Arduino Workshop

AAPT, 10/21/17

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Agenda

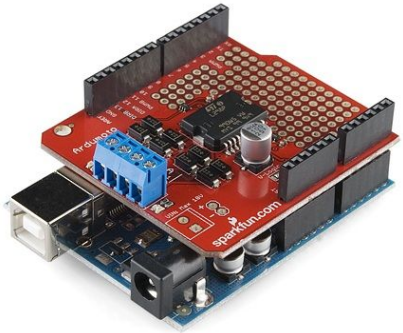
- Introduction to Arduino (15 mins)
  - Board Types
  - Board Geography
  - Writing Code
  - Uses for Educators
- Activity 1 - “Hello World” LED Blink (10-15 mins)
- Activity 2 (45 mins)
  - 2A: Voltage Divider
  - 2B: Input/Output Motor Control
- Wrap-up and Q&A (5 mins)

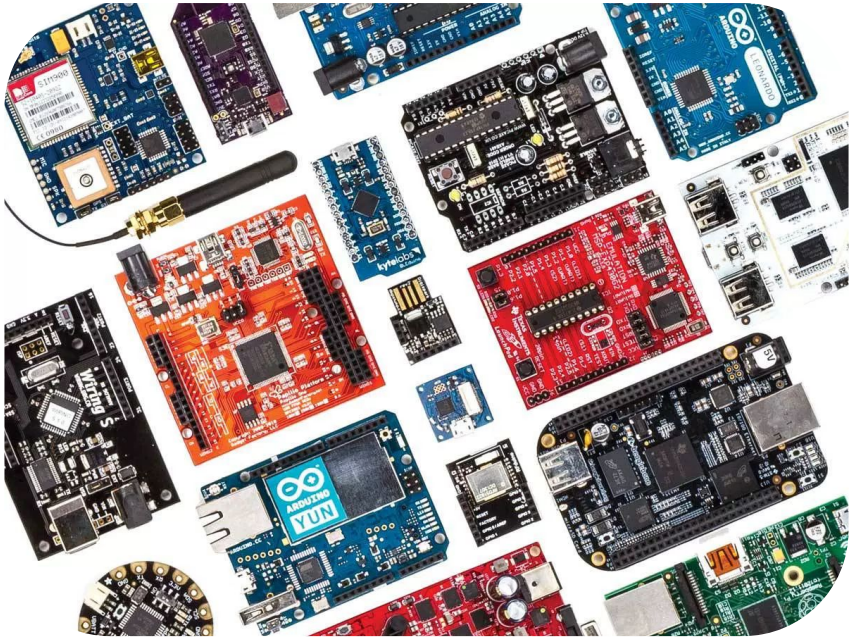
Introduction to Arduino

- What is it?
  - a company
  - a product category
  - a movement
- Why do I keep hearing about it?
  - Low cost ($20-40 boards, $50-75 kits)
  - Open source
  - Makes DIY electronics accessible to laymen
  - Has a large, strong community
  - Is perfect for students

Pick a Board, Any Board

- Boards
  - Single-board computers (Raspberry Pi)
  - Microcontrollers for DIY electronics projects
    - Arduino
    - BeagleBone
    - Intel
    - many more
- Shields
  - Motor control
  - Datalogging
  - Wifi
  - Bluetooth
  - Prototyping (breadboard)



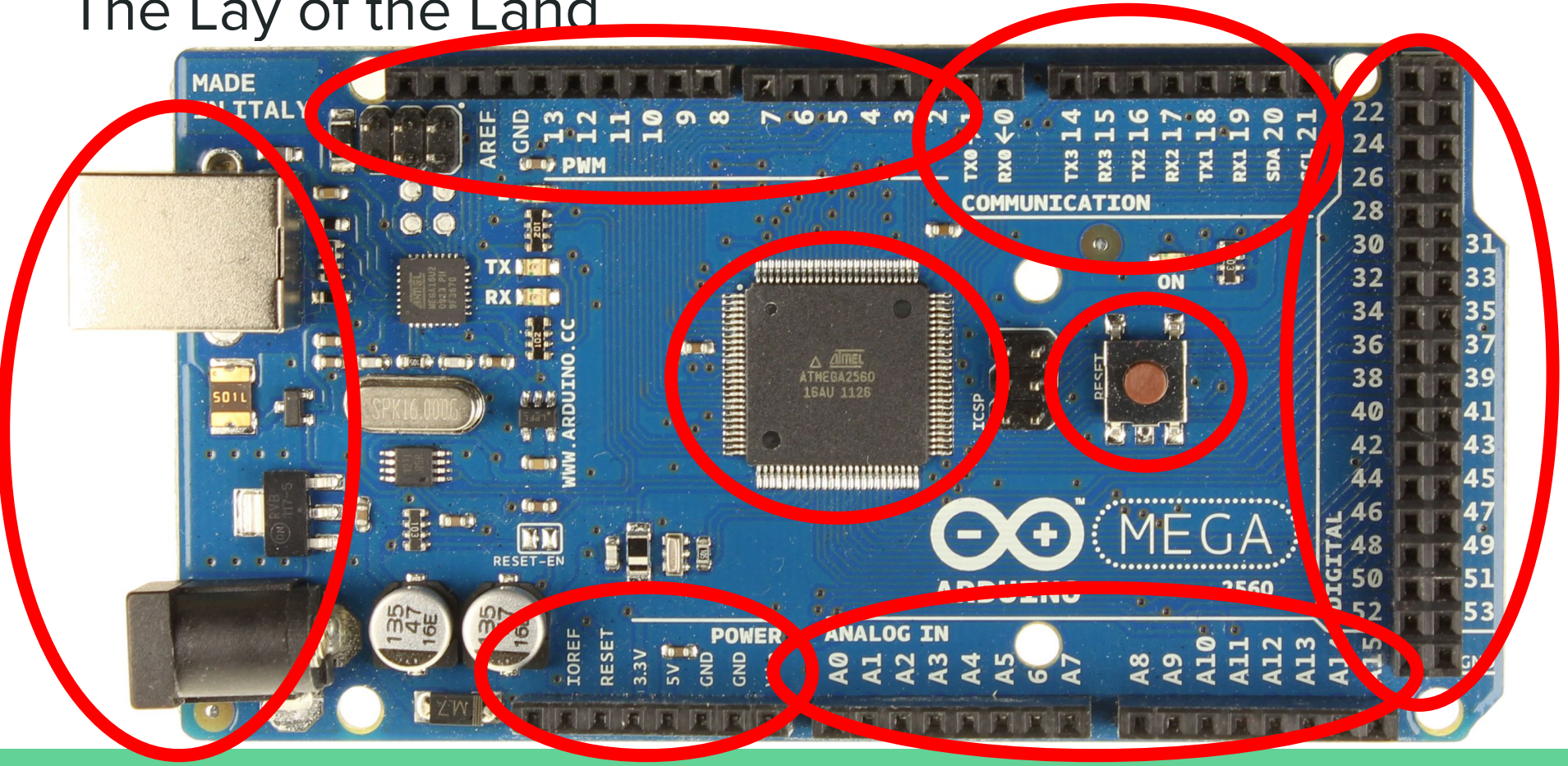


- Vendors:

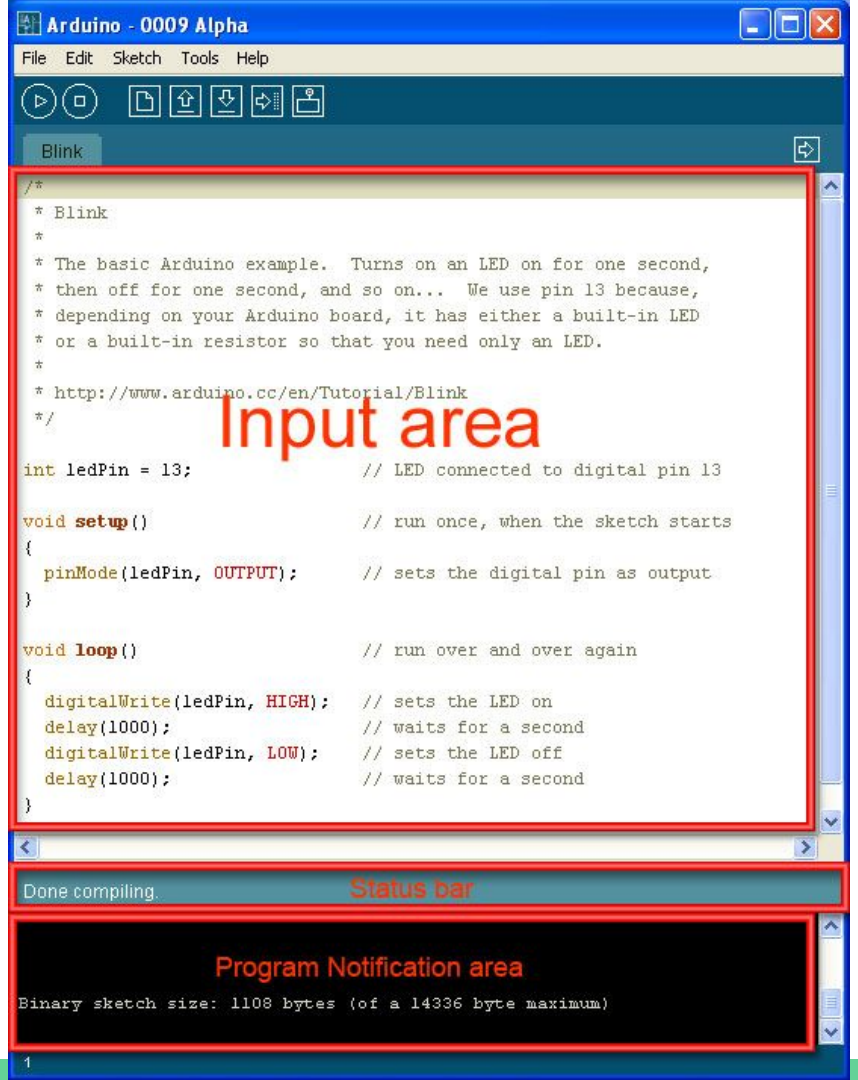
  Sparkfun, RobotShop, Adafruit, Amazon, Makershed
- Resource for board selection:

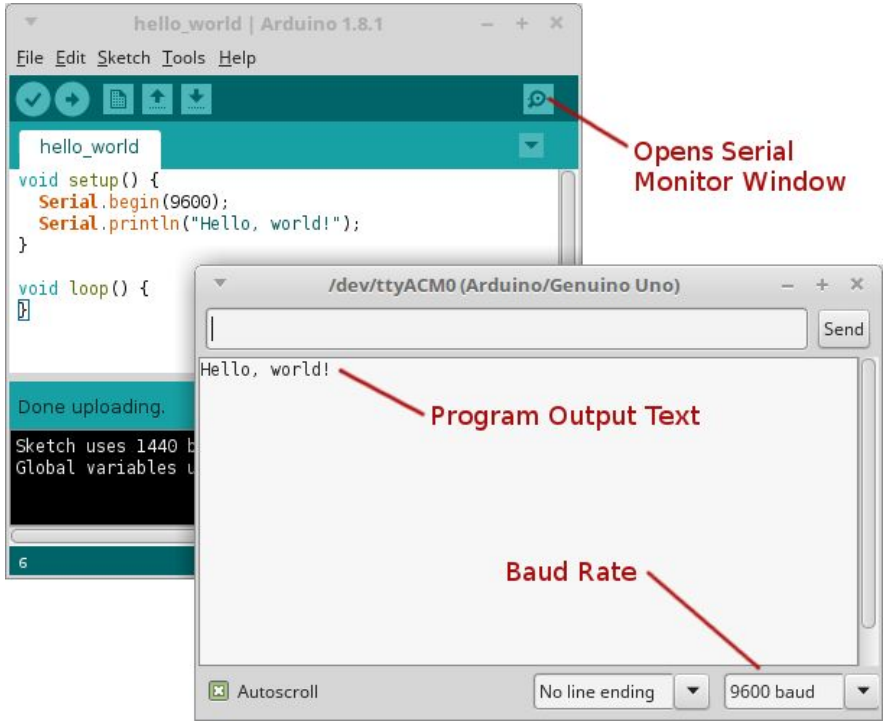
  https://makezine.com/comparison/boards/

The Lay of the Land



Writing Arduino Code





Why are low-cost microcontrollers relevant to me?

- Designing lab experiments or lecture demos (instructor use)
- Undergraduate research (instructor and student use)
- Learning physics in context: (student use)
  - DC circuits
  - Electronics (transistors, ICs, etc)
  - Light (e.g. Carvalho & Hahn. A Simple Experimental Setup for Teaching Additive Colors with Arduino. The Physics Teacher 54, 244 (2016).)
  - Kinematics (e.g. Galeriu et al. An Arduino Investigation of Simple Harmonic Motion. The Physics Teacher 52, 157 (2014).)
  - Motors
- Resources:
  - Arduino's Main Education Site, including instructor resources
  - Blogger using Arduino in AP Physics, Five Examples of Arduino-Based Physics Experiments
  - Bouquet et al. (2016). Project-based physics labs using low-cost open-source h Journal of Physics. 85. . 10.1119/1.4972043.
  - Galeriu, C. An Arduino-Controlled Photogate. The Physics Teacher 51, 156 (2013).

Activity 1 - “Hello World” LED Blink

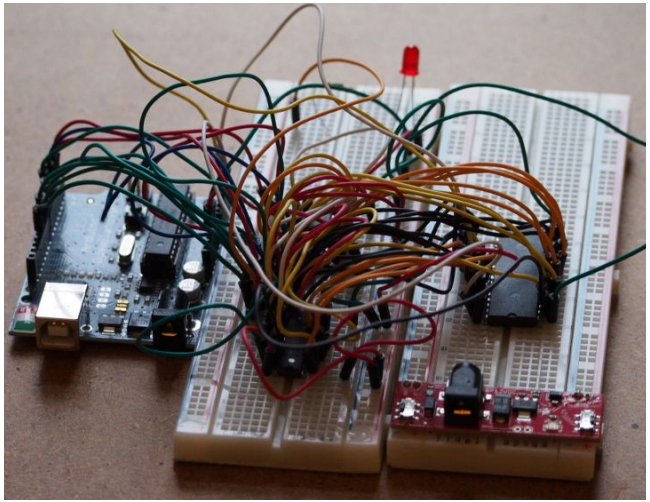
Objective: Get everything connected and run a very simple sketch.

1. Open kit. Get out Arduino Mega and blue USB cord.
2. Turn on computer and open Arduino IDE software.
3. Plug USB cord into Arduino and computer.
4. Click “Tools” and set Board (Arduino MEGA 2560) and COM port.
5. Open “Blink” example sketch.
6. Click “Upload” icon and observe blinking LED.
7. Change something to modify blink timing.
8. If time permits, insert LED (from kit) from pin 12 to GND and modify code.

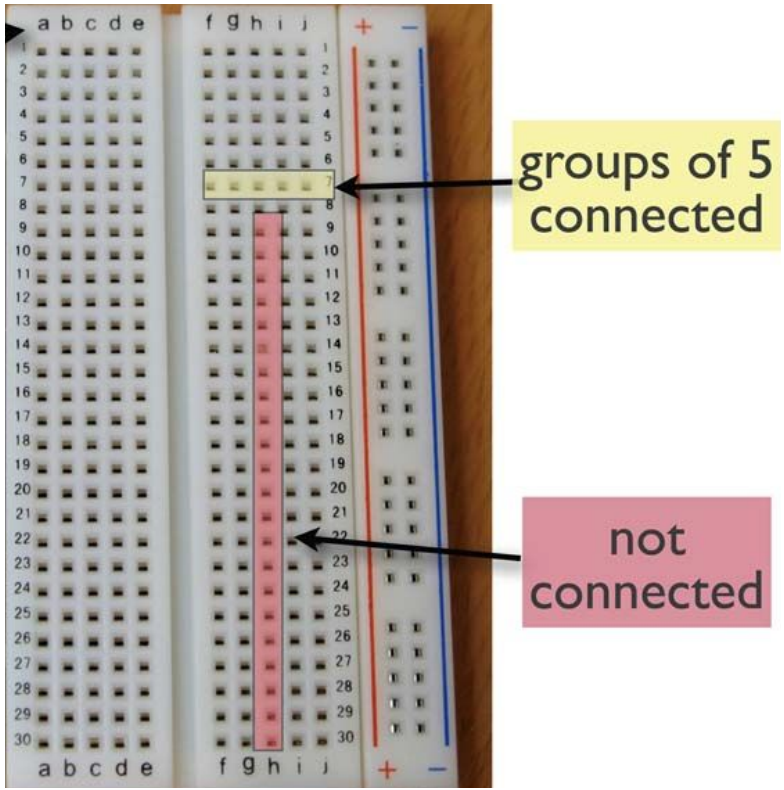
Activity 2

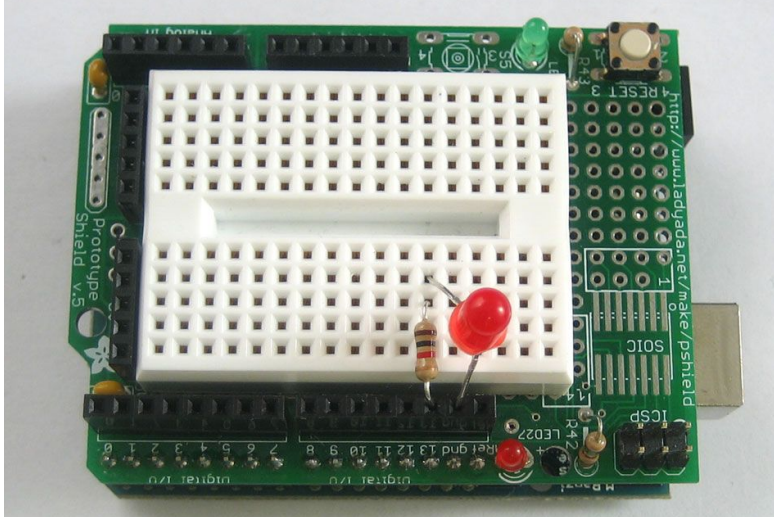
Using the provided hard copies, complete one or both activities, in pairs.

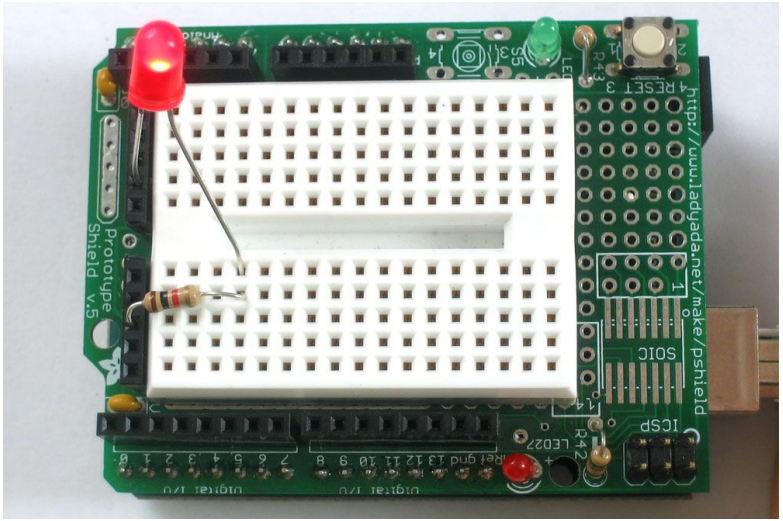
- Activity 2A - Reading a resistive sensor using a voltage divider circuit.
- Activity 2B - Using an input (microphone) to control an output (servo motor).
- Notes:
  - Both activities use the prototype shield found in your kit.
  - Activity 2A is easier; start here if you are new to Arduino.



Breadboarding



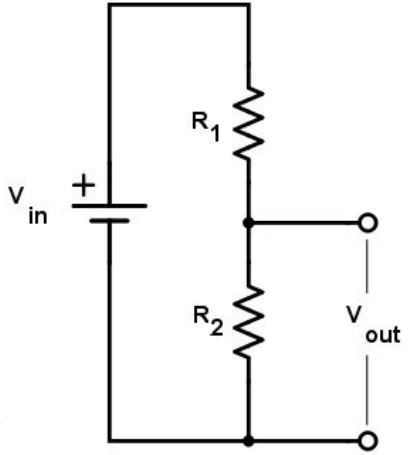




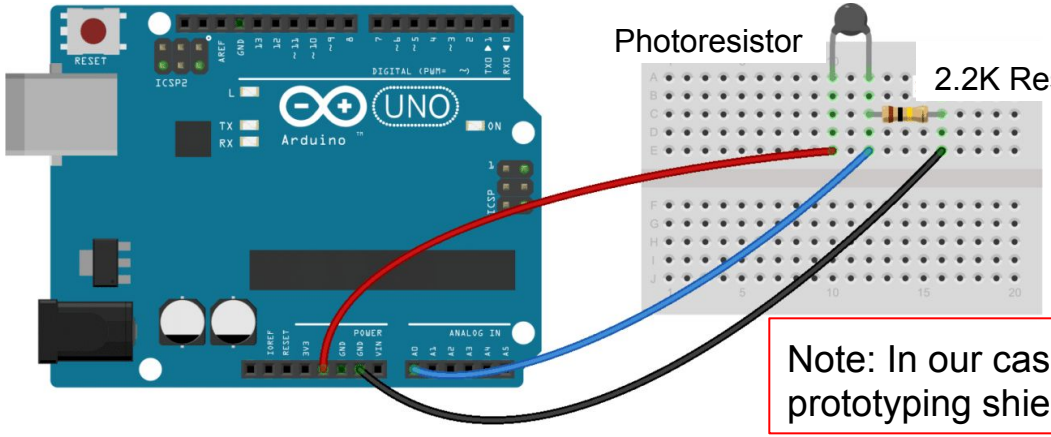
Activity 2A - Voltage Divider

Objective: Read a resistive sensor using a voltage divider, displaying raw output to serial monitor.

1. Attach prototyping shield to Arduino.
2. Build DC circuit shown, using photoresistor (analog sensor) and 2.2KOhm resistor.
3. Open “ReadAnalogVoltage” example sketch. Click “Upload” icon.
4. Wait a few seconds. Click “Serial Monitor” icon to see output.
5. Change incident light intensity and observe change in voltage.



Voltage divider: The simplest way to indirectly measure a change in resistance.



Note: In our case, the breadboard is part of the prototyping shield. Wire to the pins on the shield.

Activity 2B - Input/Output Motor Control

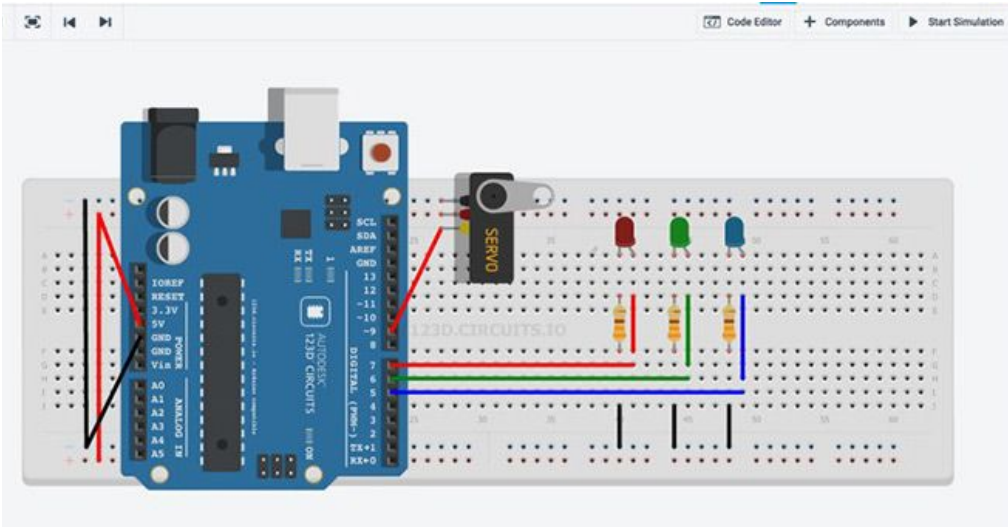
Objective: Use input (digital sound sensor) to control output (servo motor).

1. Find servo motor in kit.
2. Wire servo to prototyping shield:
   Brown ➔ Gnd, Red ➔ 5V, Orange ➔ Pin 9 (Digital I/O)
3. Open “Sweep” example sketch.
4. Upload/run “Sweep” to confirm servo operation.
5. Find sound sensor module (digital sensor) in kit.
6. Wire sensor to prototyping shield:
   GND ➔ Gnd, VCC ➔ 5V, OUT ➔ Pin 7 (Digital I/O)
7. Upload/run “servocontrolME” (Arduino sketch).
8. Make some noise! (testing)
9. Tweak the code and see what happens.

Turn this knob to change sound threshhold level.

Resources for Going Deeper

- Adafruit Tutorials (https://learn.adafruit.com/category/learn-arduino)
- Jeremy Blum YouTube Tutorials (https://youtu.be/fCxzA9_kg6s)
- Circuits on Tinkercad (https://www.tinkercad.com/circuits)



Thank you for attending this workshop! Any questions?