Can you help me understand why this is returning really high values of 200C when it's only 16C right now? Note, this is a Analog Thermistor sensor

```
float readTemperature() {
int rawValue = analogRead(TEMP_SENSOR_PIN);
float voltage = rawValue * (5.0 / 1023.0);
```

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Your code is returning unrealistically high temperature values (around 200°C when it's actually 16°C) because it uses an incorrect formula for converting the analog reading to temperature for a thermistor sensor. Here's why:

Why the Formula Is Incorrect

- The line `return voltage * 100;` assumes a direct linear relationship between voltage and temperature (i.e., 10 mV/°C), which is only true for certain analog temperature sensors like the LM35 or TMP36, **not** for thermistors.
- Thermistors (especially NTC types) have a **nonlinear resistance-to-temperature relationship**. Their resistance decreases exponentially as temperature increases, and the voltage across them in a voltage divider circuit does not map linearly to temperature [5] [1].

What's Happening in Your Code

- You read the analog value and convert it to voltage correctly.
- But multiplying by 100 to get temperature is only valid for specific sensors, not thermistors.
- As a result, the calculation gives you a much higher value than the actual temperature.

How to Correctly Read Temperature from a Thermistor

You need to:

1. **Calculate the Thermistor Resistance**
   If using a voltage divider:

$$R_{thermistor} = R_{fixed} \left(\frac{V_{in}}{V_{out}} - 1 \right)$$

   Where:

- R_{fixed} is the known resistor value in the divider,
- V_{in} is the supply voltage,
- V_{out} is the measured voltage at the thermistor.

2. **Convert Resistance to Temperature**
   Use the Steinhart-Hart equation or the Beta parameter equation:

$$\frac{1}{T} = \frac{1}{T_0} + \frac{1}{\beta} \ln\left(\frac{R}{R_0} \right)$$

   Where:

- T is temperature in Kelvin,
- T_0 is nominal temperature (usually 298.15 K for 25°C),
- R_0 is resistance at T_0,
- β is the thermistor's Beta value [5].

Key Points

- Thermistors require nonlinear conversion, not a simple voltage-to-temperature multiplication [5] [1].
- You need to know your thermistor’s parameters (R_o and β) and the value of the fixed resistor in your voltage divider.
- Use the correct equations to convert the measured voltage to resistance, then to temperature.

Example Arduino Code Snippet

cpp

```cpp
float readTemperature() {
  int rawValue = analogRead(TEMP_SENSOR_PIN);
  float voltage = rawValue * (5.0 / 1023.0);

  // Assuming a 10k resistor in series with the thermistor
  float R_fixed = 10000.0;
  float R_thermistor = R_fixed * (5.0 / voltage - 1.0);

  // Thermistor parameters (example values, check your datasheet)
  float beta = 3950.0;
  float T0 = 298.15; // 25°C in Kelvin
  float R0 = 10000.0; // Resistance at 25°C

  float temperatureK = 1.0 / (1.0 / T0 + (1.0 / beta) * log(R_thermistor
/ R0));
  float temperatureC = temperatureK - 273.15;
  return temperatureC;
}
```

Summary Table

Sensor Type	Voltage-to-Temp Formula	Nonlinear Conversion Needed?
LM35/TMP36	Yes (e.g., V × 100)	No
Thermistor (NTC)	No	Yes

You need to use the thermistor's resistance and apply a nonlinear equation to get an accurate temperature reading. [5] [1]

Related

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