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Real-Time Fire Monitoring System with Arduino

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Abstract: This paper aims in designing a fire alarm detector for a modern fire safety systems, designed to identify fire hazards at an early stage and send alerts to remote locations or systems. This project focuses on developing a low-cost, Arduino-based fire alarm detector capable of real-time monitoring and early warning. The system employs flame and smoke sensors to detect signs of fire and immediately activates visual and audible alerts. Additionally, it can be configured to send notifications to mobile devices or security services, ensuring prompt action even when the premises are unoccupied. By leveraging the simplicity and versatility of Arduino, the project demonstrates how embedded technology can enhance fire safety and provide reliable, remote fire hazard detection for residential and commercial applications.

Keywords: Fire alarm detector, notification, accident, Arduino, live monitoring.

I. INTRODUCTION

Remote fire alarm detectors are advanced safety devices that combine fire detection technology with real-time alert systems to enhance fire response and protection. These detectors typically include various types of sensors: smoke detectors, which use ionization or photoelectric methods to sense smoke particles; heat detectors, which identify rapid increases in temperature; and flame detectors, which detect infrared or ultraviolet light emitted by flames. Connected to a central monitoring system via Wi-Fi, cellular networks, or dedicated lines, these devices can send instant alerts to mobile apps (through SMS, email, or push notifications), alarm control panels, or directly to emergency services like fire departments. There are several types of remote fire alarm detectors, including standalone units with built-in communication modules (like Wi-Fi or GSM), smart fire alarms integrated into IoT-based home systems, and commercial systems linked to centralized fire alarm control panels. These systems are powered either by batteries—with alerts for low power—or are hardwired with battery backups for reliability during power outages. For connectivity, they use Wi-Fi, cellular/GSM networks, or smart home protocols like Zigbee and Z-Wave. Additionally, many modern detectors feature self-testing and diagnostics, regularly checking their operational status and sending remote alerts in case of sensor faults or system malfunctions. Together, these capabilities make remote fire alarm detectors a vital component of modern fire safety infrastructure in both residential and commercial settings.

II. ARDUINO UNO SOFTWARE

The Arduino Uno is one of the most popular and widely used microcontroller boards in the Arduino ecosystem, known for its simplicity, versatility, and strong community support—making it ideal for beginners and hobbyists. At its core, it features the ATmega328P microcontroller, an 8-bit AVR chip that runs at a clock speed of 16 MHz. The board operates on 5V, with a recommended input voltage of 7–12V, which can be supplied via USB or a barrel jack. It offers 14 digital I/O pins, 6 of which support PWM output for applications like motor control or simulating analog signals. Additionally, it includes 6 analog input pins (A0 to A5) to interface with sensors like temperature or light detectors. The Arduino Uno provides 32 KB of flash memory for program storage, 2 KB of SRAM for runtime data, and 1 KB of EEPROM for non-volatile storage. For connectivity and programming, it includes a USB port, an ICSP header for low-level access, and TX/RX LEDs to indicate serial communication. It also features a convenient reset button for restarting the program. These features make the Arduino Uno a powerful yet approachable platform for a wide range of electronics and embedded system projects.

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III. CIRCUIT DIAGRAM AND PROGRAM

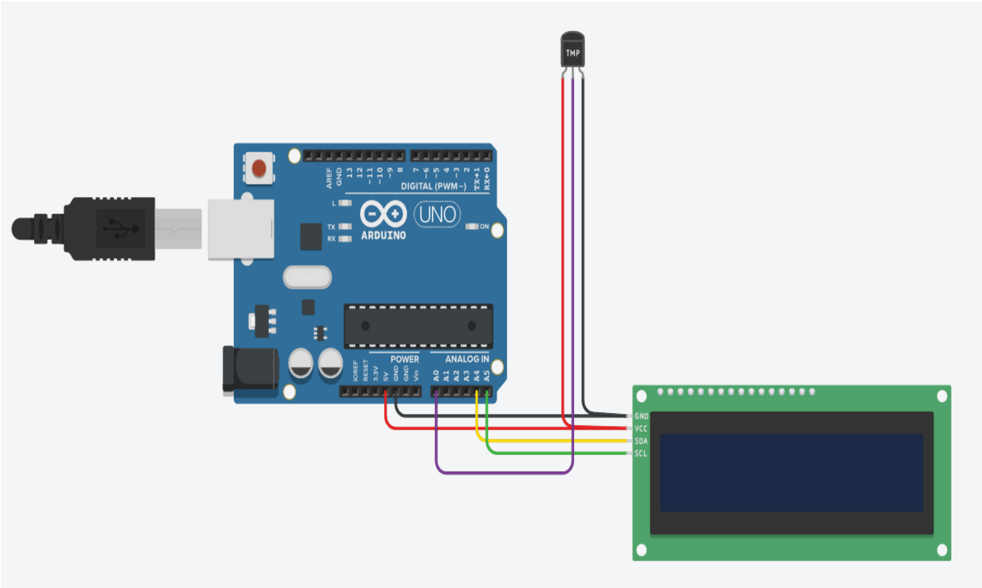

Fig: 1 Circuit Diagram

Pin Configuration (Common 16x2 LCD):
1. VSS: Ground (GND).
2. VDD: Power supply (5V).
3. VO: Contrast adjustment (connected to a potentiometer).
4. RS: Register select (Command/Data mode).
5. RW: Read/Write (set to GND for writing).
6.E: Enable (used to start data read/write).
7-14. D0 to D7: Data pins (for sending data/commands).
15. LED+: Backlight power (5V).
16. LED-: Backlight ground (GND).

IV. WORKING

Based on the schematic, the system integrates a 16x2 LCD display and a temperature sensor with the Arduino Uno to create a simple fire detection and alert system. The LCD is used to display real-time temperature readings and fire status messages, providing clear visual feedback. Although the temperature sensor is not explicitly labeled, it is likely connected to one of the analog input pins of the Arduino. The sensor continuously monitors ambient temperature, and the Arduino reads this data to assess the environment. Under normal conditions, the LCD displays the current temperature in Celsius along with a status message like “Normal.” If the temperature exceeds a predefined threshold (e.g., 50°C), indicating possible fire conditions, the Arduino activates a fire alarm state. In response, the display updates with a warning such as “Fire Detected!”, and additional output devices such as a buzzer or LED can be triggered to provide audible and visual alerts. This setup enables early fire detection and user notification, making it a useful and accessible safety project using Arduino.

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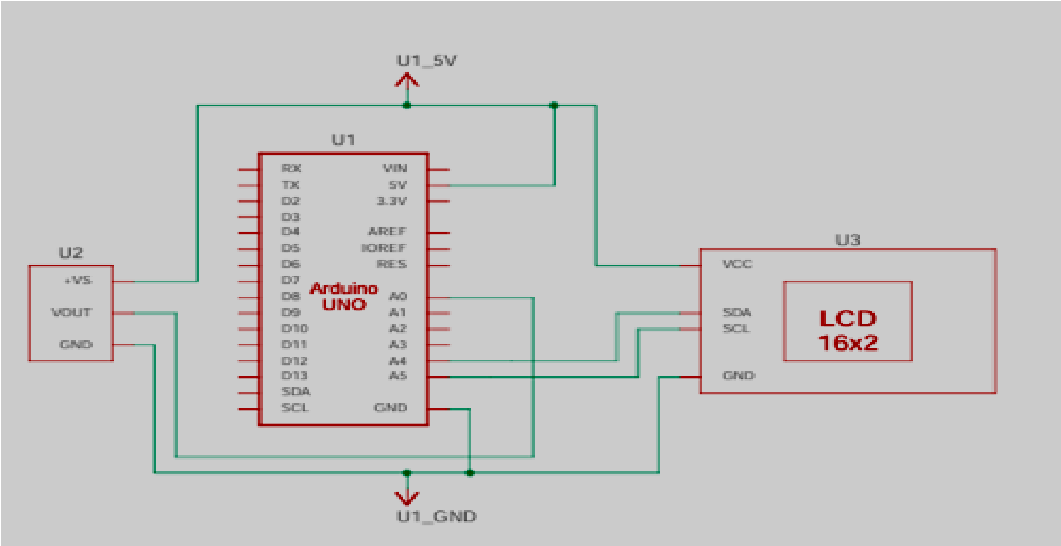

Fig: 2 Block Diagram

V. CONCLUSION

The Arduino-based fire alarm system provides a cost-effective and reliable solution for early fire detection and alerting. By integrating a temperature sensor and a 16x2 LCD display with the Arduino Uno, the system is capable of continuously monitoring the environment and providing real-time temperature readings. When abnormal temperature levels indicative of a fire are detected, the system promptly triggers visual and audible alerts, ensuring timely warnings. The simplicity of the design, along with its adaptability and potential for further enhancements—such as GSM notifications or integration with IoT platforms—makes this project an ideal prototype for use in homes, small offices, and educational settings. Overall, it demonstrates how embedded systems and basic electronic components can be effectively utilized to improve safety and awareness in fire-prone areas.

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BIOGRAPHY

Manish Paul received a Ph.D. degree in Electrical Engineering department from NERIST, Arunachal Pradesh in 2024, and the Master in Technology in Electrical Engineering from NIT Agartala in 2014. He is currently a faculty with the Department of Electrical Engineering, ICFAI University, Tripura, India. His research interests include electric motor drives, wind energy conversion, control of doubly fed machines for variable speed applications, and reluctance machine. He can be contacted at email: manishpaul@iutripura.edu.in.