Bionics Club:
Actuation Workshop

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WPI Bionics Club • 9/27/23

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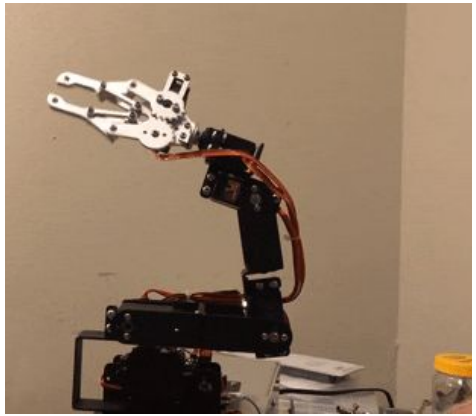
MyWPI

Agenda

- Actuation Station
- Sensors, Servos, and Strings (oh my)
- Circuit Diagrams yay
- Code™ sponsored by stackoverflow
- What time is it? Guided Build Time

What is Actuation?

- Making things move
- Motors are used to actuate mechanical design with electronics
- We frequently base our electronic systems for actuation off of Arduino Microcontrollers



Components

Servo

Specs: SG90 Micro Servo
- 180 degree rotation
- 4.2-6V operating voltage

Pros:
- Small enough to fit in a hand
- Allows for precise control over position

Cons:
- Limited rotation requires additional mechanics for greater range of motion

Alternatives:
- Brushed DC motor

Servo

- There connection wires:
  - Brown = ground
    - Connect to gnd on the arduino
  - Red = power
    - Connect to 5V on arduino
  - Orange = signal
    - Connect to digital pin on arduino

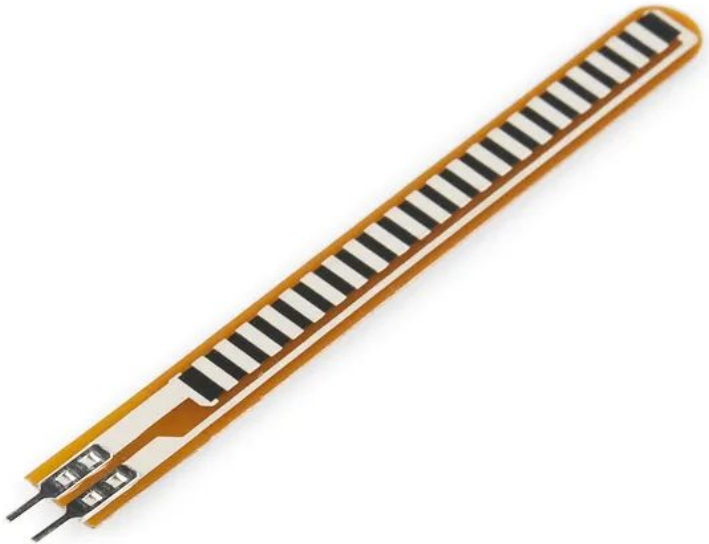
Flex Sensor (it's a love hate relationship here tbh)

Specs: Thincol Force Sensor
- 100mm x 10mm dimensions
- Takes 3.3V dc
- <10ms response time

Pros:
- Simple integration (just two wires!(kinda))
- Easier for tracking bending of joints than myoelectric sensors

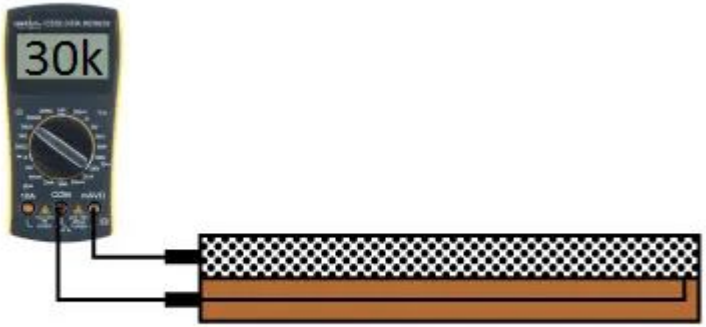
Cons:
- Can deform under too much strain (easy to break)

Alternatives:
- Better flex sensors
- Myoelectric sensors
- Potentiometer

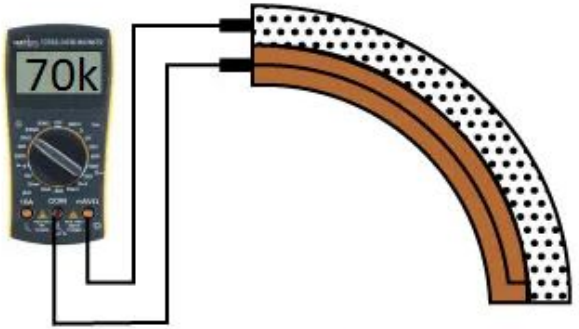


Flex Sensor

- Metal sheet within sensor bends and stretches causing resistance to increase
- Bidirectional. Just like a resistor, it doesn't matter which sides are connected to what
- One side connects to analog input (Ax) on the Arduino



Conductive particles close together - 30kΩ.



Conductive particles further apart - 70kΩ.

Arduino(ish) Nano

Specs: Nano Microcontroller with CH340 driver

- 20 digital I/O, 8 analog input pins
- 6 PWM pins (helpful for power control)
- 3.3 and 5V power output pins
- Works with 3.3-10V external voltage

Pros:

- Inexpensive
- Easy interfacing with servo and sensors
- small

Cons:

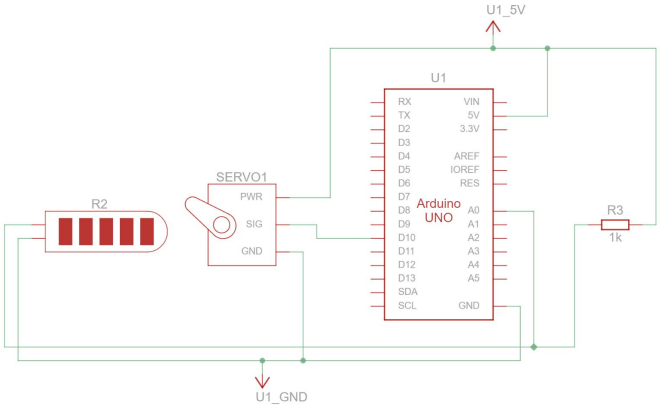
- Limited memory/processing power

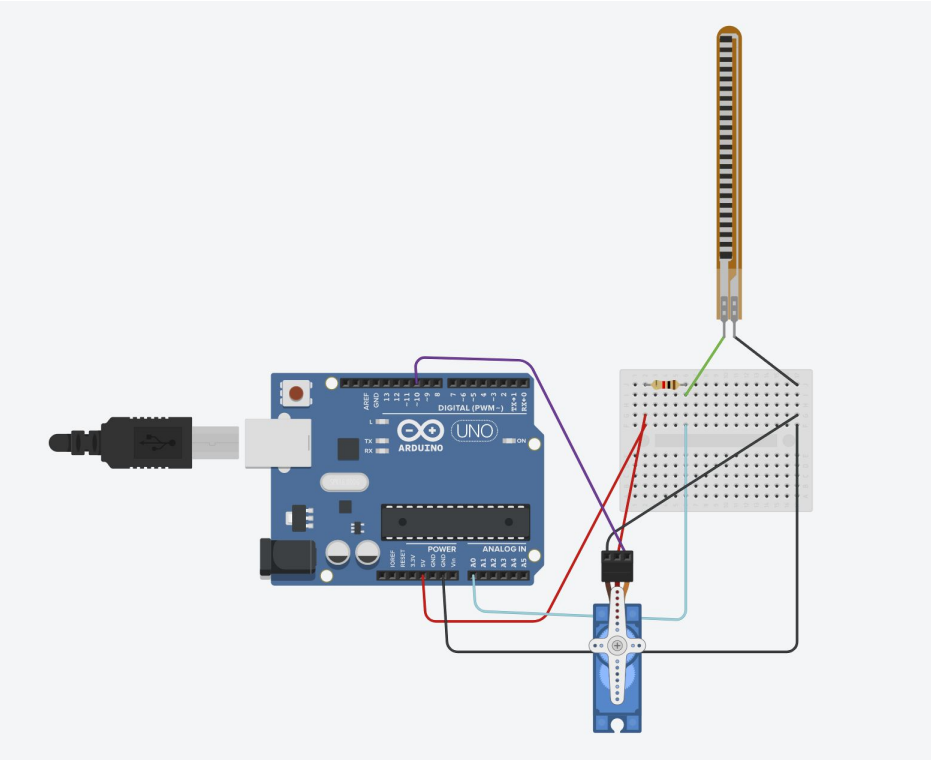
Alternatives:

- More robust arduino or other microcontroller

Diagram

Circuit Construction





Code

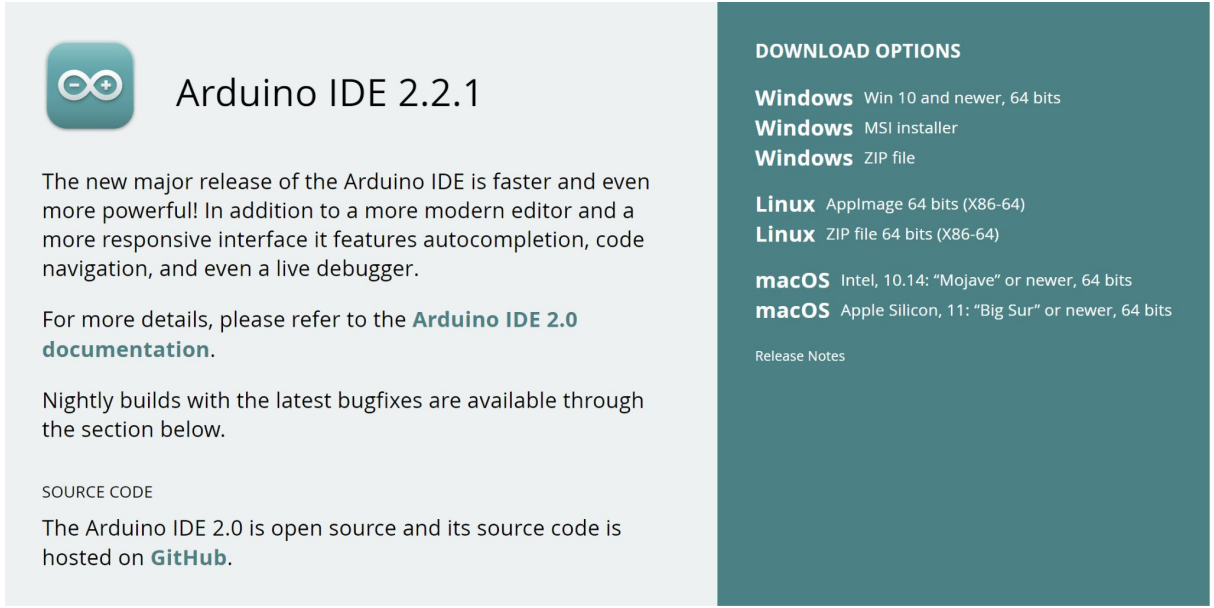
Code

We will be using the Arduino Integrated Development Environment for our code

Download the Arduino IDE:

https://www.arduino.cc/en/software

Scan for IDE



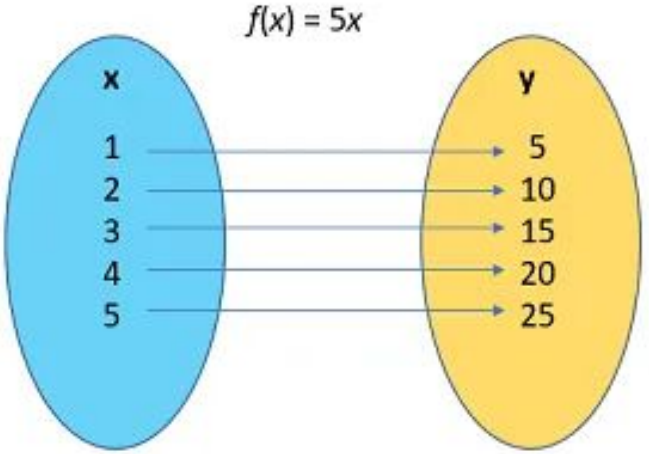
Code

```
#include <Servo.h>

Servo servo; //creates servo object

void setup() {
  Serial.begin(9600); //begins serial monitor
  pinMode(A0, INPUT); //declares flexsensor as input

  servo.attach(10); //creates servo object on pin 9

}

void loop() {
  int ServoPos = 0;
  int FlexVal = analogRead(A0); //reads value of sensor
  Serial.println(FlexVal);

  ServoPos = map(FlexVal, 550, 800, 180, 0); //maps sensor input to servo range of motion

  servo.write(ServoPos);

}
```

Scan for Code

Mapping Function

- Arduino has a built in library mapping function
- Takes a set of values and translates each one into a value within a different set



How Does it Work?

1. Power (voltage) output by 5V pin is split across the resistor and flex sensor
2. Pin A0 reads voltage drop across Flex Sensor
3. Arduino maps sensor voltage to degrees available for the servo to rotate
4. The corresponding degree value is sent to the servo through pin D10
5. Servo continues to change position as the Flex Sensor bends

Build Time!

Additional Resources

Bidirectional flex sensor: https://www.instructables.com/How-to-Make-Bi-Directional-Flex-Sensors/

Github: https://github.com/wpi-bionics-club/Workshops/blob/main/FingerFlexExample.ino

Circuit Model: https://www.tinkercad.com/things/cr2UjAk1GDH?sharecode=QIiLjWwCl8IIKWHNWv_yORAiZoJq_qugzCJHmoNdW0Q

QR Codes

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