CSE360: Computer Interfacing

Project title:

Fire and Smoke Detection System Using Arduino

Section: 03

Group Number: 05

Group members:

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Introduction

In today's fast-paced and technology-driven world, the ever-present threat of fire hazards has heightened the importance of safeguarding against potential disasters. Preserving both property and human life has become a top priority, underscoring the crucial need for a reliable fire and smoke detection system. Thanks to recent advancements in microcontrollers and sensors, the development of cost-effective and dependable fire detection systems has become increasingly viable. Our project aims to capitalize on these innovations by designing and implementing a state-of-the-art fire and smoke detection system utilizing Arduino and specialized sensors. By integrating a flame sensor and an MQ-2 Gas & Smoke sensor, our vigilant system will continuously monitor the surroundings for any indications of fire. Prompt action will be taken as soon as smoke or flames are detected, instantly activating an alarm to alert building occupants. Additionally, the system will offer the convenience of sending notifications to mobile devices through a Bluetooth module, ensuring a comprehensive and timely response to any potential fire threats.

Application Area

The application area of a fire detection system using Arduino and sensors is vast, encompassing various fields where safety and asset protection are paramount. Some of the key areas where this system can be utilized include:

- ☐ **Industrial Plants:**

  High-risk industrial facilities such as power plants, chemical plants, and oil refineries can greatly benefit from the system's ability to detect and prevent fires caused by hazardous materials.

- ☐ **Buildings and Public Libraries:**

  The system is crucial in residential buildings with multiple stories and commercial establishments like offices, factories, and warehouses, ensuring occupant safety and minimizing fire damage.

- **Educational Institutions:**

  Schools, colleges, and universities, with their high population density, can enhance their safety measures by deploying the fire detection system to mitigate fire risks.

- **Hospitals:** The continuous operation and critical nature of hospitals make them vulnerable to potential disruptions from fires. Implementing the system can safeguard patients and staff while ensuring seamless operations.

The versatility of the fire detection system using Arduino and sensors allows it to be applied in diverse settings, providing a proactive approach to fire safety and asset protection across various industries and institutions.

Technology and tools

- 16x2 Serial LCD Module
- MQ-2 Gas & Smoke Sensor
- Passive Buzzer 5V
- Connecting wires
- Arduino Bluetooth Module HC06
- Breadboard
- LED (Red and Green)
- Flame sensor
- Arduino UNO
- 220 Ohm 1/4W Resistor

Working mechanism of Sensors

- **Flame sensor:**

The flame sensor is designed to detect and respond to the presence of flames or fire. It operates within a short range, providing mostly accurate results up to 3 feet. The sensor is highly sensitive to the IR wavelength at 760 nm ~ 1100 nm, allowing it to detect the infrared light emitted by flames. By adjusting the potentiometer, a predefined threshold level can be set. When the sensing signal level exceeds the threshold, the module output pin (D0) goes LOW, indicating the presence of a flame. Otherwise, the default status of D0 remains HIGH. The power supply requirement for the flame sensor is 3.3V to 5V.

- **16x2 Serial LCD Module:**

The 16x2 Serial LCD Module provides a clear display with 16 characters per line and 2 lines. It has high contrast white text on a blue backlight, ensuring readability. This module overcomes the limitations of the LCD1602 Parallel LCD Display, which consumes many Arduino pins. By using an I2C adapter directly soldered onto the display pins, only the I2C pins need to be connected. The I2C is a type of serial bus developed by Philips, employing two bidirectional lines called SDA (Serial Data Line) and SCL (Serial Clock Line). These lines must be connected via pulled-up resistors. The module supports usage voltages of 5V and 3.3V.

- **Bluetooth sensor HC06:**

The HC06 Bluetooth sensor facilitates wireless communication between devices through Bluetooth technology. It operates as a serial communication module and establishes a wireless connection with other Bluetooth-enabled devices. Based on Bluetooth 2.0 protocol and Bluetooth Serial Port Profile (SPP), it enables data exchange between devices within a certain range. The range varies based on the environment and Bluetooth

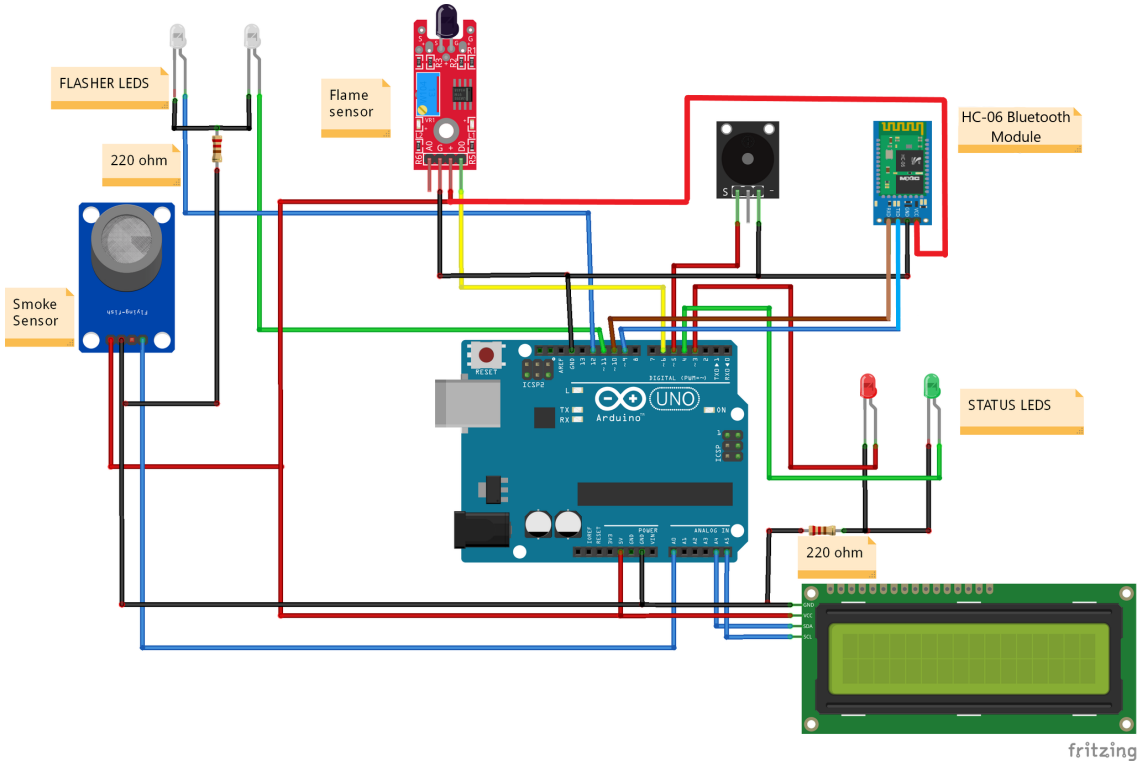
signal strength, typically up to 10 meters in open areas. However, obstacles or interference can reduce the range. The HC06 is designed with low power consumption, making it suitable for battery-powered devices. It includes a sleep mode to conserve power when not in use.

- **MQ-2 Gas & Smoke Sensor:** The MQ-2 Gas sensor detector module measures toxic gasses in very low concentrations, with a detection range of 300-10000 ppm. It can detect various gasses, including H2, LPG, CH4, CO, Alcohol, Smoke, and Propane. The sensor's high sensitivity and fast response time enable quick measurements. By adjusting the potentiometer, the sensor's sensitivity can be customized. The MQ-2 gas sensor contains gas-sensitive material, such as stannic oxide or tin oxide (SnO2). When flammable gasses are present in the environment, the sensor's conductivity increases proportionally with the concentration of combustible gas in the air, allowing for effective gas detection.

Programming Languages

The Arduino code is written in C++ and includes specific methods and functions. C++ is a computer language that is easy to understand. When we generate a sketch (the default name for Arduino code files), it is processed and compiled to machine language, and the Arduino follows the instructions of the code.

Connection with ICs



Data flow from sensors through ICs to I/O devices

Sensor Data Acquisition: The Flame sensor and MQ-2 sensor detect fire and smoke, generating analog or digital signals read by the Arduino UNO microcontroller through its digital or analog pins.

Data Processing: The Arduino UNO processes the sensor data to determine fire and smoke levels, comparing readings with thresholds and applying algorithms for alerts.

Output Control: Arduino UNO controls output devices like LED (Red), Passive Buzzer, and LCD display for alert responses.

Bluetooth Communication: Arduino UNO communicates with HC06 Bluetooth module via serial communication to send notifications to a connected mobile device.

Mobile Device Notification: HC06 sends notifications to the mobile device via Bluetooth with app or software for visual/audible alerts.

User Interaction: User interacts through LCD display, LED (Red), and Passive Buzzer, taking appropriate actions upon receiving alerts.

Estimated cost analysis

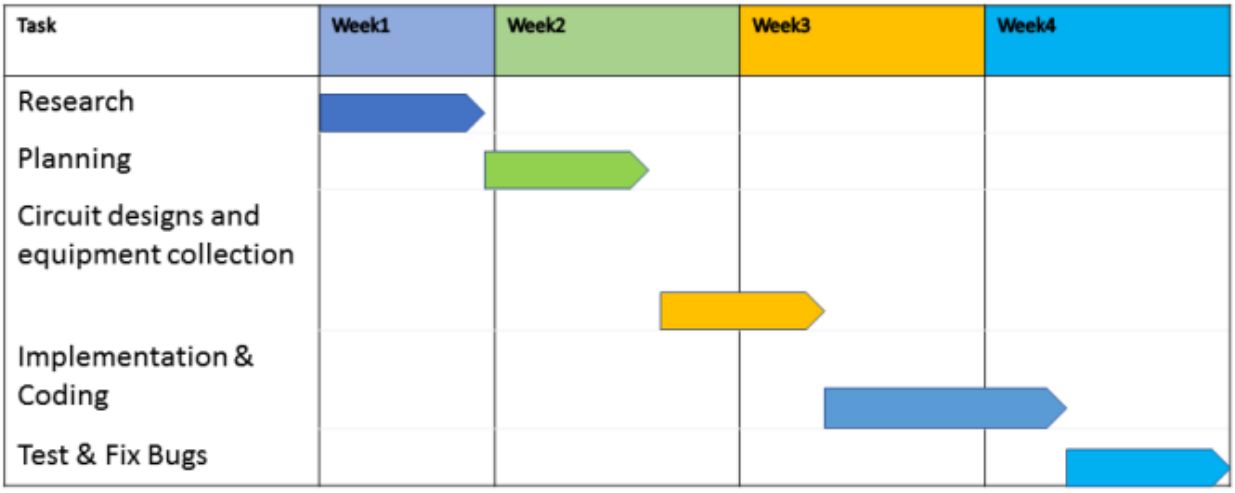
Component	Quantity	Price (Tk)
Arduino Uno R3	1	1050
Flame Sensor	1	90
MQ-2 Gas & Smoke Sensor (RBD-0671)	1	180
16x2 Serial LCD Module (LCD-1602)	1	410
LED (Red and Green)	8	30
220 Ohm 1/4W Resistor	20	25
Jumper wire	40	135
Passive Buzzer 5V	1	20
Breadboard (400Pin)	1	80
Arduino Bluetooth Module HC06	1	330

Responsibilities of each member

Name and ID	Responsibility
ATIKUR RAHMAN 20301440	Introduction Working mechanism of Sensors Application Area Programming Languages Technology and tools
SHUDEB GHOSH BARNO 20301222	Estimated cost analysis Data flow from sensors through ICs to I/O devices Connection with ICs
MUSAIB IBN HABIB MIKDAD 20301356	Estimated cost analysis Data flow from sensors through ICs to I/O devices Connection with ICs
NABILA ISLAM BORNO 20301117	Working mechanism of Sensors Technology and tools Programming Languages Workplan (Gantt Chart) Conclusion

MD.RAFIUL ISLAM MAHI 20301324	Estimated cost analysis Data flow from sensors through ICs to I/O devices Connection with ICs

Workplan (Gantt Chart)



Conclusion

The fire detection system has gained significant recognition in our country due to the frequent incidents of fire in homes, restaurants, garment factories, shops, and other places. The devastating nature of fires can lead to extensive damage and loss of property. This project offers a promising solution to mitigate the impact of fire incidents and reduce the losses.

One of the notable advantages of this fire detection system is its cost-effectiveness. It is affordable and accessible to a wide range of users, making it feasible for implementation in homes, garment factories, shops, restaurants, and more.

Although the current system effectively detects fires, there is room for enhancement. Integrating the fire detection system with a fire suppression mechanism could automate the process of extinguishing fires, further enhancing its efficiency. Additionally, connecting the system to a cloud-based platform would enable remote monitoring and management, providing real-time insights and timely responses to potential fire threats.

In conclusion, the fire detection system using Arduino and sensors serves as a crucial safety measure that can be easily adopted in diverse settings to prevent fires and safeguard lives. The continuous development and implementation of such systems contribute to a safer and more secure environment for everyone.

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