BME 405 Project 3: "Digital Temperature Sensor"

Goal: You will design an Arduino based device which displays the temperature of water on a laptop screen and reports if the temperature is hot or cold.

Design Input: Using only one or two 9V batteries, Arduino, laptop, any resistors, any thermistors (any model), any basic op-amps, any LEDs, any buzzer, lights, wires, and materials to support connection (bread board, and solder). You can use any mechanical components you want of any kind. You must use the multi-meter temperature sensor provided as the gold standard.

Testing Conditions: You will place your thermistor probe inside a small bucket of water of unknown temperature and report a temperature reading within 15 seconds. We will have 3 buckets and you will have 15 seconds to report the temperature for each bucket and 5 seconds to move between buckets. The temperature probes must be long enough to go inside the bucket and durable enough to move from one bucket to the next bucket. In addition, if the temperature of water is above 40°C, an LED must light up indicating hot temperature. If the temperature of water is below 15°C, your device must indicate cold temperature with an LED lighting up. Your device must be clearly labeled with "hot" and "cold". We will not test your device in temperature above 75°C and below 5°C.
Cold: below 15°C
Hot: above 40°C

Minimum Requirements (10 points)
Your device must meet the following conditions in order to pass:

- The labels must be clear.
- The LEDs must be clearly visible in room light.
- The LEDs must not be flickering from one label to another.
- You will have 30 seconds to set up the device and provide any specific instructions. Once the device is set up, you cannot provide any further instructions or touch any parts of your device. You cannot ask the user to switch around wires, LEDs or make any rearrangements to your circuit.
- The device must be operational for at least 5 minutes.
- Your thermistor must not short out when measuring temperature.

1. **2 Points:** If the temperature reading is within 5°C of the gold standard (Multimeter temperature sensor)
2. **2.5 Points:** If the temperature reading is within 1°C of the gold standard (Multimeter temperature sensor)
3. **2 Points:** If the LED lights are functional for the hot and cold temperatures for at least 5 minutes duration.
4. **0.5 points:** Calibration

1 page single sided report: (3 points- sections must be clearly labeled)
Temperature calculation: How and what techniques were used to for converting thermistor resistance values to temperature reading?
Calibration: How and what calibration techniques were used for calibration.
Note: Additional pages may be used for data tables, schematics (required) and codes (required). Each section of code must be commented with clear explanation. A beginner in programming language must be able to understand the code easily.

Extra Credit: 1 page single sided report (5 points- sections must be clearly labeled)
2.5 points: Save temperature values to computer file. In your report plot the change of temperature over time from boiling to room temperature. Find an equation for the plot. You must

include how the temperate was saved on computer and which codes were used. You will only receive points if the temperature values are saved automatically and not manually by you (copy-paste technique not allowed).
2.5 points: Include a digital or analog filter: How and which filter was designed and tested. Only exhaustive testing will receive credit.

Online Upload: The code must be uploaded online. Upload link will be provided via email.