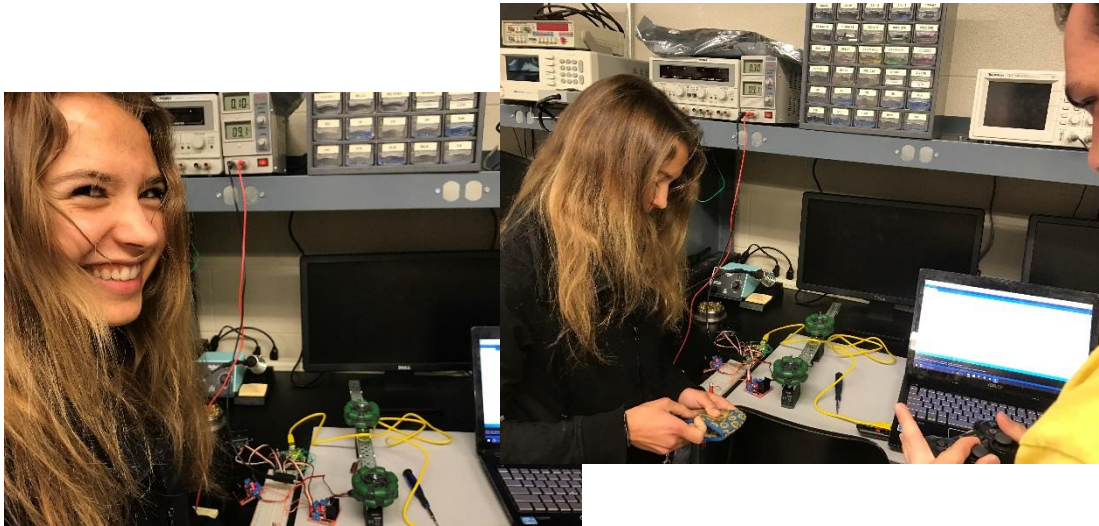


# Using Arduinos to Teach Engineering Concepts

**Andrew G. Bell**



**October 27, 2016**



**CHANGING LIVES  
MAKING INDIANA GREAT**

# Ivy Tech

Ivy Tech Community College is Indiana's largest public postsecondary institution and the nation's largest singly accredited statewide community college system.

We offer Associates of Science degrees in:

Electrical Engineering Technology  
Mechanical Engineering Technology  
Engineering Technology  
Pre- Engineering  
Nanotechnology  
Design Technology

over 40 degree programs



# What is an Arduino?

Arduino is a inexpensive Microcontroller CCA that interface to your PC via USB

They typically cost ~ 20 to 25 and are available many places online

Software to program them is free, open source. <https://www.arduino.cc/>

Arduino Uno (and other models) have daughter boards call “shields” that you can stack

Shields include Motor Drives, Prototype boards, Displays, etc.

Arduino microcontrollers have become very popular with hobbyist, students and colleges.

<http://www.jameco.com/>

<https://www.adafruit.com/>

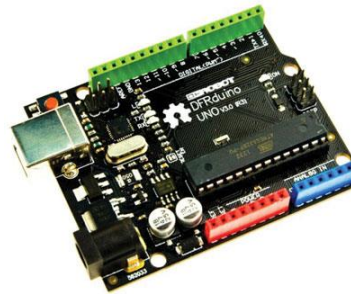
<http://www.elepx.com>



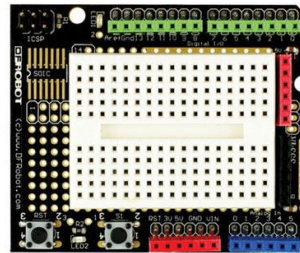
# Arduino Uno

## Specification

|                   |            |
|-------------------|------------|
| Microcontroller   | ATmega328P |
| Operating Voltage | 5V         |
| Input Voltage     | 7-12V      |
| Digital I/O Pins  | 14         |
| Analog Input Pins | 6          |
| Flash Memory      | 32 KB      |
| SRAM              | 2 KB       |
| EEPROM            | 1 KB       |
| Clock Speed       | 16 MHz     |
| PC Interface      | USB        |



Arduino Uno



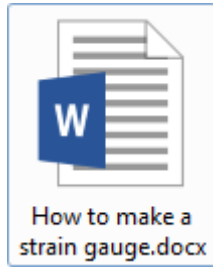
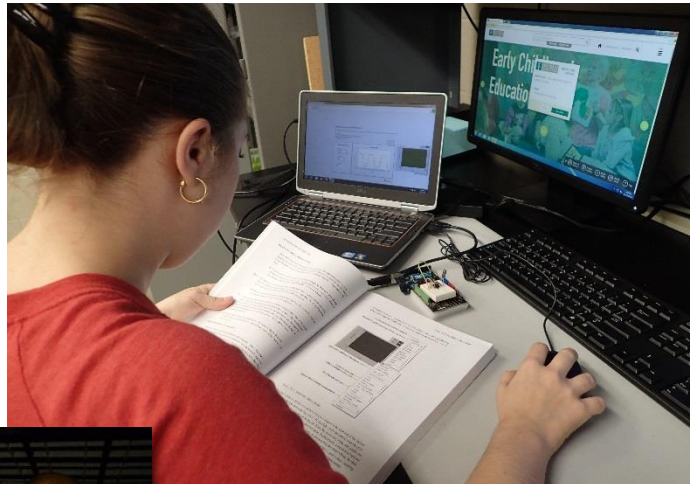
Prototype Shield

```
Wuxi4 | Arduino 1.0.6
File Edit Sketch Tools Help
Wuxi4
//WUXI Professional School of Science and Technology
//11/13/2014
//Code to control Single Axis Tracker Solar Panel & Limit Switches
int pbIn2 = 2;
int pbIn3 = 3;
//The two limit switches should be physically connected to pins 2
int ledOut12 = 12;
int ledOut13 = 13;
//The two limit switch LEDs are connect to pins 12 and 13 of the A
//When the state is high the limit switches is not engaged, i.e. t
int state2 = HIGH;
int state3 = HIGH;
//The states should both be high and would translate into the limi
int E1 = 4;
//This state of this pin enables or disable the motor drive.
int potPin = A0;
//The pot wiper should be connected to the A0 pin
int motorPin = 5;
//This state of this pin determines the direction of rotation of t
int potValue = 0;
//Initially the pot value is set equal to zero
int motorValue = 0;
//Initially the motor power value is set equal to zero
```

<https://www.arduino.cc/en/Main/ArduinoBoardUno>

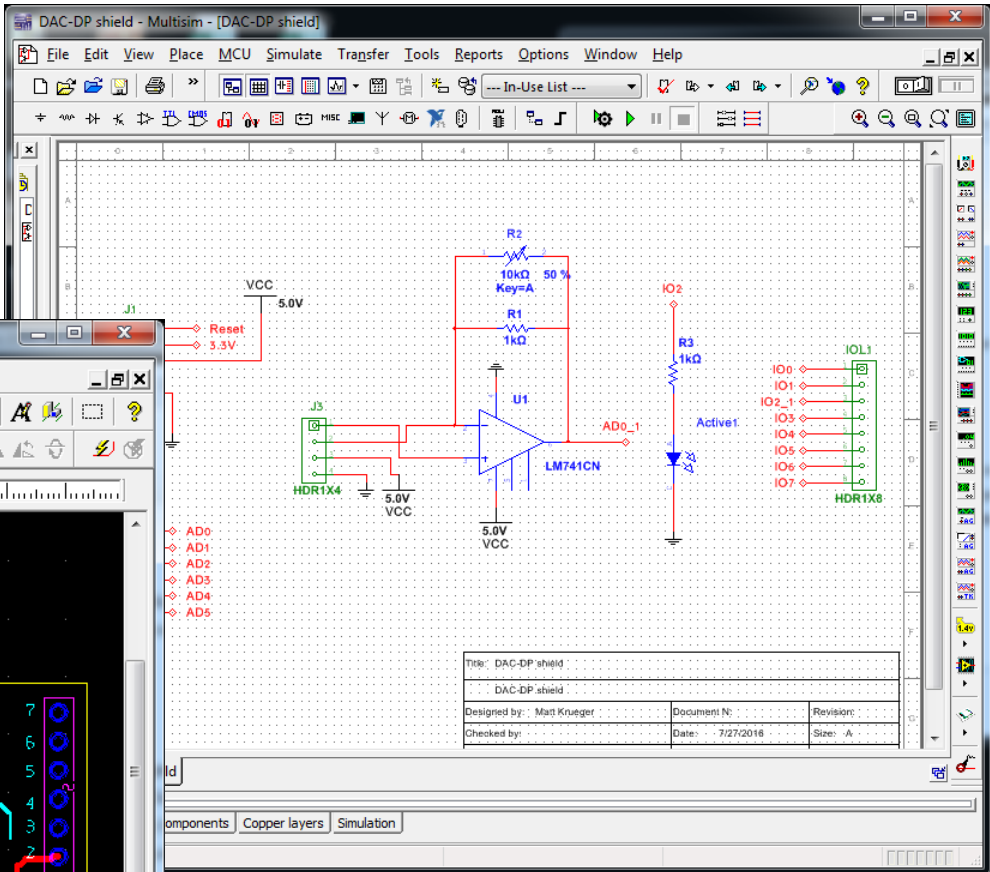
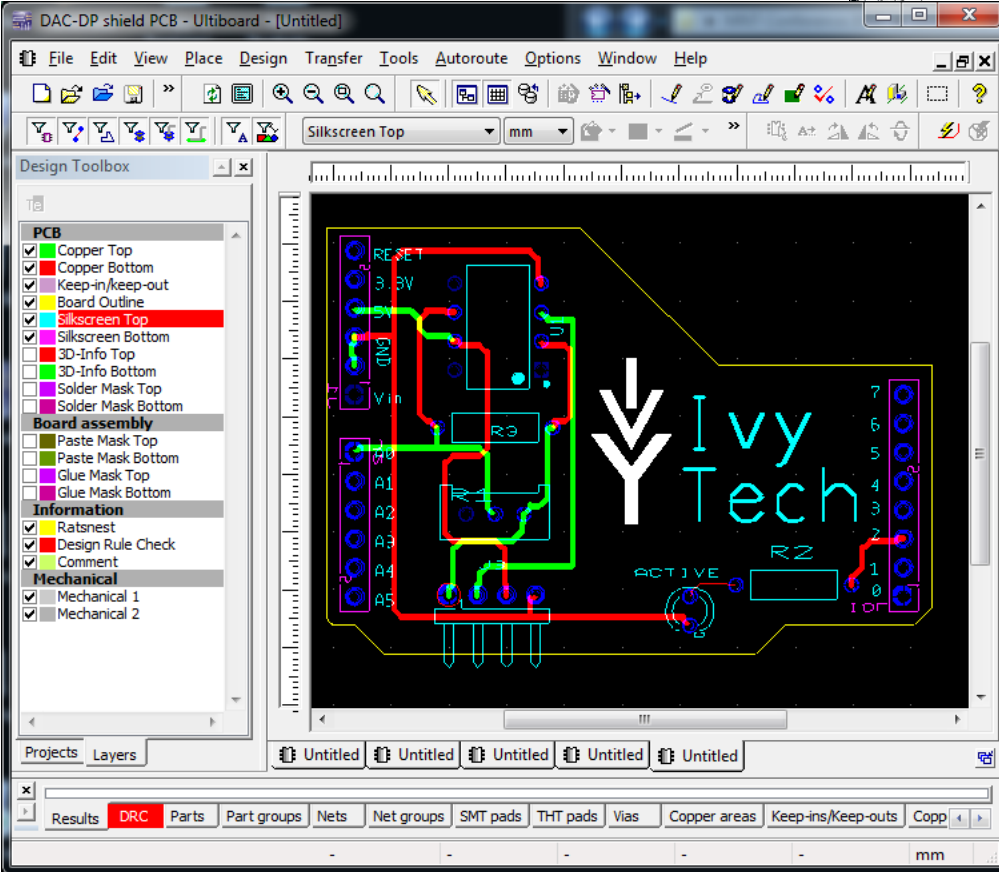
# Discovery Based

- 1.) Give students general idea and requirements for design
- 2.) Provide students with resources to design, build and test
- 3.) Provide feedback as needed but don't micromanage
- 4.) Allow students time to learn, fail and succeed
- 5.) Provide positive feedback and recognition
- 6.) Step back and let them learn ...



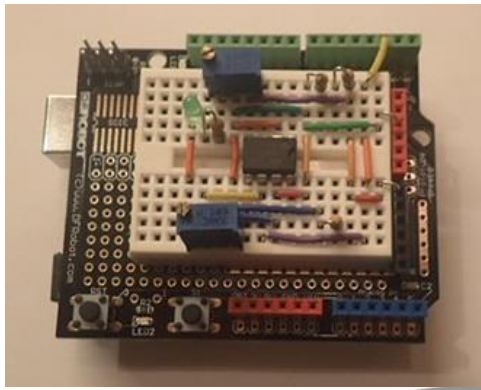
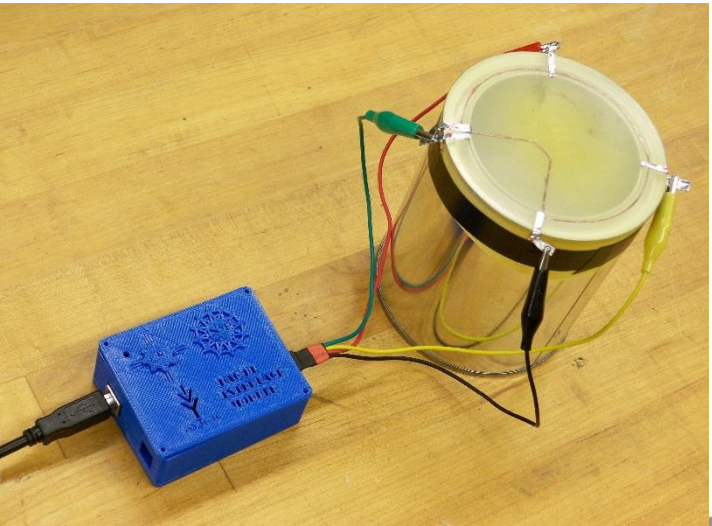
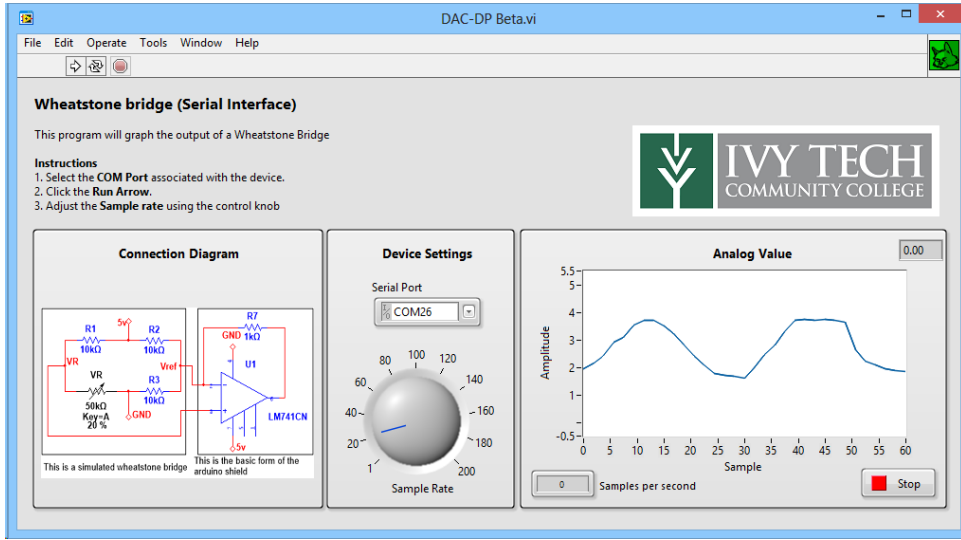
# NI Tools

Multisim schematic  
Utliboard PWB



# DAK for MEMS

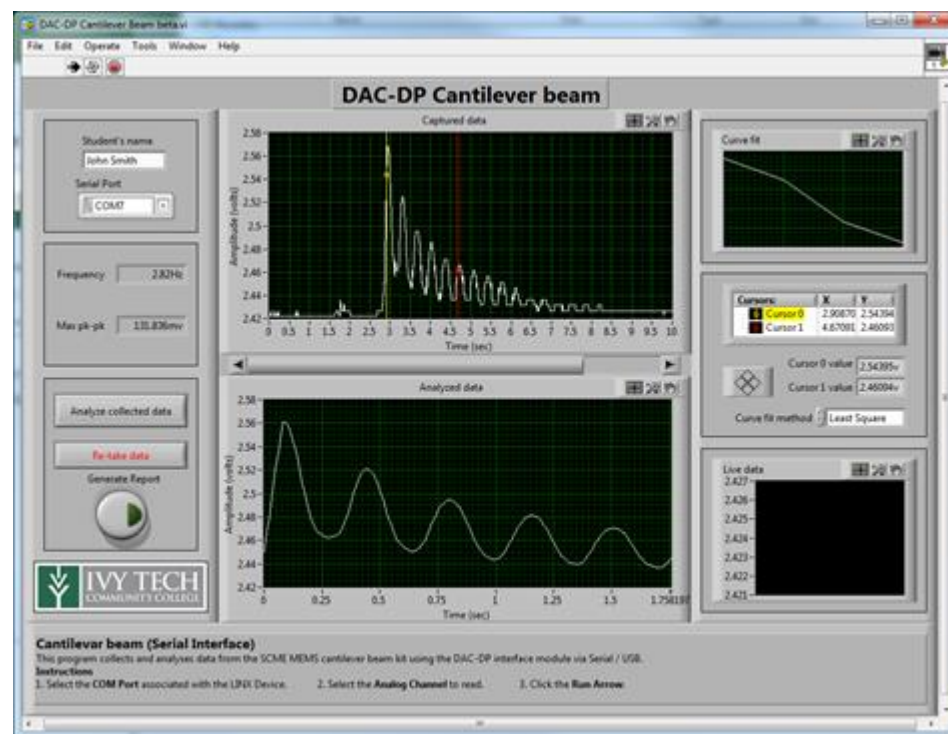
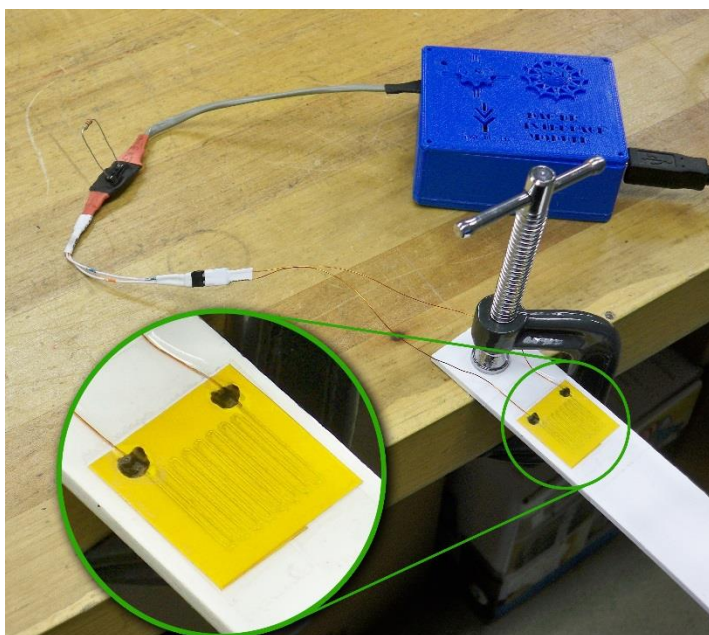
SCME Pressure Sensor Kit Includes – Arduino Uno based DAK interface module, instruction manual, Executable LabView Data acquisition software, USB cable, and pressure sensor interface cable.



# DAK for MEMS

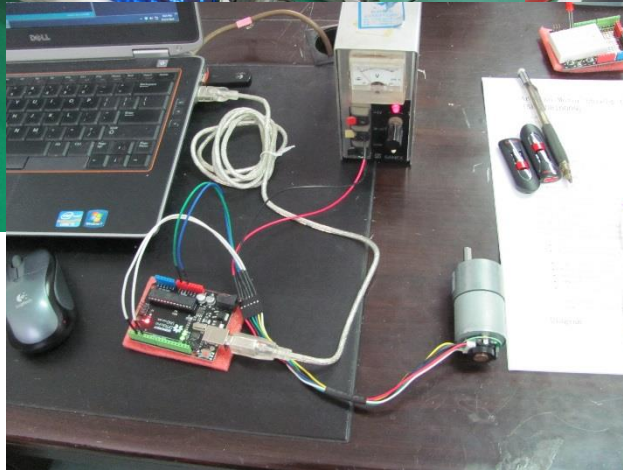
## SCME Cantilever Kit

Includes - Arduino Uno based DAK interface module, instruction manual, executable LabView Data acquisition software, USB cable, and Cantilever beam Strain gauge interface – Discovered “How to make a Strain Gauge”





# Wuxi – 100W Single Axis Solar Panel Tracker



Video



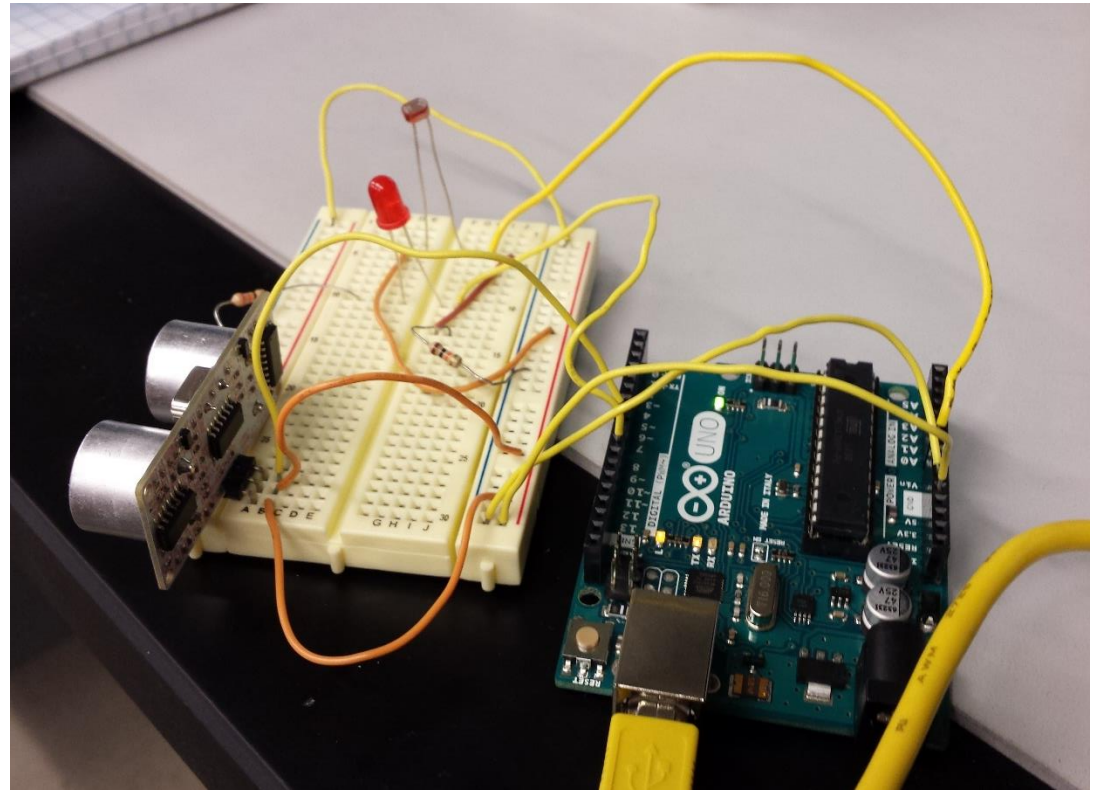
<https://www.youtube.com/watch?v=ibURmCctnWk>

# Student Lab Notebook examples

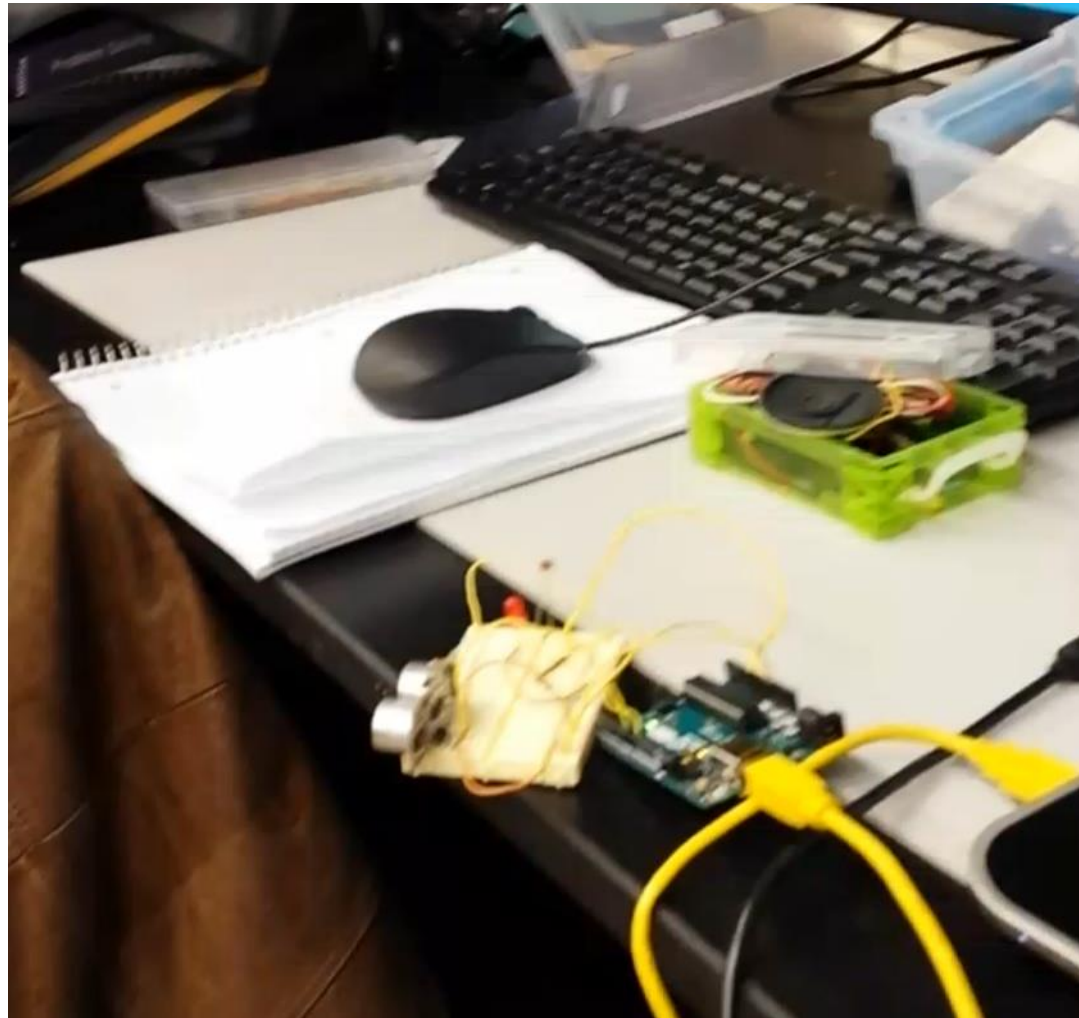
- Ultrasonic Sensor (Adam Beauchot)
- Photo Diode (Adam Beauchot)
- LCD Examples (Ryan Noyes)
- Two direction Solar Tracker (Ryan Noyes)

# Using Sensors:

This project used two sensors together, a light sensing diode and a range finding sonic eye. The objective was to get the sonic eye to determine the range of an object and or determine if their was movement in a room only at night time, similar to a type of burglar alarm.



# Video



<https://www.youtube.com/watch?v=aQlpAhh8Wyl>

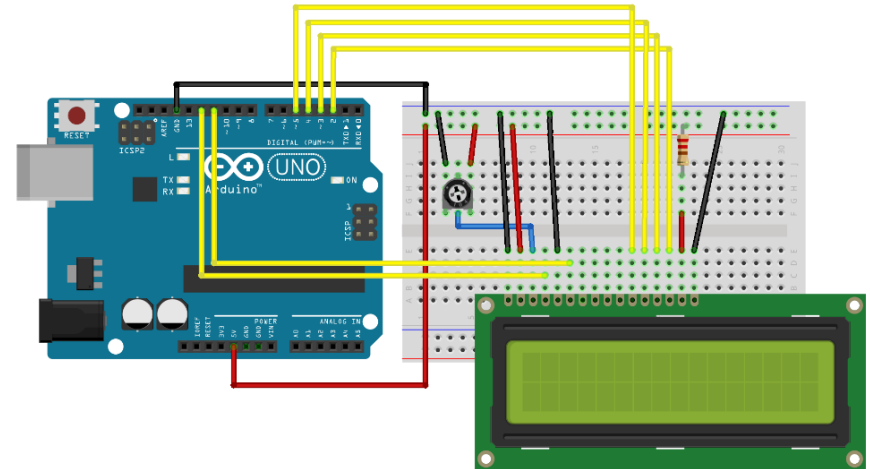
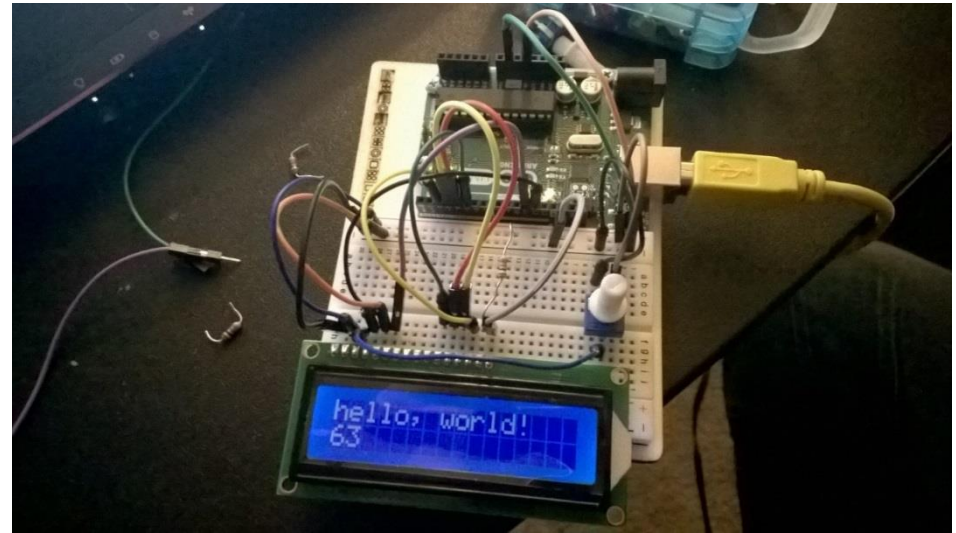
# Using LCD Display:

```
// include the library code:
#include <LiquidCrystal.h>

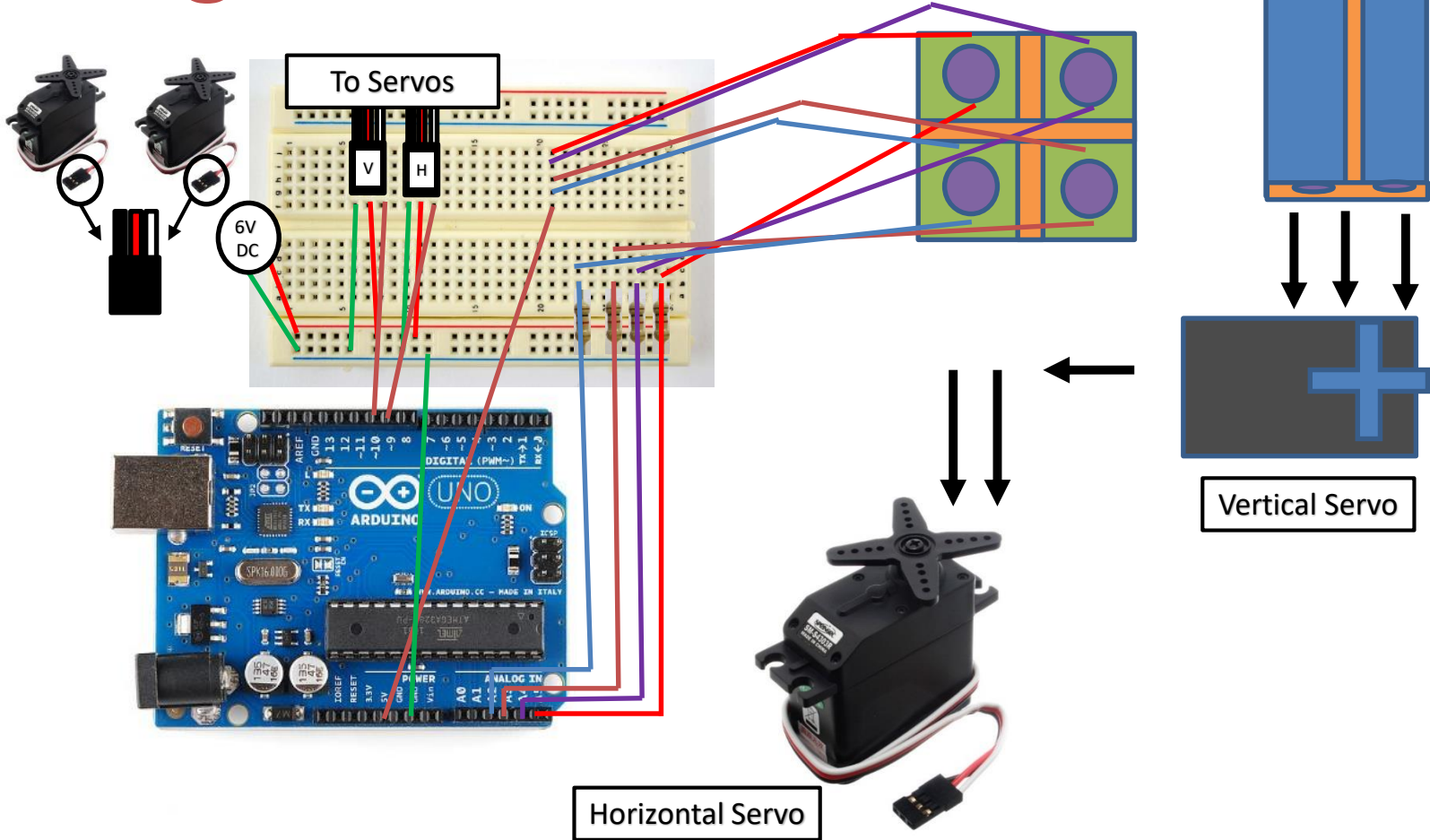
// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

void setup() {
  // set up the LCD's number of columns and rows:
  lcd.begin(16, 2);
  // Print a message to the LCD.
  lcd.print("hello, world!");
}

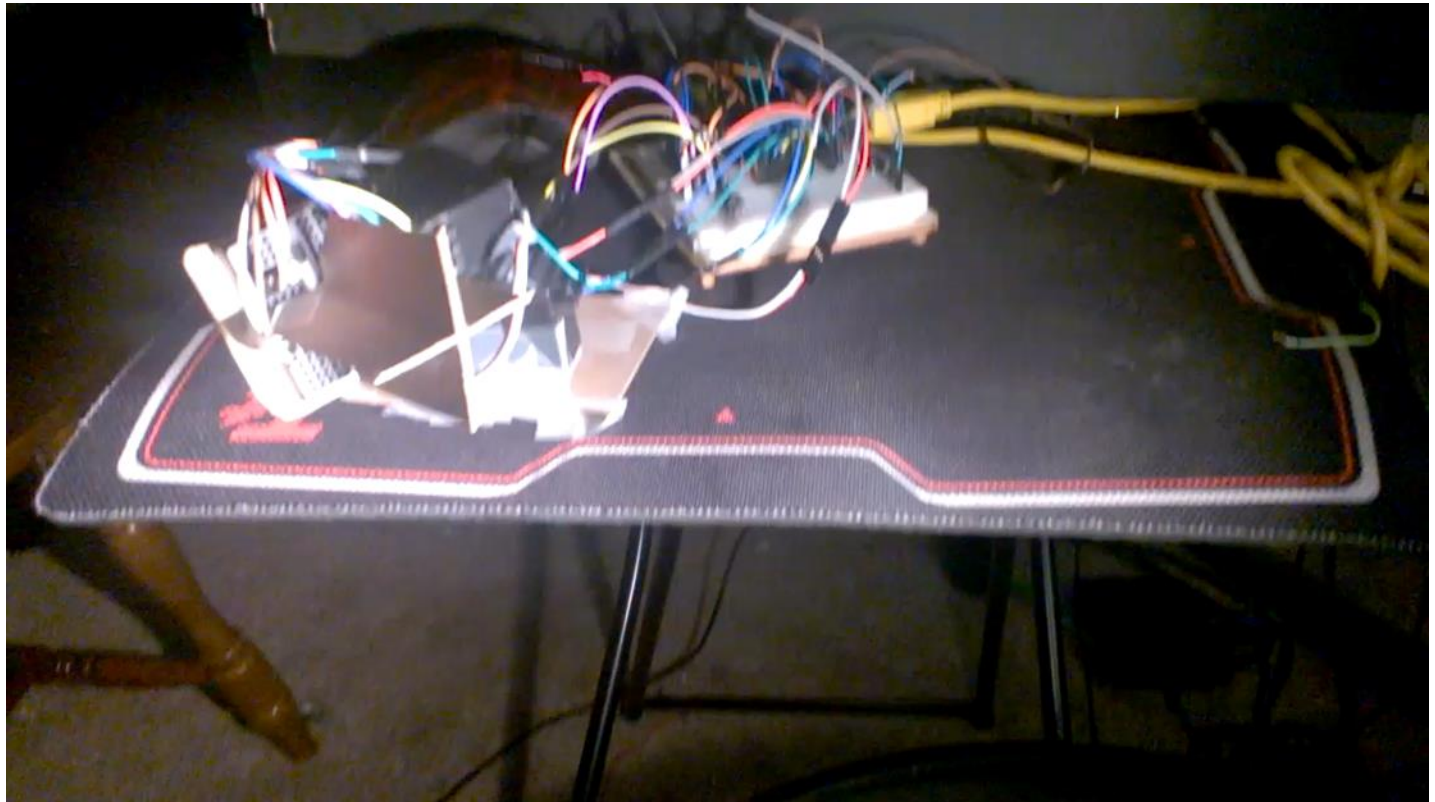
void loop() {
  // set the cursor to column 0, line 1
  // (note: line 1 is the second row, since counting begins with 0):
  lcd.setCursor(0, 1);
  // print the number of seconds since reset:
  lcd.print(millis() / 1000);
}
```



# Using Motors and Sensors:



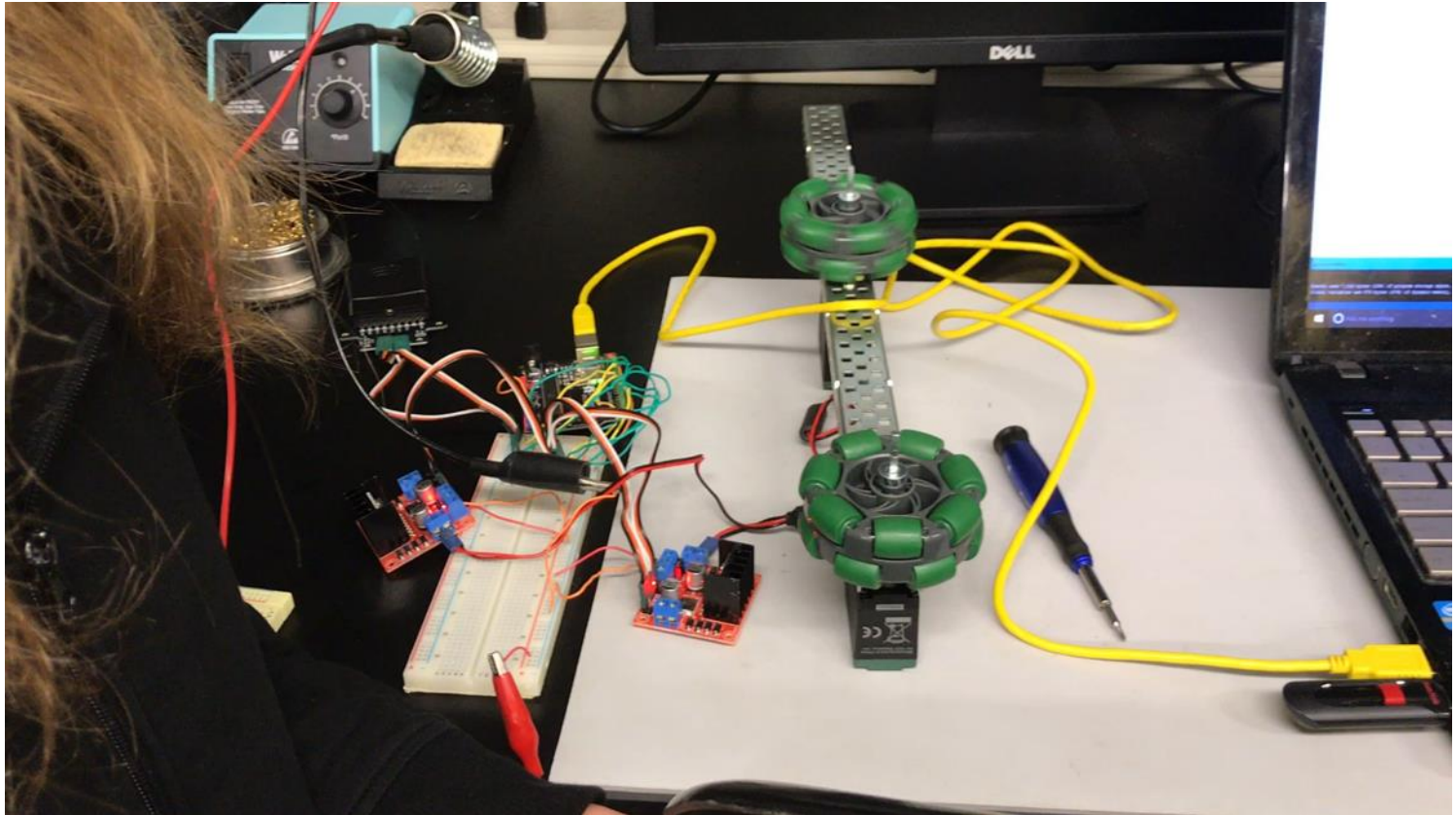
# Video



<https://www.youtube.com/watch?v=baPeL3r8GSg>



# BB8 using Arduino



Andy Bell  
Department Chair – Engineering  
Ivy Tech Community College – Northeast  
Phone: 260-481-2288 : Fax: 260-480-2052 : [abell118@ivytech.edu](mailto:abell118@ivytech.edu)  
SDKB Technology Center, Room TC1240R, 3800 N. Anthony Blvd.,  
Fort Wayne, IN 46805

<https://www.youtube.com/watch?v=0nQ-1o1mHpl>