Program Logic

This program measures the temperature using a PT100 sensor by calculating its resistance and converting it to a temperature value. Here's a breakdown of the program's logic:

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1. Initialization (Setup)

- **Serial Communication:**
  Initializes Serial Monitor with `Serial.begin(9600);` for outputting data for debugging.
- **Array Initialization:**
  Creates an array `readings[]` to store the latest 50 analog readings (`numReadings = 50`), and sets all values to zero. This is used for averaging the sensor readings to reduce noise.
- **LCD Initialization:**
  Initializes an I2C LCD using `lcd.begin(16, 2)` for a 16x2 display, and clears the display with `lcd.clear()` to prepare for output.

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2. Main Program Logic (Loop)

The main loop runs continuously and performs the following tasks:

a. Reading the Analog Pin

- **Read Analog Value:**
  It reads the analog value from pin `A3` using `analogRead(analogPin);`.

b. Averaging the Readings

- **Moving Average Calculation:**
  - Subtract the oldest reading in the `readings[]` array (`total = total - readings[readIndex];`).
  - Store the new reading in `readings[readIndex]` and add it to the total (`total = total + readings[readIndex];`).
  - Increment the `readIndex`, and if it reaches `numReadings` (50), reset it to 0.
  - The average value is calculated by dividing the total sum of the readings by `numReadings` (`averageValue = total / numReadings;`).

c. Timing Control (1-second Interval)

- The program checks if 1 second has passed since the last update using `millis()` function.
    - If 1 second has passed, the program proceeds to calculate and display new data.

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3. Calculating the PT100 Resistance

- **Convert Raw Value to Voltage:**
  The analog reading (ranging from 0 to 1023) is converted to a voltage value (`voltage = rawValue * (Aref / 1023.0);`), where `Aref` is the reference voltage (5.02V).
- **Calculate PT100 Resistance:**
  The PT100 resistance is calculated using the voltage divider formula:
  RPT100=R2×(VccV−1)R_{PT100} = R2 \times \left(\frac{Vcc}{V} - 1 \right)RPT100=R2×(VVcc−1)
  where `R2` is the 10kΩ resistor, `Vcc` is the supply voltage (3.340V), and `V` is the measured voltage from the sensor.

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4. Temperature Calculation

- **Apply Calibration Factor:**
  The calculated PT100 resistance is adjusted using a **calibration factor** (default `0.9725`), which compensates for sensor or circuit inaccuracies:
  RPT100=RPT100×calibrationFactorR_{PT100} = R_{PT100} \times \text{calibrationFactor}RPT100=RPT100×calibrationFactor
- **Convert Resistance to Temperature:**
  The temperature is calculated using a linear approximation formula based on the PT100's characteristics:
  Temperature=RPT100−100α×100\text{Temperature} = \frac{R_{PT100} - 100}{\alpha \times 100}Temperature=α×100RPT100−100
  where `α` is the temperature coefficient (0.00385), which indicates the change in resistance per degree Celsius.

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5. Display and Output

- **LCD Display:**
  The program clears the LCD and displays:
    - The calculated PT100 resistance in ohms (`Res: <resistance> ohm`).

    - The calculated temperature in Celsius (`Temp: <temperature> C`).
- **Serial Monitor Output:**
  The same values for PT100 resistance and temperature are also printed to the Serial Monitor for debugging or monitoring.

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6. Repeat

- The loop repeats continuously, taking new readings, calculating the resistance and temperature, updating the LCD and Serial Monitor every second.