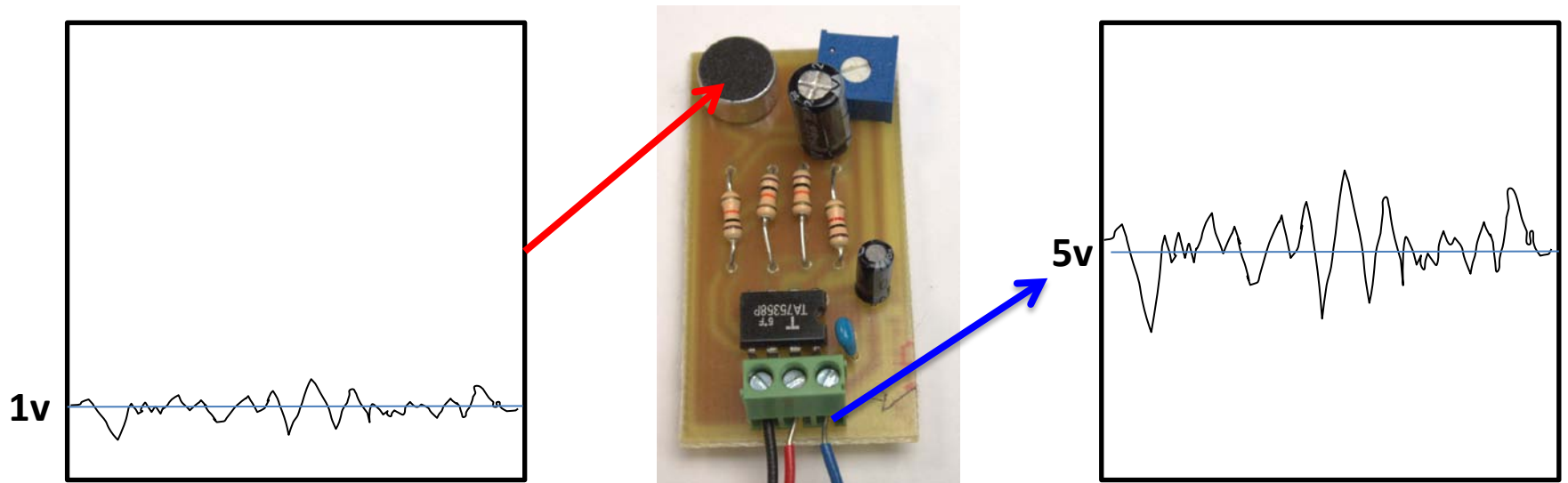
microphone mic gain



GND 5V A0

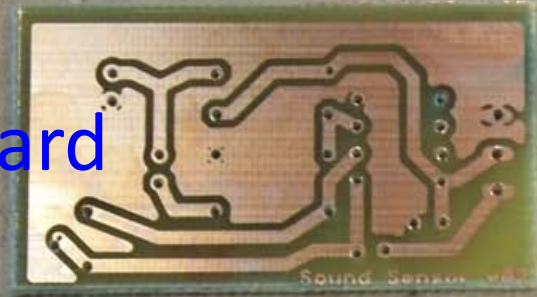


SoundSensor/ microphone amplifier



Sound Sensor Components List

PCB board



mic

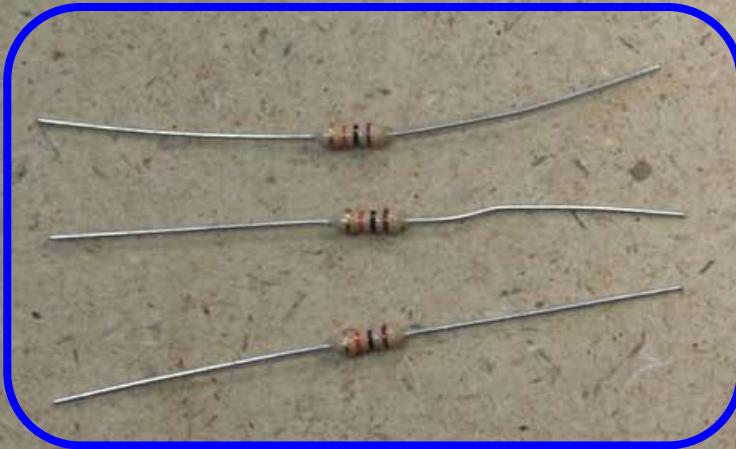


Capacitor
220uF 10uF



10K

Resistors



1K



Potentiometer
(100k)



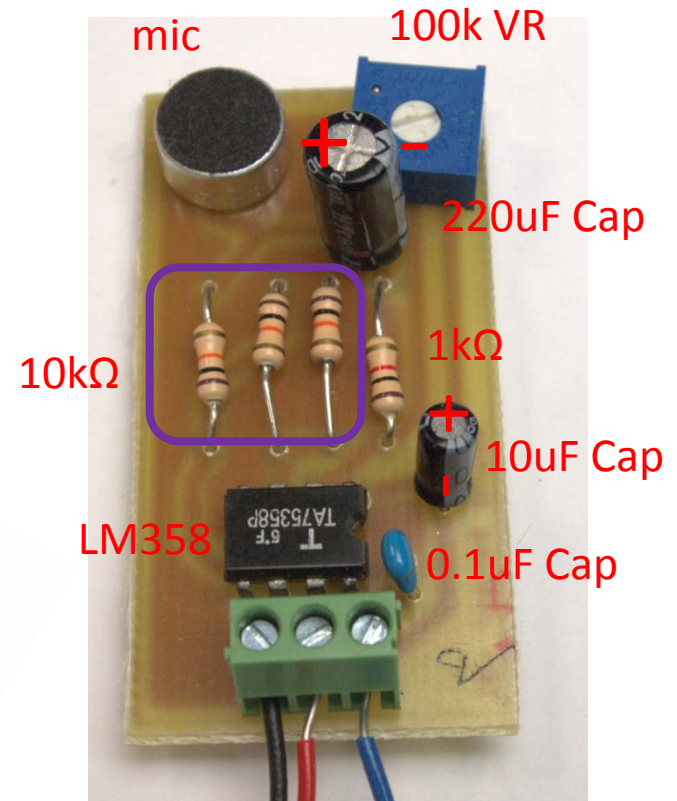
OpAmp
(lm358)



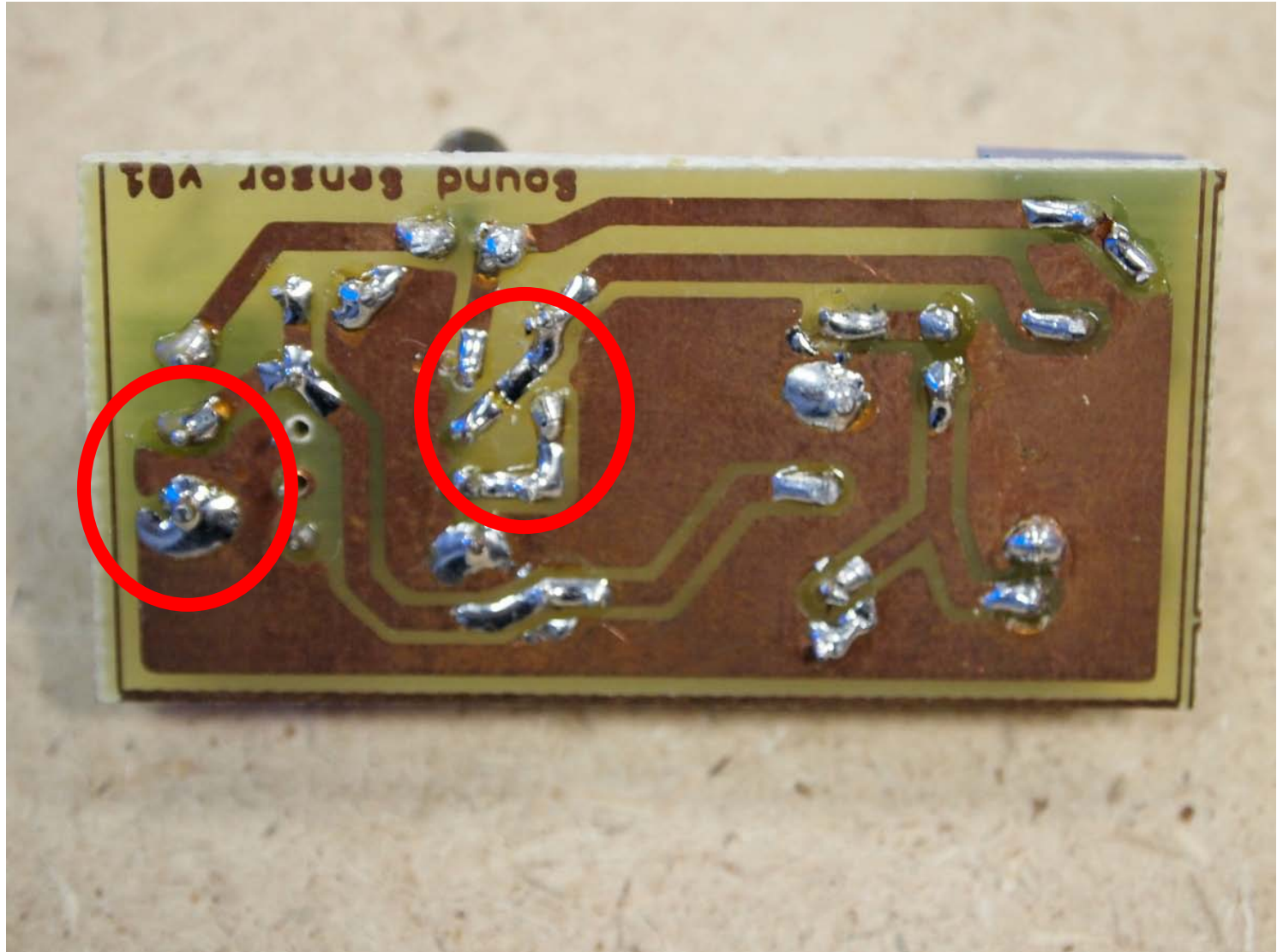
Sound Sensor ASSY

Order of Soldering
(shorter profile first)

1. Resistors(10kΩ x3 1kΩ x1)
2. LM358
3. 0.1uF Capacitor
4. mic and 100kVP
5. 220uF & 10uF
6. 3pin Connector

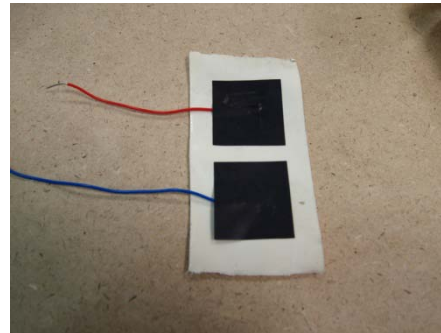
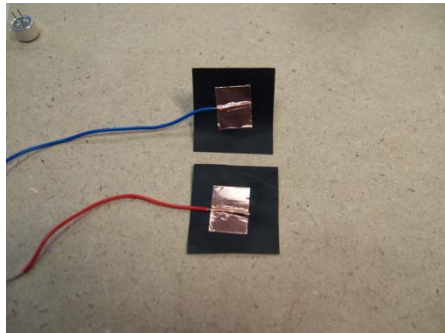
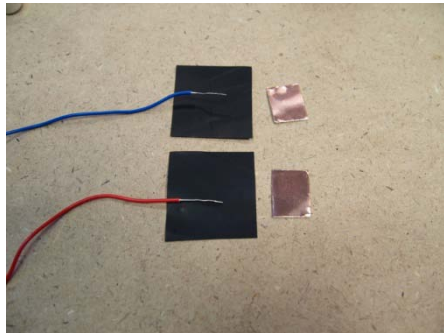


Do Check All connections
before plug into Arduino

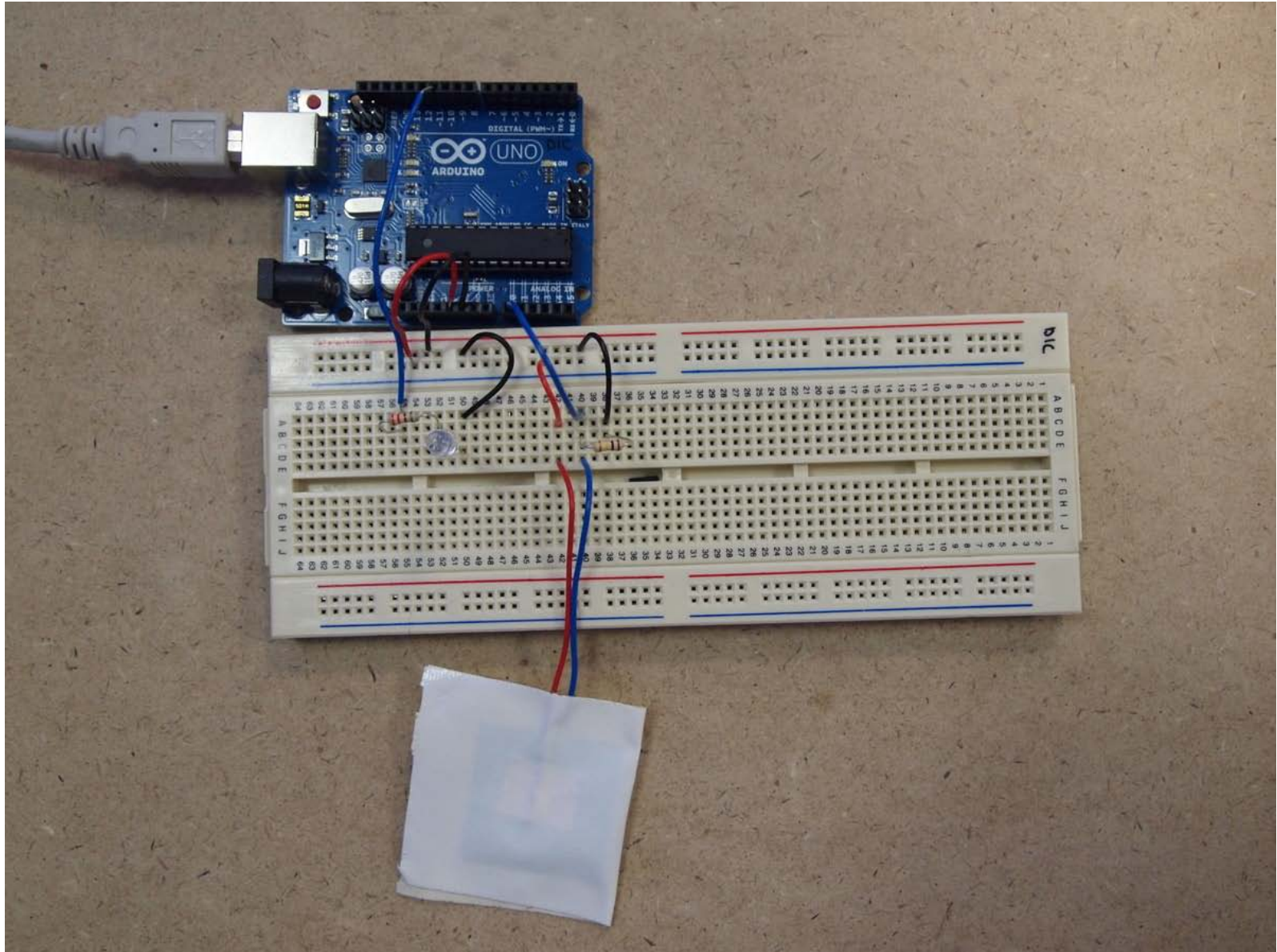


Making a Pressure Sensor

- **Stickytape Bend Sensor in less than 4 minutes**
http://www.youtube.com/watch?feature=player_embedded&v=FEPgLbPv6NM
- Material: 1. Conductive Plastic Bag 2. Copper Tape



Pressure Sensor Circuit



List of Actuators

Servo



DC Geared Motor



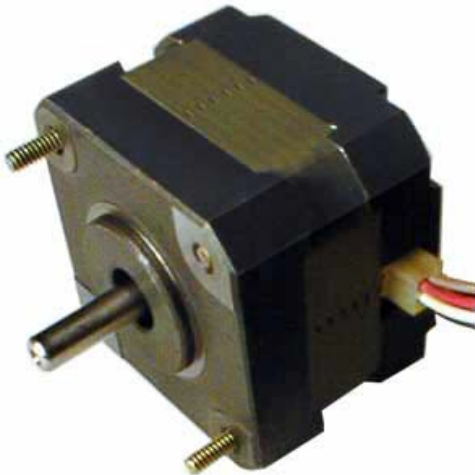
DC Motor



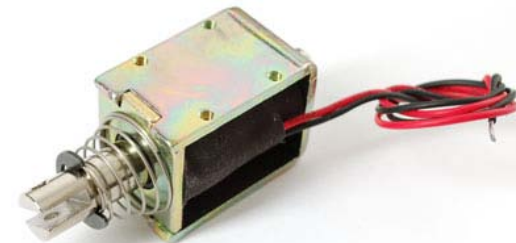
Linear Servo



Stepper Motor



Solenoid

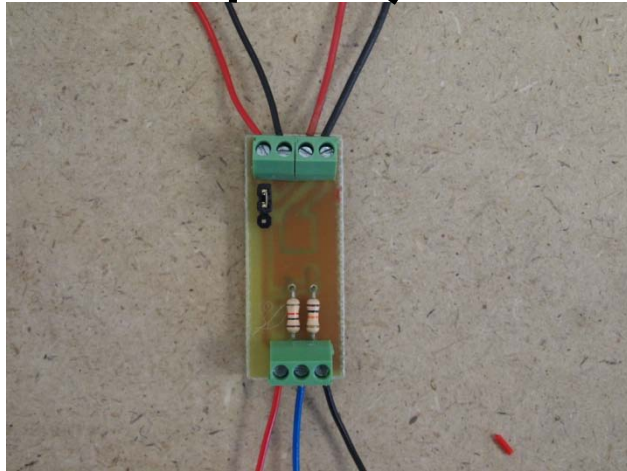


DC Geared motor



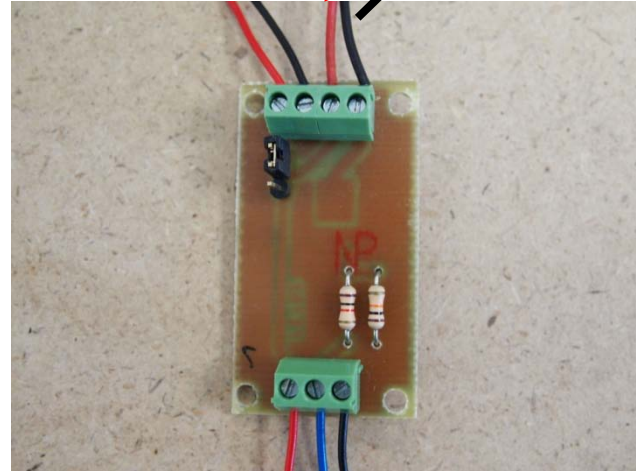
FET module

Ext power 0v-24v
ExtGND
Out+
Out-



+5v CTL GND

Ext power 0v-24v
ExtGND
Out+
Out-



+5v CTL GND

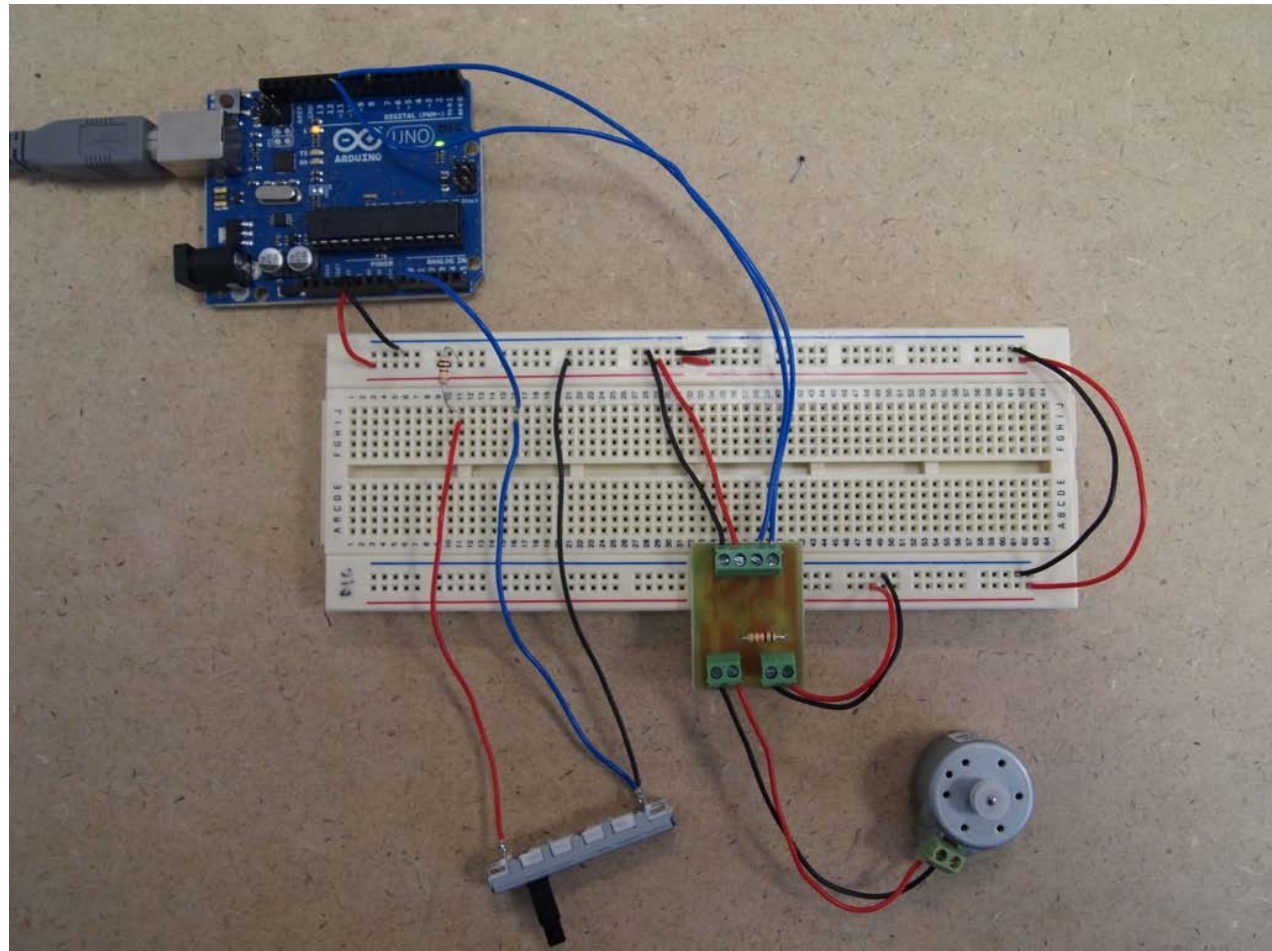
DC Motor Control (H-Bridge driver)

Ext power
0v-7v

Ext GND



FWD RWD +5v GND



Servo Motor (Geared motor + angle sensor)

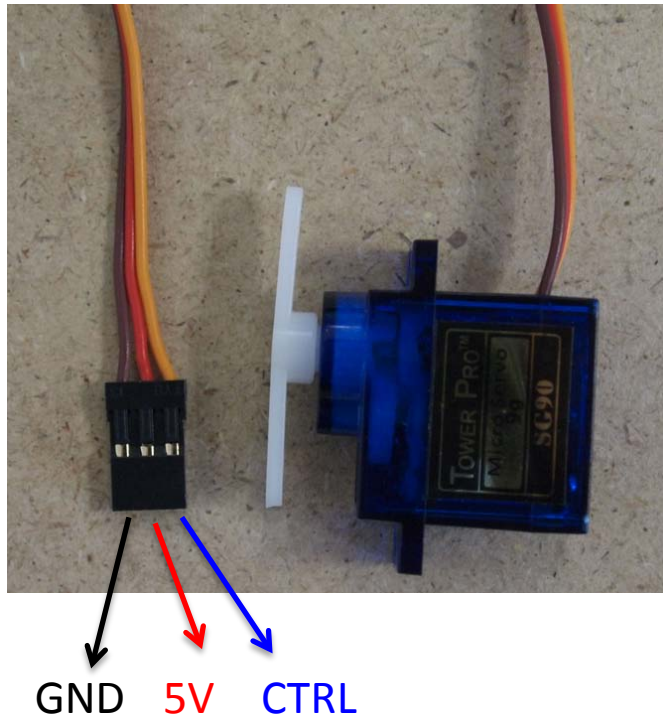
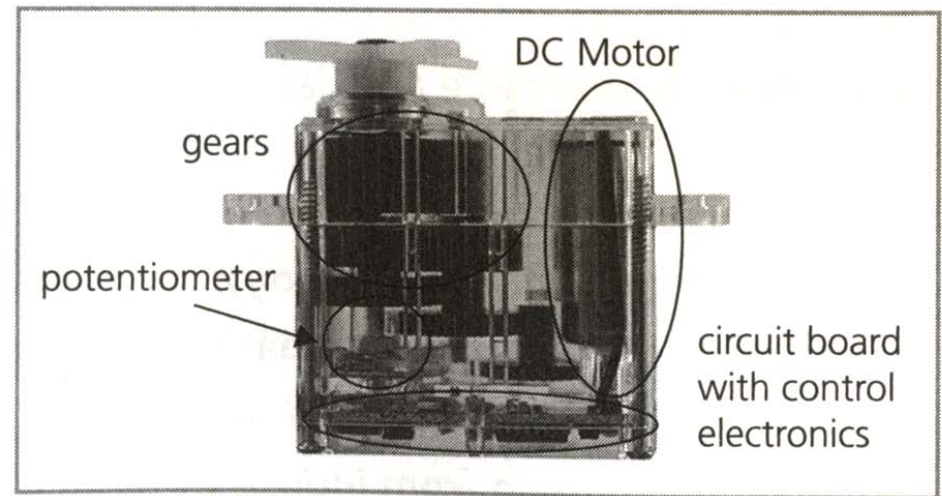
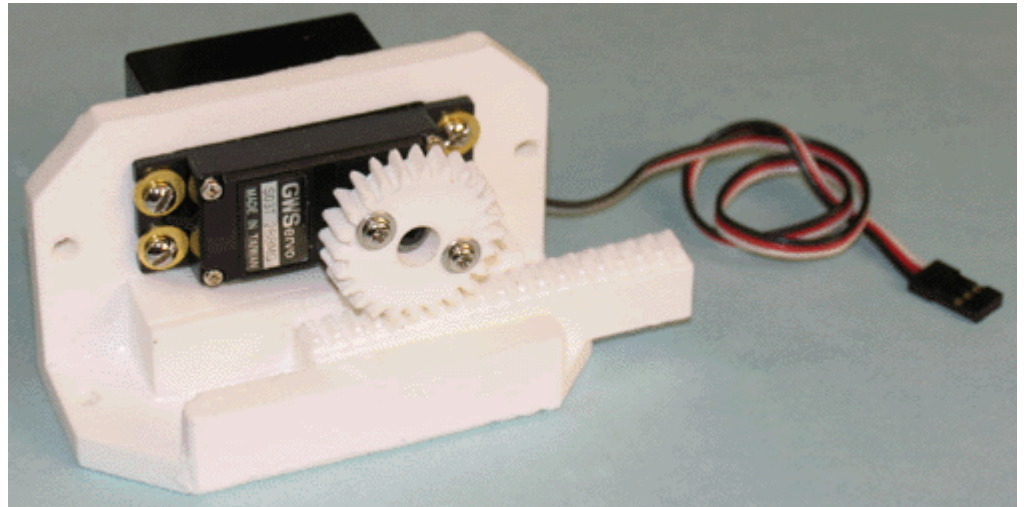


FIGURE 6-9 Anatomy of a hobby servo motor
(image used with permission from ServoCity)



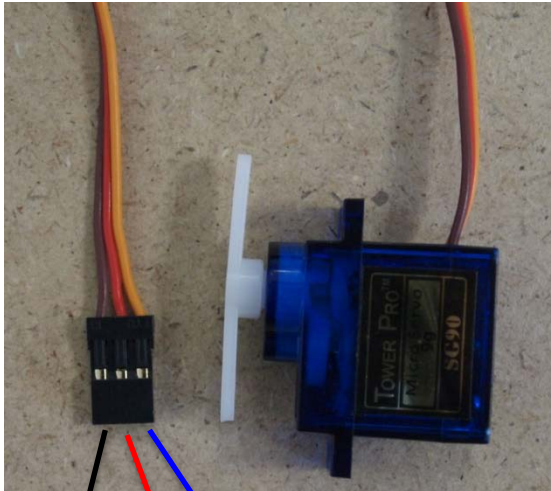
Make Things Move

Linear Servo

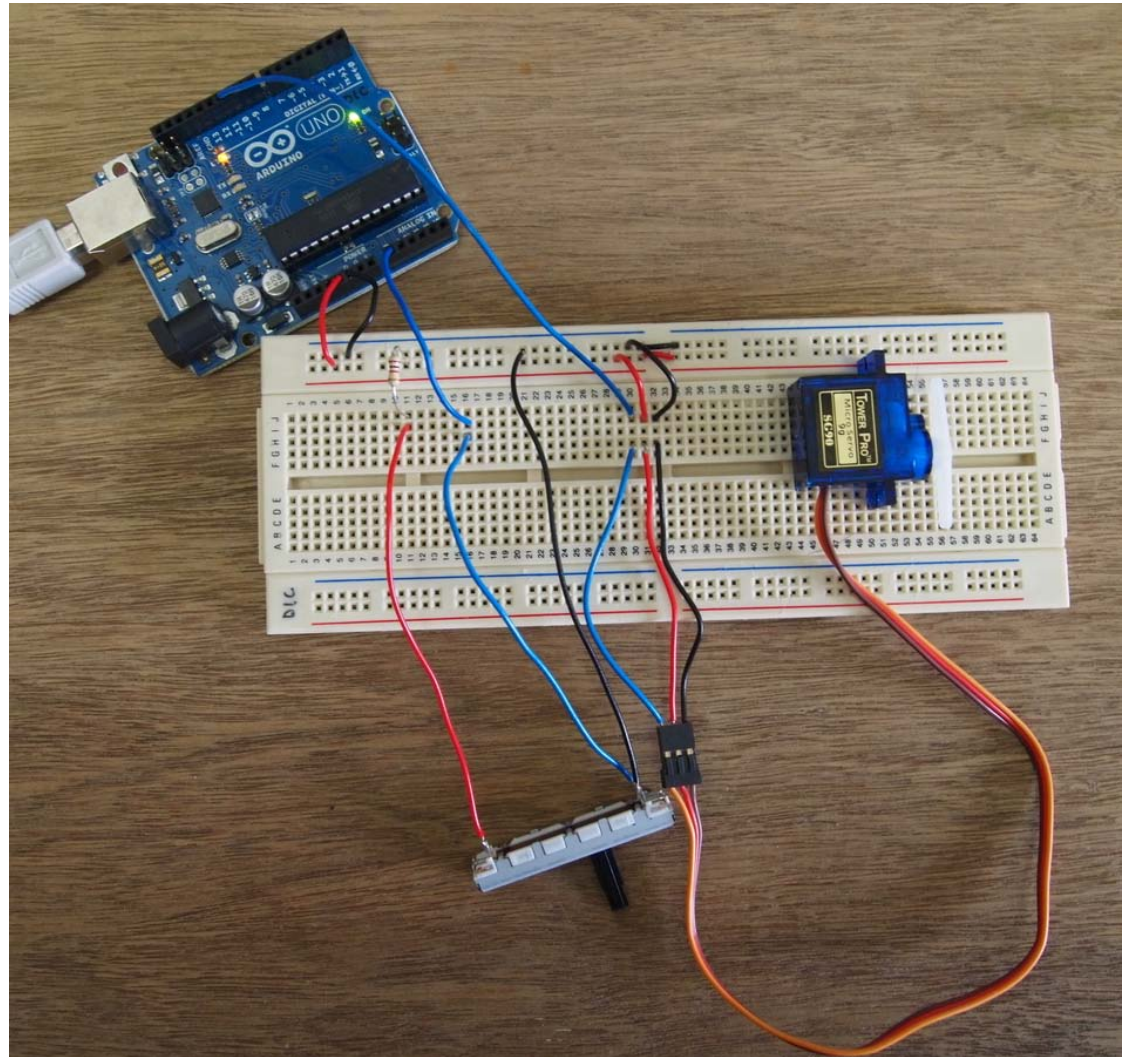


<http://www.youtube.com/watch?v=fq5u7jFQFCg&feature=relmfu>

Servo Control



GND 5V D11



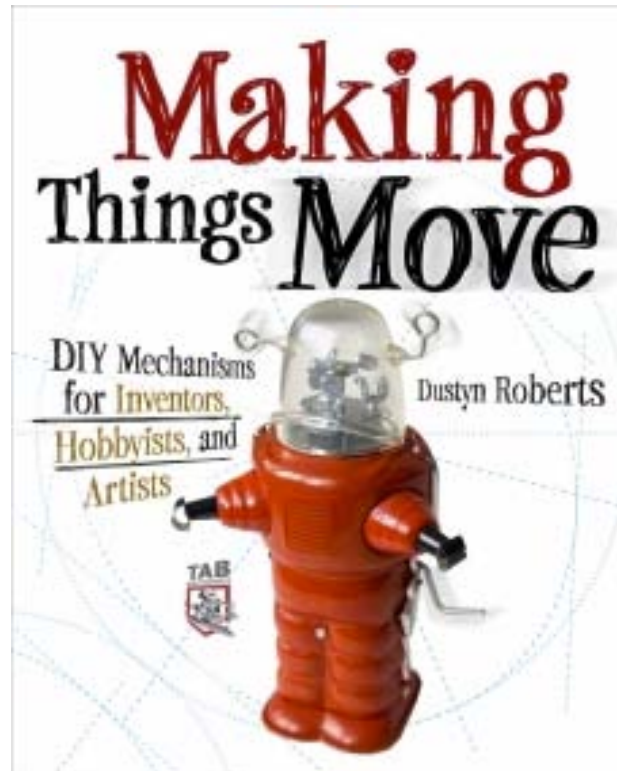
What do we do with Sensors/Actuators?

- <http://www.youtube.com/watch?v=DIGTD1WGFdM>
1. Transform Energy
 2. Transfer Energy
 3. Multiply / Change direction of force
 4. Multiply Speed

Making Things Move

Dustyn Roberts

- <http://www.makingthingsmove.com/>



Basic Mechatronics

1.Lever

2.Pulleys

3.Gears

4.Wheel

Lever

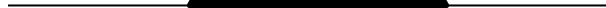
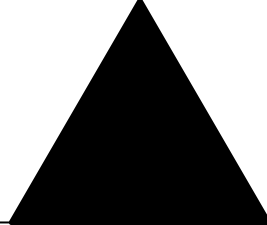
Input



Fulcrum

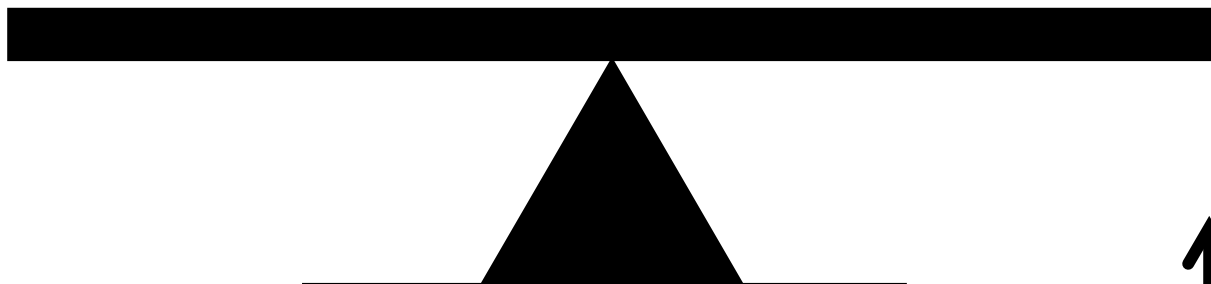


output



$$\text{Output} = D_i/D_o$$

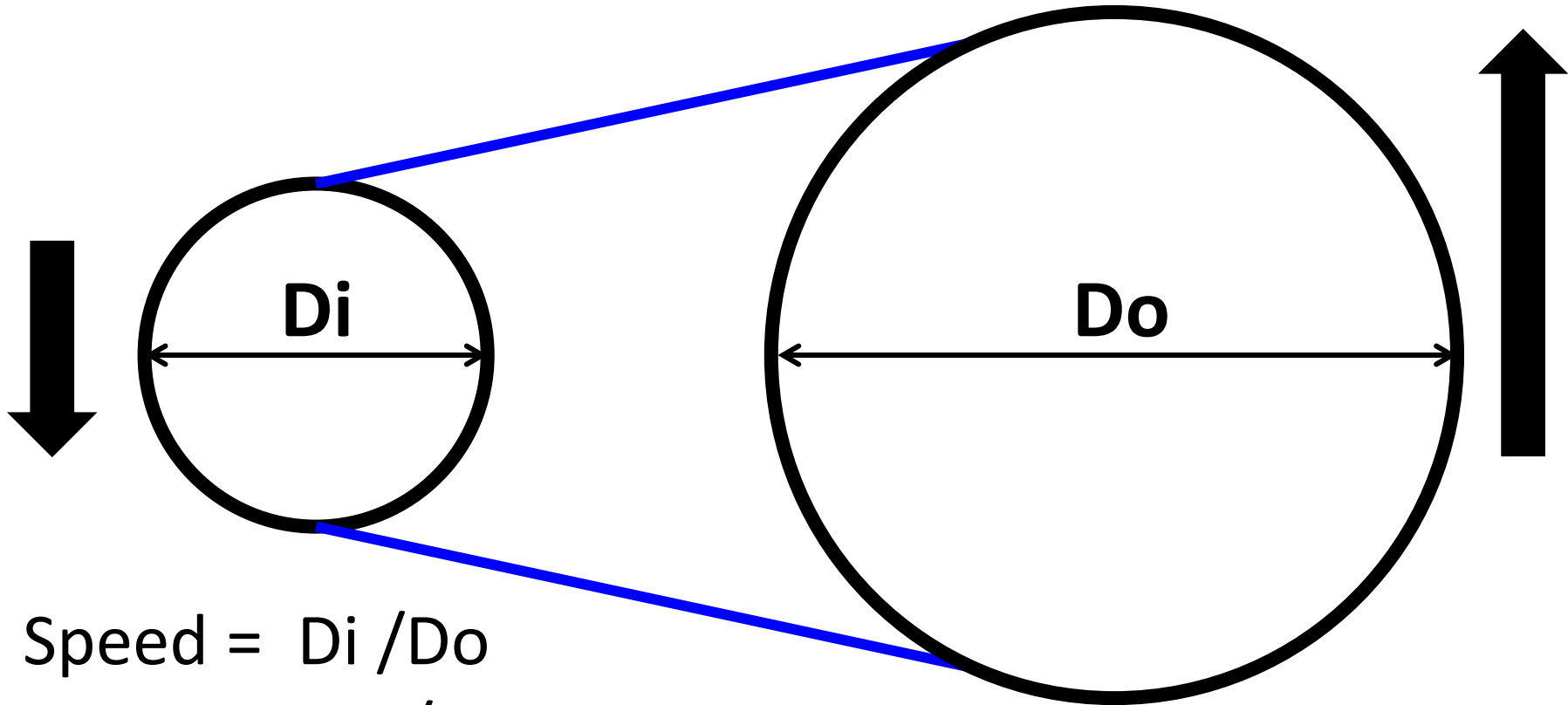
$1 \downarrow$ D_i D_o $\uparrow 1$
 1 1 $:$ 1



$1 \downarrow$ $2/3$ $:$ $1/3$ $\uparrow 2$



Pulley:

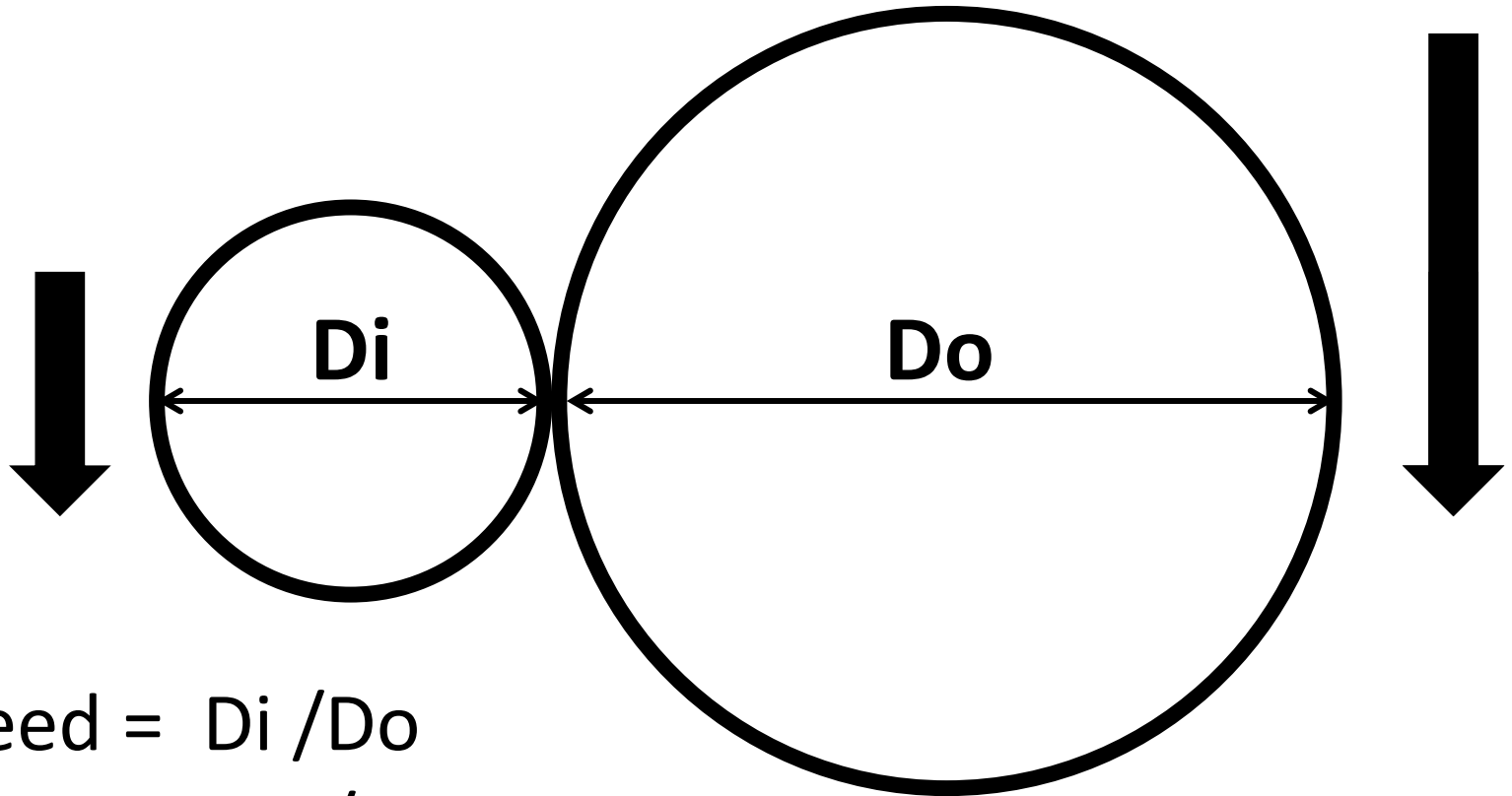


$$\text{Speed} = D_i / D_o$$

$$\text{Torque} = D_o / D_i$$

Rotate Same the Direction

Gear



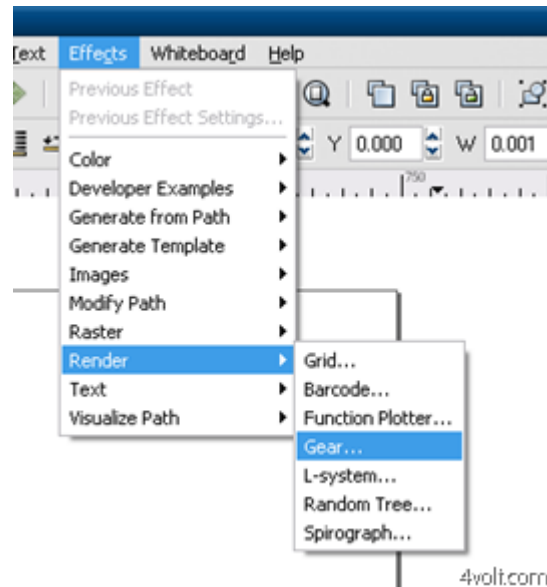
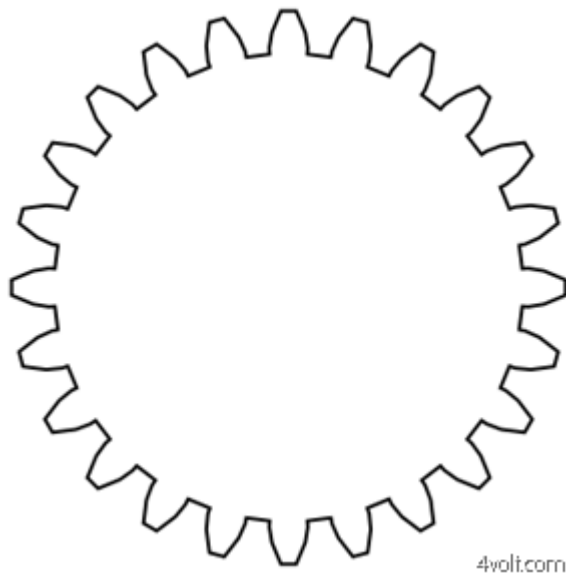
$$\text{Speed} = D_i / D_o$$

$$\text{Torque} = D_o / D_i$$

Rotate Opposite Directions

Making Laser Cut Gears with InkScape Tutorial

- <http://4volt.com/Blog/archive/2009/01/05/laser-cut-gears-and-inkscape.aspx>



Assignment1: Rolling Ball machine

Design a rolling ball machine

- *Size within w:42cm h: 30cm d:30cm (A4 paper)*
- A mechanism to lift up balls
- Minimum 3 Gimmicks using switches or sensors
- <http://www.oobject.com/category/15-videos-of-amazing-rolling-ball-machines/>
-

List of Shops for materials/components.

- Sim-lim tower
 - B1 Continental Electronic
 - 4F Kaichin/SunLight
- Sgbotic:
 - www.sgbotic.com
- Sparkfun products
 - <http://www.sparkfun.com/>
- Element14
 - <http://sg.element14.com/>
- RS-components
 - <http://singapore.rs-online.com>
- RotorHobby
 - <http://rotor.com.sg/>
- McMasterCarr
 - <http://www.mcmaster.com/#>
- *ServoCity*
 - <http://www.servocity.com>