Determination of the coefficient of variation of resistance of a material according to the temperature

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Objective of the experiment

The objective of this project is to determine the coefficient R0 and α specific to the material under study

Methodology

Most electricity conductors have a resistance that varies with the ambient temperature. However, resistance sensitivity to temperature is specific to each material. The relationship between the temperature and the resistance of a material can be expressed by the formula (1) below:

$$R = [R0 \times (1 + \alpha(T - T0)]$$

R: Resistance at a given temperature; R0: resistance at reference temperature; T: given temperature; T0: reference temperature; α: coefficient of resistivity variation per unit of temperature. Equation (1) has the generic form of the equation of a straight line:

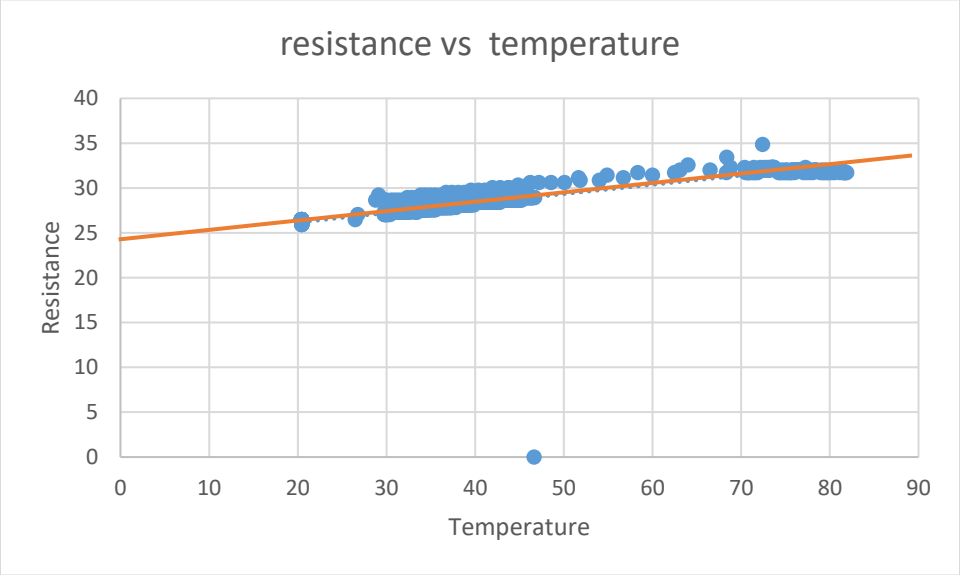
$$y = mX + C$$

Where C is equivalent to R0, m is equivalent to R0α and (T- T0) is equivalent to the variable X

Data Collection

1. Connected the ohmmeter to the copper wire coil and used it to check what the resistance of the coil at room temperature is.
2. Installed the Pt-100 thermometer and MAX13836 amplifier as the temperature sensor, to monitor the water-bath temperature.
3. The final circuit is shown below on Appendix A:
4. Wrote the code to record the timestamp, the temperature of the water and the corresponding resistance and printed it on the Arduspreadsheet every 90 seconds
5. For logging the data to an Excel spreadsheet ensure Arduspreadsheet is installed in your Arduino IDE
6. Immersed the copper coil and thermometer in the hot water bath and allow the system to cool from ~80 Celcius to ~30 Celcius.
7. Run the program to collect the timestamp, the temperature data and the corresponding resistance value and log this in an Excel spreadsheet.

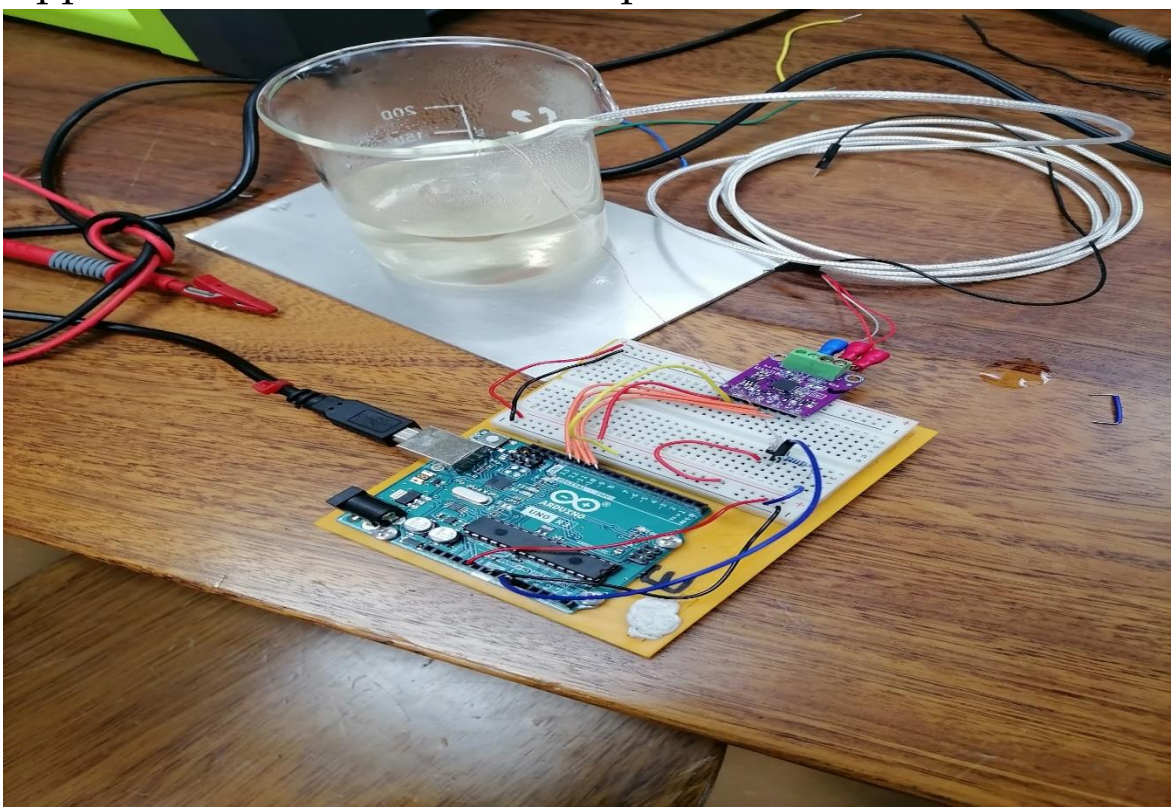
Data Analysis



Recommendations

The steps are given and should be followed correctly so that the data can be collected since collecting, processing and obtaining measurements are the important steps in the Data acquisition. Larger lengths of wire and a greater time interval should be used to reduce the heating effect of the current on the wire because the current will be lower for longer lengths of wire. This improves accuracy since resistance is affected by the temperature of the wire, by controlling more variables, improving measurement technique, increasing randomization to reduce sample bias, blinding the experiment, and adding control groups can improve sensivity of Data acquisition.

Appendix A – Picture of the setup



Appendix B - Code for the Arduino

```
#include <Adafruit_MAX31865.h>


// Use software SPI: CS, DI, DO, CLK

Adafruit_MAX31865 thermo = Adafruit_MAX31865(10, 11, 12, 13);


// The value of the Rref resistor. Use 430.0 for PT100 and 4300.0 for PT1000

#define RREF      430.0


#define RNOMINAL  100.0

int analogPin = 0;
```

```
int raw = 0;
int Vin = 5;
float Vout = 0;
float R1 = 220;//reading of the resistor 1
float R2 = 0;
float buffer = 0;
void setup() {
  Serial.begin(115200);
  thermo.begin(MAX31865_3WIRE);  // set to 2WIRE or 4WIRE as necessary
}


void loop() {
  Serial.print("Resistance =");
  Serial.print("\t");
  Serial.print(R2);
  Serial.print("\t");
  Serial.print("Temperature =");
  Serial.print("\t");
  Serial.println(thermo.temperature(RNOMINAL, RREF));
  Serial.print("\t");
  raw = analogRead(analogPin);
  if(raw){
    buffer = raw * Vin;
    Vout = (buffer)/1024.0;
    buffer = (Vin/Vout) - 1;
    R2= R1 * buffer;
```

```
    delay(1000);

  }

  Serial.println();
  delay(1000);
}
```