

Design Process of Room Temperature Monitor

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04/28/2025

1 Summary

2 Introduction

Maintaining a comfortable and stable indoor temperature is crucial to modern building management and directly impacts both energy consumption as well as the wellbeing of those who occupy it. Traditional thermostats regulate heating and cooling systems based on set threshold temperatures, but commercial units can be costly and therefore inaccessible for small-scale or experimental applications. In response to growing concerns over energy efficiency and sustainability, it is important to explore low-cost, modular solutions that allow fine-grained temperature monitoring and control in real world environments.

This project addresses the need for an accessible, do-it-yourself room temperature monitoring system by integrating a TMP36 analog temperature sensor, a 16×2 I²C LCD, and an Arduino UNO microcontroller. By automating the measurement and display of ambient temperature, the device can inform control actions in the event loop (such as triggering a fan or heater), enabling users to avoid over-adjusting the temperature in their spaces, reducing unnecessary energy use. A 9 V battery, switch, green and red LEDs, and a buzzer provide basic power, status indication, and alerts without reliance on wall plug electricity.

This project has two main aims: first, to replicate the core functionality of a simple thermostat using components and techniques covered in our course. Second, to develop skills in assembling electronic hardware, writing microcontroller code (in C++), and designing enclosures in CAD. For that part of the project enclosure, lid, battery holder, and internal baseplate were modeled and fabricated to store and organize all components, wired using 22 AWG and female-to-female jumper cables for I²C data connections.

The purpose of this report is to document the design process, from component selection and design to circuit assembly and firmware development, and to evaluate the system's performance against expected objectives. By following the design methodology outlined here, we demonstrate how simple and easily sourceable parts can be combined into a cohesive temperature monitoring tool.

3 Design elements

Explain your design decisions. Address each of the following:

1. List Of Used Components

- 1 × Injection Mold ABS Enclosure (Bottom and Lid)
- 1 × Transparent Acrylic Laser Cut Base Plate
- 8 × Polycarbonate Flat Top Phillips Screws
- 8 × Polycarbonate Bolts
- 8 × Metal Round Head Phillips Screws
- 8 × Plastic 0.5 mm spacers
- 1 × 9V Battery
- 1 × PLA FDM Printed 9V Battery holder
- 1 × Arduino UNO microcontroller
- 1 × Alphanumeric 16 × 2 I²C LCD with SDA SCL pins
- 1 × TMP36 Analog Temperature sensor
- 1 × Piezo Capsule Buzzer
- 1 × Red LED
- 1 × Green LED
- 1 × 2 way switch
- 2 × Female-Female 4'' jumper wires
- 15 × 6'' 22 AWG Wires (White and Red)
- 1 × 220Ω resistor
- 1 × 1kΩ resistor
- 2 × Twist Nut Caps
- 2 × Spade Connectors

2. Precision measurements

Table 1: Relevant dimensions of major components (see Appendix A for Figures)

Item	Fig. ID	W [mm]	L [mm]	H [mm]	Ø [mm]
Injection Mold ABS Enclosure (Bottom & Lid)	1	100	200	50	-
Transparent Acrylic Laser-Cut Base Plate	2	200	100	3	-
9 V Battery & PLA-Printed Holder	3	60	30	20	-
Arduino UNO Microcontroller	4	70	50	15	-
Alphanumeric 16 × 2 I ² C LCD	5	80	35	15	-
TMP36 Analog Temperature Sensor	6	-	-	5	3
Piezo Capsule Buzzer	7	-	-	-	10
LEDs (Red & Green)	8	-	-	5	5
2-Way Switch	9	10	20	15	-

3. CAD drawings

Include a screenshot of your final assembly.

Figure 1: CAD assembly of the prototype.

4. Prototype photographs

Top view of actual prototype, with and without lid, powered on.

(a) With lid

(b) Without lid

Figure 2: Top views of the working prototype.

5. Purpose of using an Arduino board

Explain role of the Arduino in the circuit.

6. Wiring diagram and methods

Show diagram and discuss soldering, jumper wires, twist nut caps, spade connectors, etc.

Figure 3: Circuit wiring diagram.

7. Wire gauge and resistor values

Specify wire gauge used and justify choice (jumper vs. 22 AWG). State resistor values in series with green/red LEDs, calculate operating currents using KVL.

8. Internal power supply

Discuss why a 9 V battery, its charge capacity, expected runtime, and external power options.

9. Arduino code

Provide the code listing used in your design.

Listing 1: Arduino sketch for temperature monitoring

```
// Example placeholder code
void setup() { Serial.begin(9600);
// initialization...
} void loop() { float temp = readTemperature(); Serial.println(temp);
// control LEDs...
delay(1000); }
```

10. Prototype specifications

List:

- Voltage of power supply
- Operating voltage of circuit
- Total current drawn (measured with DMM)
- Battery operating time
- Sensor temperature range (from datasheet)
- Comfortable temperature range
- Use KVL to explain resistor choices (1 k Ω for green LED, 220 Ω for red LED)

4 Evaluation of Results

- Degree to which design objectives were met
- Summary of outcomes and comparison to standard thermometers
- Limitations and recommendations for future work (battery life, size, weight, etc.)
- Highlight usefulness of the design

A Supporting Materials