

Lab 3: “Feel the Heat”

Based on Arduino book labs 03 and 04

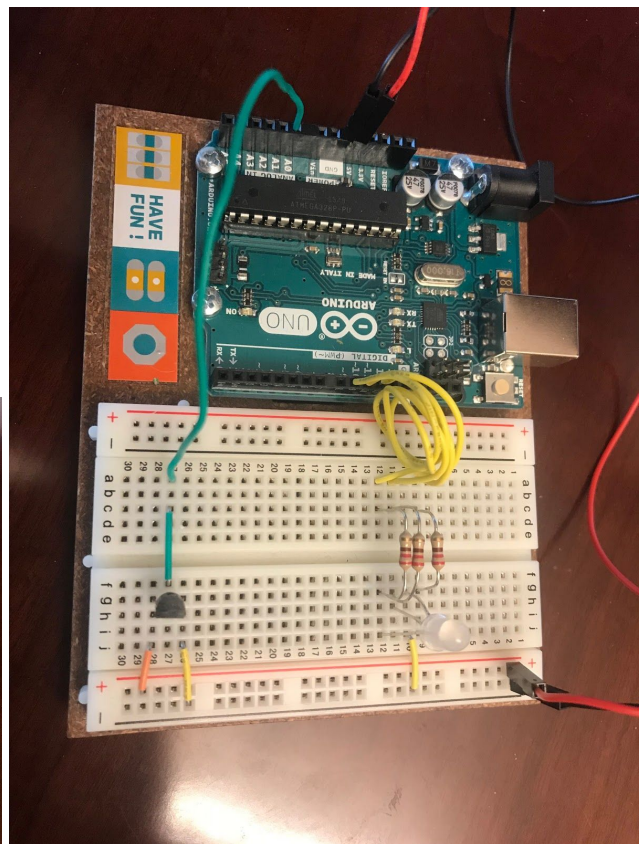
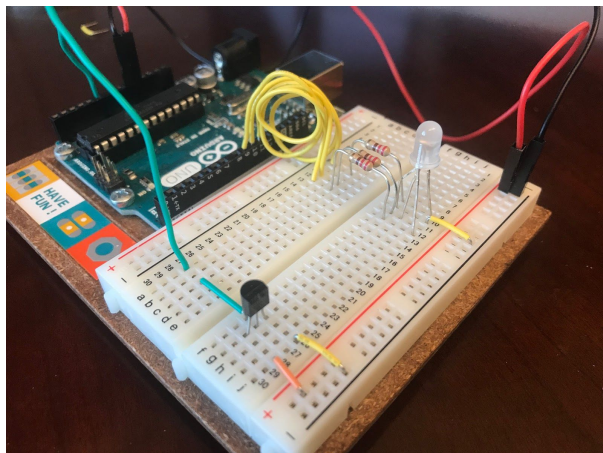
Due: October 1st, 2018 [in lab review]

40 Points

Name _____

Purpose: Now that we have finished a few labs we are going to use 2 parts of two labs from the Arduino book as a base (Arduino 03 and 04) and build our own custom program to bring them together. We are going to start by constructing the circuit for the TMP 36 temperature sensor in Arduino project 03. (you will not be using the 3 separate LEDs from this lab) We will combine this with the multi-color LED circuit from Arduino project 04 (you will not need the photo-resistors)

Here are some photos of the assembled project:



Your goal is use the data collected from the temperature sensor to change the color of the LED from blue when it is not being touched, to red when you are holding it. You can use parts of the code from each lab that helps you get the sensor data and send the correct values to the 3 colors on the light sensor, but you additionally will have to write the following pieces to make this work:

1. You should have serial output with the following information for each iteration of your main loop and reading of your temperature sensor:
 - a. Sensor Value (The returned value from the analogRead of the temperature sensor)
 - b. The normalized sensor value that results from requirement 4, below
 - c. The voltage of the sensor at provided value
 - d. The temperature in Celcius read by the sensor
 - e. **Optional:** the amount the temperature is over the “base” (room) temperature
 - f. **Optional:** The values passed to the red and blue LED pins to set the brightness of the color LEDs.

Example:

Sensor Value:148 Normalized Sensor Value:149, Volts: 0.73, Degrees C: 22.75, Over Threshold: 0.98, Red Value: 37.11, Blue Value: 217.89

2. You will have to find both lower and upper limits for what the temperature sensor reads as “room temperature” which should produce a blue LED and “warm” which is the temperature it reads when you are holding the sensor.
 - a. **Optional / Extra credit:** you can set the lower limit by taking initial sensor readings (must work fairly accurately, you may have to average initial readings!)
3. The output from the temperature sensor must be provided as input to the LED blue and red colors to produce the change in color. You will have to make the LEDs color change linear, with the lower “room temp” threshold being blue and the higher “warm” temperature being red.
4. The sensor will produce unexceptable variations in readings, note that the datasheet for the TMP36 shows accuracy of + or - 2 degrees celsius! you will need to “smooth” the readings by averaging them. You should use at least 5 samples to produce a reading. This means that if you start with 5 readings, (reading 1, 2, 3, 4 and 5) your output will be average of these readings. When you take reading 6, your output will be the average of readings 2, 3, 4, 5 and 6. This is known as using a rolling average (or rolling mean) and is a common way of working with jittery and noisy inputs.

You will want to read through both labs in the book to get started. Some topics to look for:

- Temperature sensor readings
 - Use the TMP36 datasheet:
http://www.analog.com/media/en/technical-documentation/data-sheets/TMP35_36_37.pdf along with the information in Lab 03 to determine what the temperature in Celcius is that the sensor is reading.
- PWM pins (Lab 4)
 - What are they?
 - What is the range of values you can use to vary the brightness of each color of the LED?
 - Do you use analog or digital write?

Submission: You will show me the lab working in class and also submit it in iLearn. You must include 2 things in your iLearn submission, either attached or pasted into the assignment text box.

1. Your entire code (attached as a file is preferable).
2. The answers to the questions below (pasted or attached)

Questions:

1. How is the voltage returned by the TMP36 sensor determined?
 - a. Show the math:

b. What is the reason we have to do this conversion?

2. How is the temperature in celsius determined?
 - a. Show the Math:

b. What is the reason we have to do this conversion?

3. Pins 3,5,6,9,10 and 11 on your arduino are special (note they have a ~ symbol near the pin number on the board).

a. What are these pins called? (what type of pin are they?)

b. What do they accomplish?

c. How do we utilize them? (how do we utilize their special ability in our lab)