ECEN435: Embedded Real-Time Systems Project

Temperature Meter with Heater and Air Conditioner

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Abstract

This project involves the development of an automated temperature control system using an ATmega32 microcontroller, an LM35 temperature sensor, and an LCD display. The system monitors temperature and adjusts environmental conditions by activating a fan to reduce heat or another fan to increase warmth as needed. The real-time temperature readings are displayed on an LCD for user monitoring. This project demonstrates the integration of hardware components to create an efficient and cost-effective solution for temperature regulation.

Introduction

Maintaining a comfortable and stable temperature is essential for various settings, from residential to industrial spaces. Manual temperature control can be unreliable, often leading to energy inefficiency. Automating this process provides a more effective way to manage temperature while reducing human effort and errors.

This project uses an LM35 temperature sensor and an ATmega32 microcontroller, along with essential electronic components such as capacitors, resistors and transistors to build a reliable temperature control system. The system's ability to activate a fan or a secondary fan that warms the surrounding as needed and to display real-time temperature readings on an LCD makes it user-friendly and highly practical.

Why did we use the ATMEGA32A as our microcontroller

We used this specific microcontroller for the following reasons:

Because of its ADC module. Since it has a 10-bit ADC module, it was essential to use it for processing the analog output of the LM35 sensor.

Multiple I/O pins was essential as well to provide sufficient pins to interface with our system such as the LCD and other components.

We used the ATMEGA32A as well for its low power consumption and its cost effectiveness.

Methodology

To finalize our hardware, we first set up a simulation of the expected hardware on proteus to check that all components will function correctly and in the way they are meant to work. We then applied our code into the microcontroller (ATMEGA32A) to check if the simulation will work as intended.

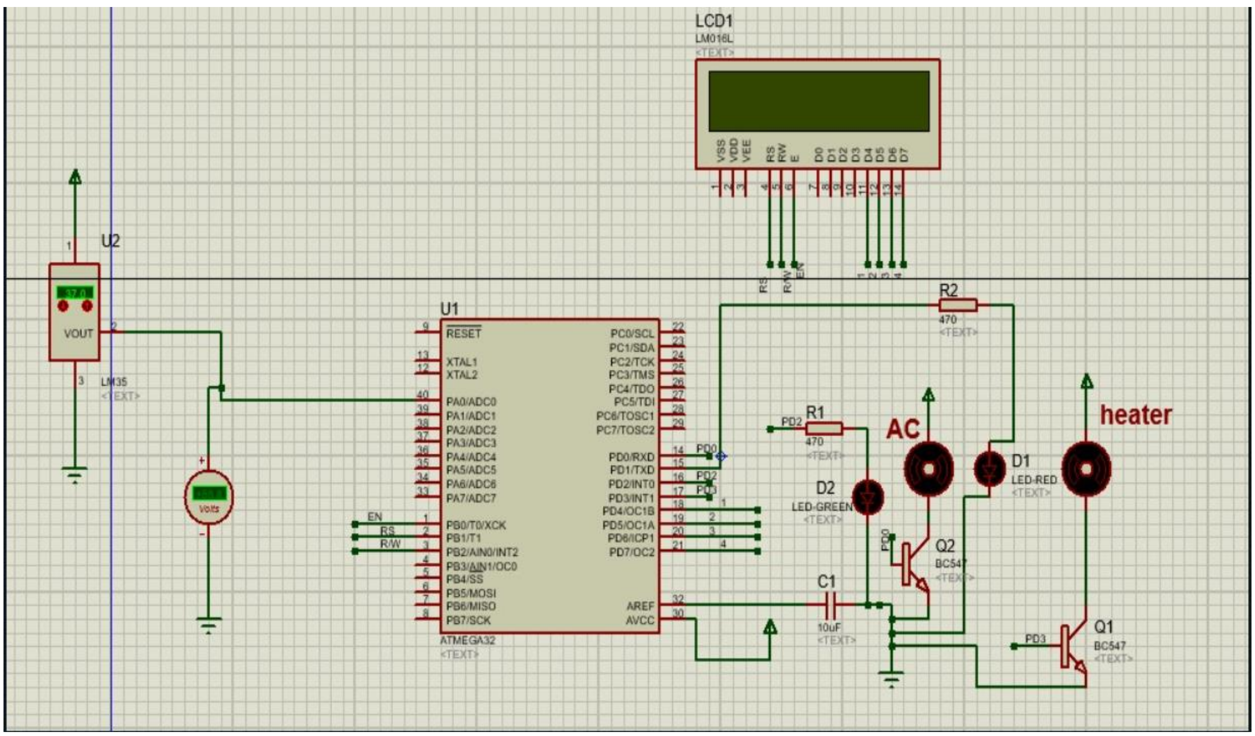

Figure 1 our Diagram

Hardware Components

- **Microcontroller:** The ATmega32 microcontroller is the core of the system, handling temperature data and controlling output devices.
- **Temperature sensor:** The LM35 sensor measures the ambient temperature, outputting an analog voltage proportional to the temperature. This signal is processed by the microcontroller's ADC module.
- **LCD display:** A LCD displays real-time temperature readings, ensuring users can monitor environmental conditions.
- **Cooling fan and warming fan:** These components are activated by the ATMEGA32 to regulate temperature based on preset thresholds.
- **Other electronic components:** Transistors, capacitors and resistors are used to stabilize the circuit and ensure reliable performance.

After gathering the required components, we started to design our circuit and implement the correct connections.

Circuit Design

The LM35 sensor is connected to the ATmega32's ADC pin to convert the analog signal into a digital value. The LCD is interfaced with the microcontroller using digital I/O pins to display real-time temperature readings. The cooling fan and the warming fan are connected to the microcontroller via NPN transistors (BC547) acting as switches, with. LEDs are used to indicate the activation status of the cooling fan (green LED) and the warming fan (red LED). The transistors ensures safe operation of the AC-powered fan and the warming fan. The circuit is stabilized with a 10µF capacitor for proper voltage regulation.

Workflow

The LM35 sensor detects the surrounding temperature and sends an analog signal to the microcontroller.

The microcontroller evaluates the signal and decides whether to turn on the fan or heater.

The activation of the cooling fan or the warming fan is indicated by the corresponding LED, while the current temperature is displayed on the LCD for user monitoring.

Hardware result and our flowchart

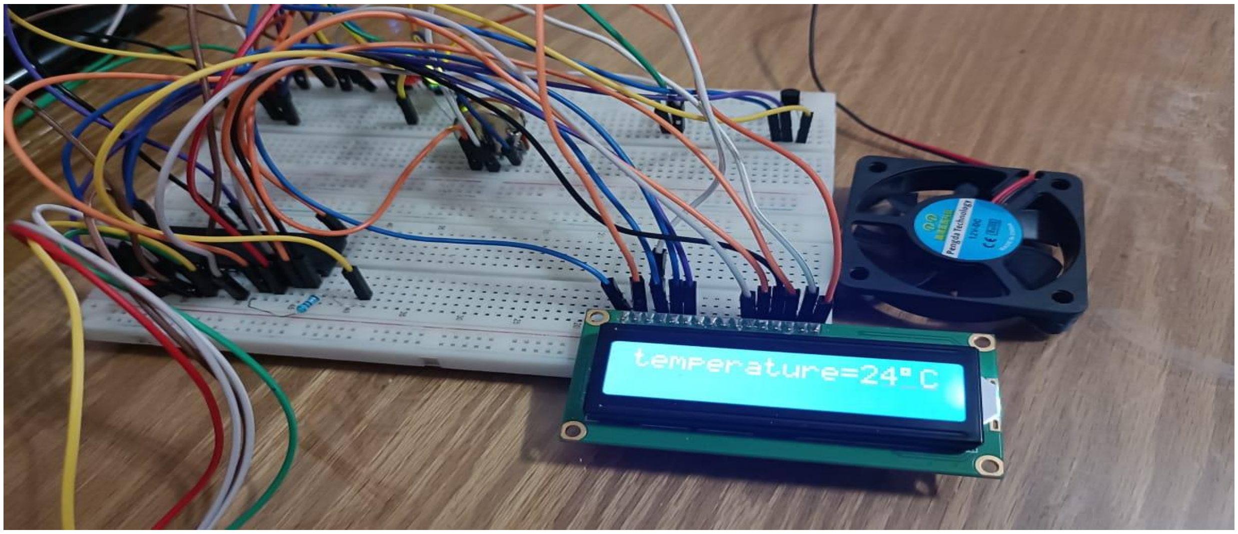

Figure 2 Tempreture reading

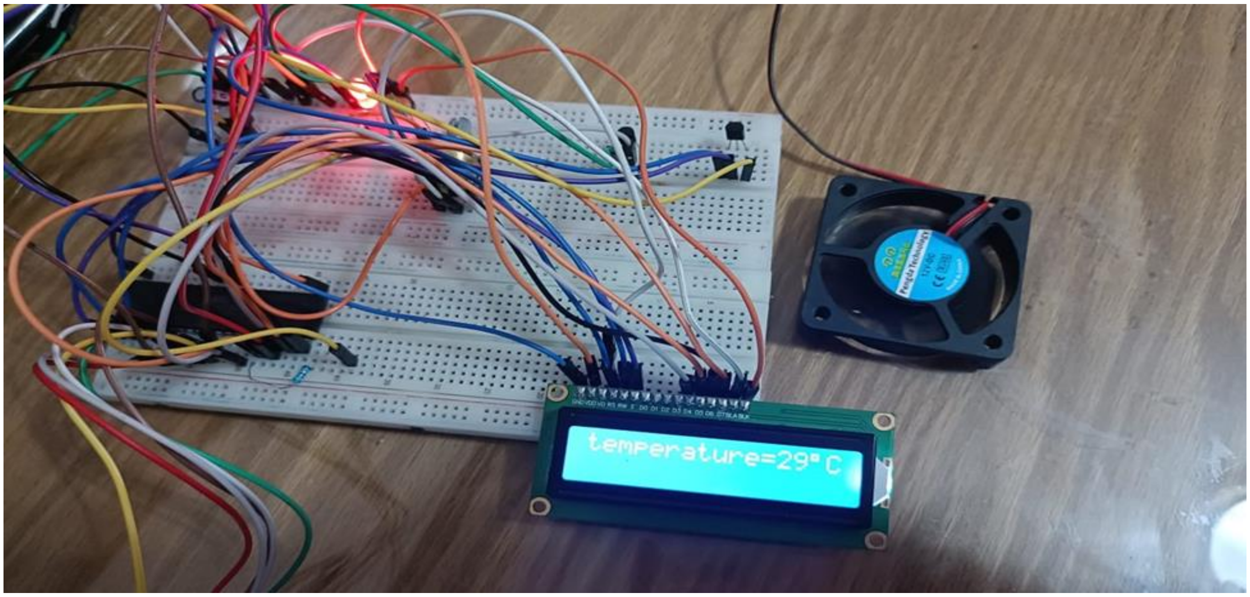

Figure 3 After testing

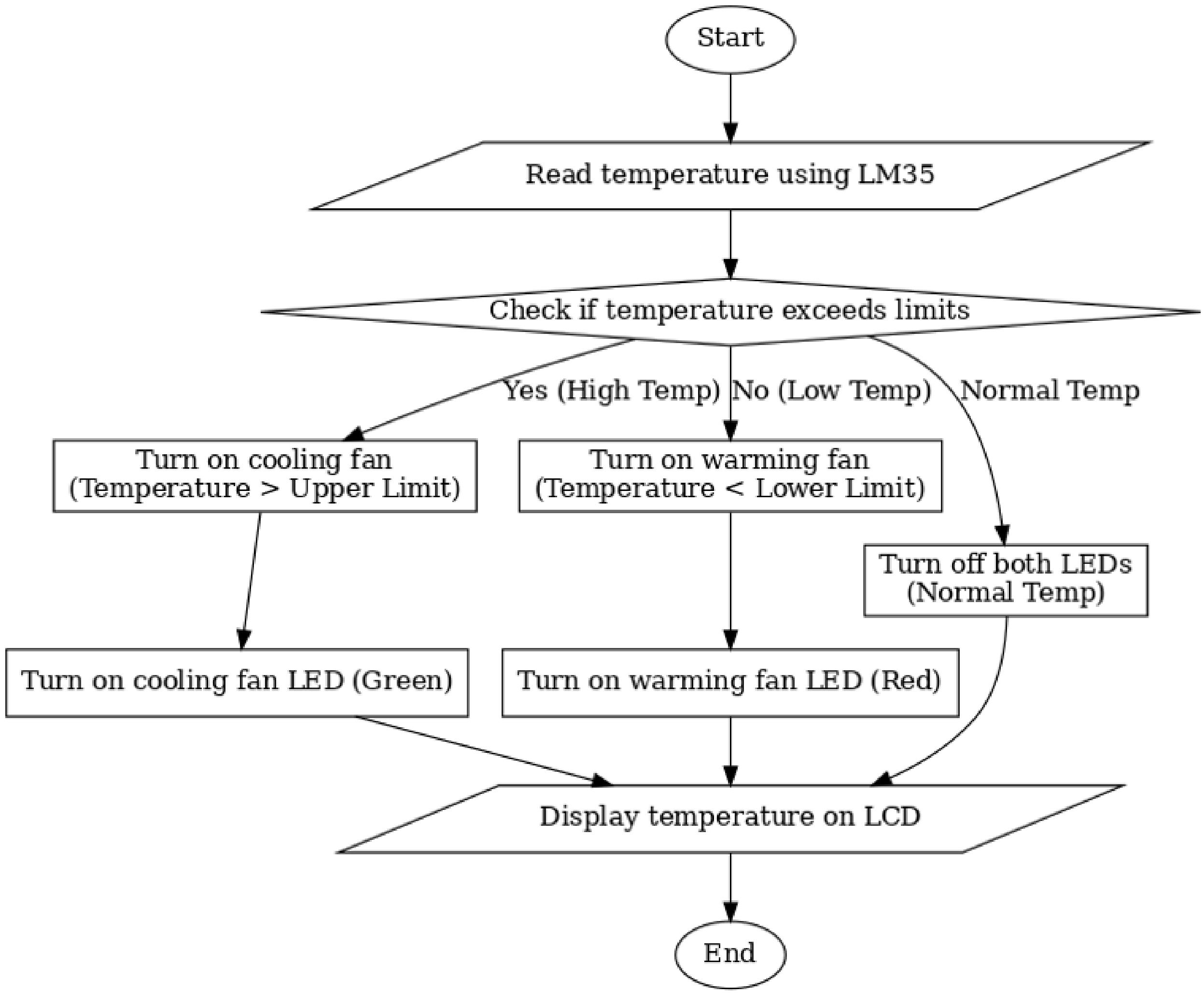

Figure 4 The FlowChart

Conclusion and future work

The automated temperature control system successfully combines a temperature sensor, microcontroller, and output devices to deliver an efficient solution for temperature management. It provides real-time monitoring and automates heating and cooling processes, enhancing user convenience and system reliability.

As a future work, we can add Iot capabilities for remote monitoring and control. Also enhancing user interaction through advanced displays or mobile applications and as well as integrating a humidity sensor for more comprehensive environmental control for more measuring features. Finally, this project demonstrates how microcontroller-based solutions can simplify everyday tasks and be adapted for broader applications in smart homes and industrial systems.