Project Report

On

Temperature Sensor

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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 with an operational amplifier (op-amp) for signal amplification. The LM35 outputs a voltage that varies linearly with temperature, and this output is amplified to improve sensitivity. An Arduino microcontroller reads the amplified signal, converts it into a temperature reading in degrees Celsius, and displays the result via the Serial Monitor. This setup 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 and implementation of a simple yet effective temperature monitoring solution, emphasizing accuracy and real-time data display.

Objective

This project is aimed at reading temperature using an LM35 temperature sensor. The output from the LM35 is amplified by an operational amplifier (op-amp) to improve sensitivity and is then converted into a temperature reading in degrees Celsius.

Components

- LM35 Temperature Sensor - A precision temperature sensor that gives an output of 10 mV per °C.
- Operational Amplifier (Op-Amp) - Used to amplify the LM35 output to make the analog reading more sensitive to small changes in temperature.
- Arduino Board - Reads the amplified analog signal, converts it to a temperature value, and outputs it to the Serial Monitor.

Code

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

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

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

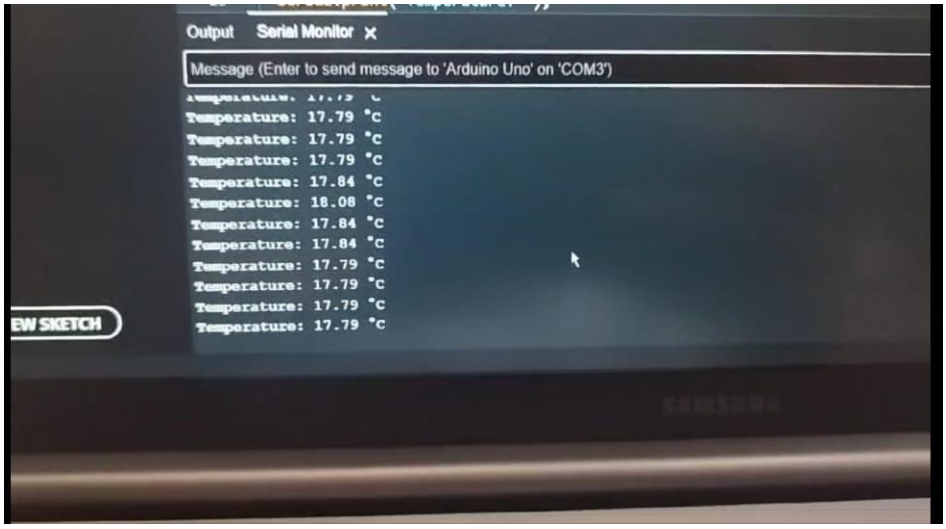
```
  // Convert the analog value to voltage
  float voltage = sensorValue * (5.0 / 1023.0);

  // Convert voltage to temperature in Celsius
  // Adjust the gain factor based on your op-amp setup.
  // For example, if gain = 10, divide voltage by 10 to get back to LM35 scale
  float gain = 10.0; // Adjust based on your actual setup
  float temperatureC = (voltage / gain) * 100.0; // LM35 gives 10mV per °C

  // Print the temperature to the Serial Monitor
  Serial.print("Temperature: ");
  Serial.print(temperatureC);
  Serial.println(" °C");

  delay(1000); // Wait a second between readings
}
```

Output



Explanation of the Code

- Pin Definition: Defines the analog pin `A0` as the input pin for the amplified output from the op-amp.
- Setup Function: Initializes serial communication at a baud rate of 9600 to allow for data output to the Serial Monitor.
- Loop Function: Reads the analog value from the op-amp output, converts it to a voltage, and then calculates the temperature in Celsius by first compensating for the op-amp gain and then scaling the result based on the LM35 sensor's output characteristic (10 mV per °C). The calculated temperature is displayed on the Serial Monitor every second.

Adjusting Gain Factor

The `gain` variable should be modified based on the actual gain setup of the op-amp circuit. If the gain is different from 10, change the value accordingly.

Output

Temperature readings are printed in Celsius to the Serial Monitor. The readings update every second, providing a real-time temperature output.

Observations and Remarks

Accuracy: The accuracy of the temperature readings depends on the gain accuracy of the op-amp circuit and the calibration of the LM35 sensor.

Applications: This setup is useful in temperature monitoring applications where small temperature changes need to be detected.

Conclusion

This project successfully demonstrates reading and amplifying temperature signals using an LM35 sensor and op-amp, with the Arduino providing real-time data output.