Project Report
On
Temperature Sensor

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FOR OFFICE USE

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Project Report

Temperature Sensing with LM35 and Op-Amp

Abstract

This project explores a **temperature sensing system** using an **LM35 temperature sensor** and an **operational amplifier (op-amp)** for signal amplification. The LM35 provides an output voltage that varies linearly with temperature. This output is amplified to improve sensitivity before being read by an **Arduino microcontroller**, which converts it into a temperature reading in degrees Celsius and displays it via the Serial Monitor.

This system is ideal for applications requiring **precise temperature monitoring**, as the amplified signal allows the system to detect small temperature changes accurately. The project highlights the **design, implementation, and real-time data display** of a simple yet effective temperature monitoring solution.

Objective

The primary goal of this project is to **accurately read temperature values** using the LM35 sensor. The **output signal from the LM35 is amplified using an op-amp** to improve sensitivity before being processed and displayed in Celsius.

Components Used

- **LM35 Temperature Sensor** – A precision sensor that outputs **10 mV per °C**.
- **Operational Amplifier (Op-Amp)** – Amplifies the LM35 output, making the analog readings more sensitive to small temperature changes.
- **Arduino Board** – Reads the amplified signal, converts it into temperature values, and outputs it to the Serial Monitor.

Code Implementation

```
// Temperature Sensing using LM35 and Op-Amp

// Define the analog pin connected to the op-amp output
const int tempPin = A0;

void setup() {
  Serial.begin(9600);  // Initialize serial communication at 9600 baud
}

void loop() {
  // Read the amplified analog value from the op-amp
  int sensorValue = analogRead(tempPin);
```

```
  // Convert the analog value to voltage (Arduino ADC: 10-bit resolution)
  float voltage = sensorValue * (5.0 / 1023.0);

  // Define op-amp gain factor (adjust based on circuit configuration)
  float gain = 10.0;

  // Convert voltage to temperature in Celsius
  float temperatureC = (voltage / gain) * 100.0; // LM35: 10mV per °C

  // Display temperature on Serial Monitor
  Serial.print("Temperature: ");
  Serial.print(temperatureC);
  Serial.println(" °C");

  delay(1000);  // Wait for 1 second before next reading
}
```

Code Explanation

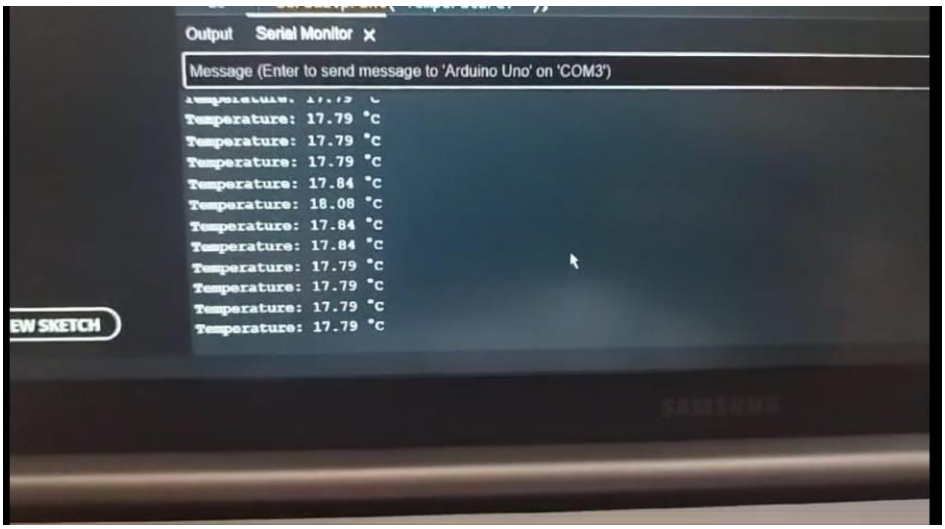
- **Pin Definition**: The analog pin A0 is used to read the amplified output from the op-amp.
- **Setup Function**: Initializes serial communication at **9600 baud rate** to display temperature readings.
- **Loop Function**:
  - Reads the **analog signal** from the op-amp.
  - Converts the analog reading into **voltage**.
  - Applies **gain compensation** to determine the correct temperature.
  - Displays the temperature value on the **Serial Monitor** every second.

Adjusting Gain Factor

The gain variable must be modified based on the actual gain configuration of the **op-amp circuit**. If the gain differs from 10, adjust the value accordingly to maintain accurate readings.

Output

- The **temperature readings** are displayed in Celsius on the Serial Monitor.
- The readings update **every second**, providing **real-time temperature output**.



Observations & Remarks

✅ **Accuracy**: The accuracy of the temperature readings depends on:

- The **gain factor** of the op-amp circuit.
- The **calibration** of the LM35 sensor.

✅ **Applications**:

- Suitable for **environmental monitoring**.
- Can be used in **temperature-sensitive industrial applications**.
- Ideal for projects requiring **real-time temperature tracking**.

Conclusion

This project successfully demonstrates the **design and implementation** of a temperature sensing system using the **LM35 sensor and op-amp**, with **Arduino providing real-time data processing and display**. The amplified signal ensures **high sensitivity**, making it suitable for applications requiring **precise temperature monitoring**.