UNIVERSITY OF ALASKA FAIRBANKS

COLLEGE OF ENGINEERING AND MINES
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

COURSE CODE	EE F102 F01 (CRN: 32862)
COURSE NAME	INTRODUCTION TO ELECTRICAL AND COMPUTER ENGINEERING
SEMESTER	SPRING
YEAR	2023
LABORATORY LOCATION	JUB 331 (ELECTRONICS LAB)
LAB SESSION DATE AND TIME	MONDAY 13 FEB 2023
TYPE OF SUBMISSION	LABORATORY REPORT
NUMBER	4
TITLE OF SUBMISSION	TEMPERATURE SENSOR DESIGN
METHOD OF SUBMISSION	ONLINE VIA CANVAS
DUE DATE OF SUBMISSION	MONDAY 20 FEB 2023
DUE TIME OF SUBMISSION	23:59

STUDENT NAME	Jewel Maldonado

MAKE THIS FORM A "COVER PAGE" FOR YOUR REPORT SUBMISSION.

FOR THE TA USE ONLY

REMARKS:

Objective

In this lab, we are asked to use our knowledge from previous labs and from class to design a temperature sensor using a thermistor and the Arduino Nano.

Circuit Diagram and Physical Circuit

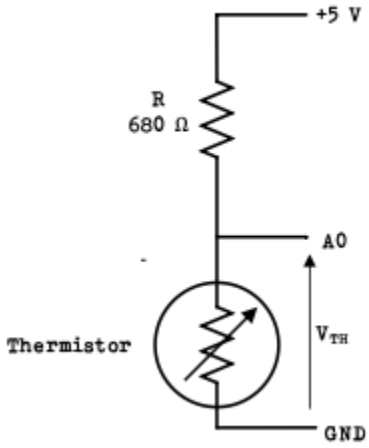

Figure I. Circuit Diagram

For the built model shown in Figure II we use the diagram from Figure I.

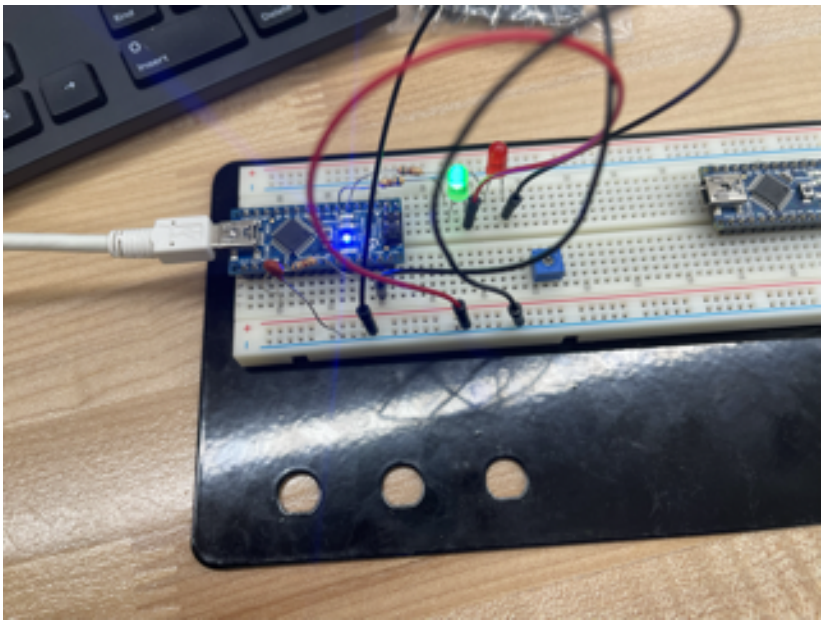

Figure II. Physical Built Circuit

In Table I, we are reading the value sent by the thermistor to the Arduino and converting the analog value to a digital value (which we will refer to as ADC) for the temperature. Afterward, we use the values to convert further into Voltage, Resistance, Temperature in Kelvin, and Fahrenheit.

Table I. Thermistor input values converted to Voltage, Resistance, and Temperature

ADC Value	Voltage in Volts	Resistance in Ohm	Temp in Kelvin	Temp in Fahrenheit
961	4.70	10539.99	297.01	74.96
947	4.63	8473.15	301.79	83.54
941	4.60	7803.41	303.63	86.86
943	4.61	8015.50	303.02	85.77
952	4.65	9117.74	300.17	80.63
956	4.67	9702.68	298.81	78.18
958	4.68	10022.15	298.10	76.91
960	4.69	10361.90	297.38	75.62
962	4.70	10723.93	296.64	74.29
963	4.71	10913.99	296.27	73.61

Referring to lines 40 - 46 in the modified code from the appendix we see how we can use the LED to detect whether the temperature is high or low. In my modified code I made it so that any temperature that is 80 ºF and over would turn on the red LED as shown in Figure III, while anything below it will turn on the green LED which is shown in Figure IV.

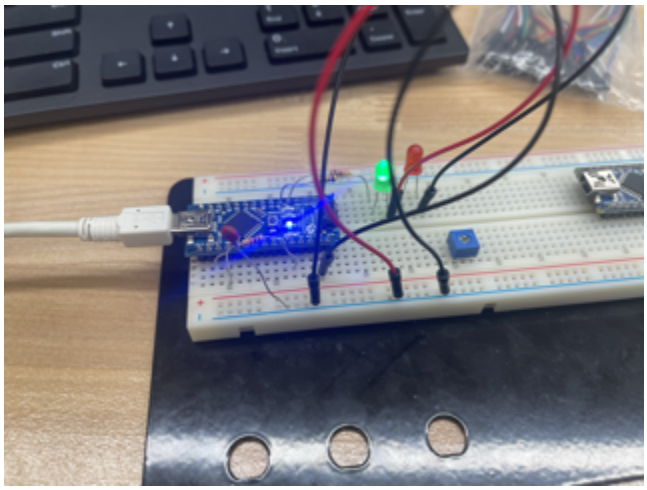

Figure III. Circuit when the temperature is below 80 ºF

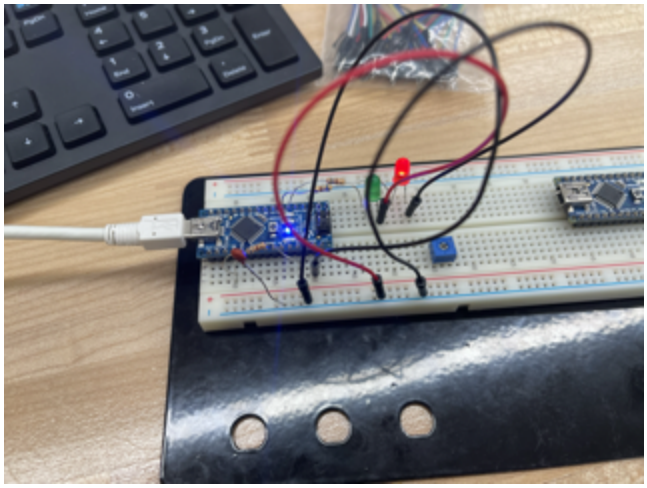

Figure IV. Circuit when the temperature is 80 ºF and over

Conclusion

In this lab, I learned how to read input from a thermistor and convert the value acquired to a digital output. I also learned how the resistor prevents the data being transmitted from overloading the thermistor. The way the inputted values from the inputted from the thermistor are converted to temperature provides a useful method to read the temperature.

Question

1. Discuss how this design was optimized based on the chosen 680 Ω. Meaning, what change would happen if we choose the 1 kΩ resistor instead of the 680 Ω?

When using a 1 kΩ resistor the resistance is too high to receive a proper reading from the thermistor. In other words, the resistance is so high there is no way for the input to be received by the Arduino.

Appendix

Modified code used in this lab:

```
1.  /* EE 102
2.   * Lab 4
3.   * Temp Sensor Design
4.  */
5.
6.  int B= 4100;
7.  int R2 = 10000;
8.  float T2 = 298.15; //converting T2 from celsius to Kelvin
9.  int R1 = 680;
10. int GREEN = 3; //modified
11. int RED = 2;   //modified
12.
13. void setup() {
14.         pinMode(GREEN, OUTPUT);       //modified
15.         pinMode(RED, OUTPUT);         //modified
16.
17.         Serial.begin(9600); //configure serial port
18. }
19.
20. void loop()
21. {
22.         int tempVal = analogRead(A0);
23.         Serial.print(tempVal);
24.         float tempVolt = tempVal*5.0/1023.0;
25.         Serial.print("\t Voltage in Volts = ");
26.         Serial.print(tempVolt);
27.         float tempRes= R1 * tempVolt / (5.0 - tempVolt);
28.         Serial.print("\t Resistance in ohm = ");
29.         Serial.print(tempRes);
30.         float tempT1Kel = 1.0 / ((1.0 / B) * log(tempRes/R2) + (1.0 / T2));
31.         Serial.print("\t Temp. in Kelvin = ");
32.         Serial.print(tempT1Kel);
33.         float tempT1Far = (9.0*(tempT1Kel - 273.15) / 5.0) + 32.0;
34.         Serial.print("\t Temp. in Fahrenheit = ");
35.         Serial.println(tempT1Far);
36.
37.    //Below code lines 40 - 45 is modified code
38.   //if temp1FAR >= 80 then red led HIGH  green led LOW
39.   //else green led HIGH red led LOW
40.        if (tempT1Far >= 80){ //if the temp is higher than 80 °F turn the red led on
41.                digitalWrite(RED, HIGH);
42.                digitalWrite(GREEN, LOW);
43.        } else { // else temp is lower than 80 °F turn the green led on and the red off
44.                digitalWrite(GREEN, HIGH);
45.                digitalWrite(RED, LOW);
46.        }
47.   delay(6000);
48. }
```

sketch_feb15a

```
  /* EE 102
   *  Lab 4
   *  Temp Sensor Design
   */
int B= 4100;
int R2 = 10000;
float T2 = 298.15;
int R1 = 680;
int GREEN = 3;
int RED = 2;
void setup() {
  pinMode(GREEN, OUTPUT);
  pinMode(RED, OUTPUT);

  Serial.begin(9600);


}

void loop()
{
  int tempVal = analogRead(A0);
  Serial.print(tempVal);
  float tempVolt = tempVal*5.0/1023.0;
  Serial.print("\t Voltage in Volts = ");
  Serial.print(tempVolt);
  float tempRes= R1 * tempVolt / (5.0 - tempVolt);
  Serial.print("\t Resistance in ohm = ");
  Serial.print(tempRes);
  float temp1Kel = 1.0 / ((1.0 / B) * log(tempRes/R2) + (1.0 / T2));
  Serial.print("\t Temp. in Kelvin = ");
  Serial.print(temp1Kel);
  float temp1Far = (9.0*(temp1Kel - 273.15) / 5.0) + 32.0;
  Serial.print("\t Temp. in Fahrenheit = ");
  Serial.println(temp1Far);

  //if temp1FAR >= 80 then red led HIGH  LOW
  //else green led HIGH LOW
  if (temp1Far >= 80){
    digitalWrite(RED, HIGH);
    digitalWrite(GREEN, LOW);
  } else {
    digitalWrite(GREEN, HIGH);
    digitalWrite(RED, LOW);
  }
```

Figure. Capture of Modified Code Sketch