Mehran University of Engineering & Technology, Jamshoro

Mini Project Report

Fire Alarm System Using NTC Thermistor and LED Indicator

Department	**Computer Systems Engineering**
Class	24CS Section 2
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Submitted By	Muhammad Tarique (24CS064)
	Mokash Kumar (24CS030)
	Naveed (24CS006)
	Dileep Kumar (24CS050)
Course Instructors	Dr Khurram Shaikh and Engr Arsha Kumari
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Abstract

This mini project focuses on the development of a low-cost fire alarm system using an NTC thermistor and LM358 operational amplifier. The system is designed to detect significant temperature rises in confined areas like homes or offices. When the temperature exceeds a defined threshold, a buzzer and red LED are triggered for both visual and audible alerts.

Built on a breadboard and powered by a 9V battery, the circuit uses basic components and is easy to assemble and test. Tools such as datasheets, circuit simulation resources, and basic electronics design tutorials were used in the process. The outcome is a functional fire alert system that demonstrates core concepts of embedded system design, including sensor interfacing and comparator logic.

Contents

Introduction

Fire outbreaks are dangerous and cause severe property damage and casualties. Early detection can significantly reduce these risks. This mini project introduces a simple yet effective fire alarm system using a temperature- sensitive NTC thermistor. The system is designed for small environments and utilizes basic electronics principles for early warning.

Importance of the Application

- Prevents fire-related accidents in small-scale environments.
- Increases awareness and promotes safety using affordable technology.
- Provides hands-on learning of embedded and analog electronics.

Objectives

- To build a fire alarm system using basic electronic components.
- To use an NTC thermistor for temperature sensing.
- To produce visual (LED) and audible (buzzer) alerts when fire is detected.

Literature Review / Existing Solutions

Traditional fire alarm systems often use expensive microcontroller-based systems or smoke detectors. Basic thermal alarms exist but lack affordability and simplicity for DIY or educational use.

Improvements in This Project

- Cost-effective solution using minimal components.
- Avoids microcontrollers to focus on analog interfacing.
- Easy to prototype and modify, ideal for learning and basic safety.

Proposed System

Block Diagram

NTC Thermistor → Voltage Divider → LM358 Comparator → Buzzer & LED

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Reference Voltage (Preset Resistor)

System Description

The NTC thermistor senses temperature changes. As temperature rises, resistance drops, changing the voltage at the op-amp's inverting input. When this voltage drops below the non-inverting reference voltage, the LM358 output goes HIGH, activating the buzzer and LED.

Key Components

- **NTC Thermistor** – Senses temperature
- **LM358 Op-Amp** – Acts as voltage comparator
- **Red LED & Buzzer** – Fire alert indicators
- **Resistors & Preset** – For voltage division and threshold setting
- **9V Battery** – Power supply

Hardware And Software Requirements

Hardware

- Breadboard
- NTC Thermistor
- LM358 IC
- 10k Preset Resistor
- 10k Resistor
- 220Ω Resistor
- Buzzer

- Red LED
- Jumper Wires
- 9V Battery
- Fire Lighter (for testing)
- Base Sheet

Software Tools

- (None required; no microcontroller or software tools were used)
- Optional: Proteus (for future simulation)

Methodology

Step-by-Step Implementation

1. Finalize components and design.
2. Create voltage divider using NTC thermistor.
3. Connect thermistor and preset to LM358 inputs.
4. Connect LM358 output to LED and buzzer.
5. Calibrate threshold voltage using the preset.
6. Test system by applying heat.

Flowchart

Start → Power ON → Read Temp via Thermistor

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Compare Voltage using LM358

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Temp < Threshold → LED & Buzzer OFF

Temp ≥ Threshold → LED & Buzzer ON

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Repeat

Results Testing

Observations

- LED and buzzer activate reliably when temperature crosses threshold.
- System successfully detects lighter flame during test.
- Works with 9V battery for several hours.

Challenges

- Calibrating threshold for accurate triggering.
- Ensuring stability in ambient conditions.

Individual Contribution

- **Muhammad Tarique (24CS064):** Designed the main circuit and interfaced the components.
- **Mokash Kumar (24CS030):** Documented the project and prepared the report.
- **Naveed (24CS006):** Assembled hardware and managed wiring layout.
- **Dileep Kumar (24CS050):** Calibrated threshold and helped with testing.

Conclusion

The fire alarm system provides an affordable and functional early warning mechanism. It helps in understanding analog sensor interfacing and basic comparator circuits. While basic in nature, it offers a foundation for future improvements, such as microcontroller-based alerts or GSM messaging.

Limitations

- Limited to detecting temperature changes, not smoke.
- Works only in proximity due to visual and audible alerts.

Future Scope

- Add microcontroller for remote notification (e.g., SMS/GSM).
- Implement battery backup and casing for deployment.
- Upgrade to detect smoke and gas along with temperature.

References

- https://www.electronicshub.org/
- https://www.circuitdigest.com/
- Electronics Circuit Design Tutorials