CSE360: Computer Interfacing

Project title: Fire and Smoke Detection System Using Arduino Uno

Section: 03
Group Number: 07
Group members:

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Table of Contents

Introduction

In the modern era, fire protection has become a top concern because there are always fire hazards around us that can cause a great loss of property as well as human life. Therefore, it is essential to have a reliable fire and smoke detection system which can detect fire in place to ensure the safety of the occupants of a building and prevent the spread of fire. In recent years, with the advent of microcontrollers and sensors, it has become easier to develop cost-effective and reliable fire detection systems. The aim of this project is to design and implement a fire and smoke detection system using Arduino and sensors. The system will consist of a flame sensor and a MQ-2 Gas & Smoke sensor, which will continuously monitor the environment for any signs of fire. If the system detects smoke or flame, it will sound an alarm and alert the occupants of the building. The system will also be able to send a notification, to a mobile phone or other devices through a bluetooth module.

Application Area

A system like this can be used in many different fields, such as -

- **Buildings:** Our system is essential in residential buildings, especially those with multiple stories, to ensure the safety of the occupants. Also in commercial buildings, such as offices, factories, and warehouses, to prevent the spread of fire and minimize damage.
- **Industrial Plants:** Industrial plants, such as power plants, chemical plants, and oil refineries, are at high risk of fire due to the presence of hazardous materials.
- **Educational Institutions:** Educational institutions, such as schools, colleges, and universities, have a high density of people, making them vulnerable to fires.
- **Hospitals:** Hospitals are critical facilities that require continuous operation. A fire can disrupt the functioning of the hospital and put the lives of patients and staff at risk.
- **Museums:** Museums are home to valuable artifacts and exhibits that can be destroyed in case of fire.
- **Libraries:** Libraries contain thousands of books, manuscripts, and other valuable documents that can be destroyed in case of fire.

The fire detection system using Arduino and sensors has a wide range of application areas, and it can be used to ensure the safety of people and assets in various settings.

Technology and tools

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

Working mechanism of Sensors

- **Bluetooth sensor HC06:** HC06 is a popular module that allows wireless communication between devices. It is a serial communication module that uses Bluetooth technology to establish a wireless connection with other Bluetooth-enabled devices. It works on the Bluetooth 2.0 protocol and is based on the Bluetooth Serial Port Profile (SPP). The range of the HC06 Bluetooth sensor varies depending on the environment and the strength of the Bluetooth signal. In general, the range can be up to 10 meters in an open area, but it can be significantly reduced in areas with obstacles or interference. The HC06 Bluetooth sensor is designed to consume very little power, making it ideal for battery-powered devices. The module has a sleep mode that reduces power consumption when the module is not in use.

- **Flame sensor:** A flame sensor is a detector, designed to detect and respond to the presence of a flame or fire. This type of sensor can be used for detecting fire in a short range.We will be able to find mostly accurate results up to 3 feet of distance. This sensor is very sensitive to the IR wavelength at 760 nm ~ 1100 nm light. By adjusting the potentiometer we can set a predefined threshold level. If the sensing signal level is higher than the predefined threshold level, the module output pin (named as "D0") goes to LOW, whereas the default status of D0 is HIGH. The power supply needed for this is 3.3V to 5V.

- **16x2 Serial LCD Module:** The display is 16 character by 2 line display that has a very clear and high contrast white text upon a blue background/backlight. This LCD1602 Parallel LCD Display with Yellow Backlight is very easy to interface with Arduino or Other Microcontrollers. This display overcomes the drawback of LCD1602 Parallel LCD

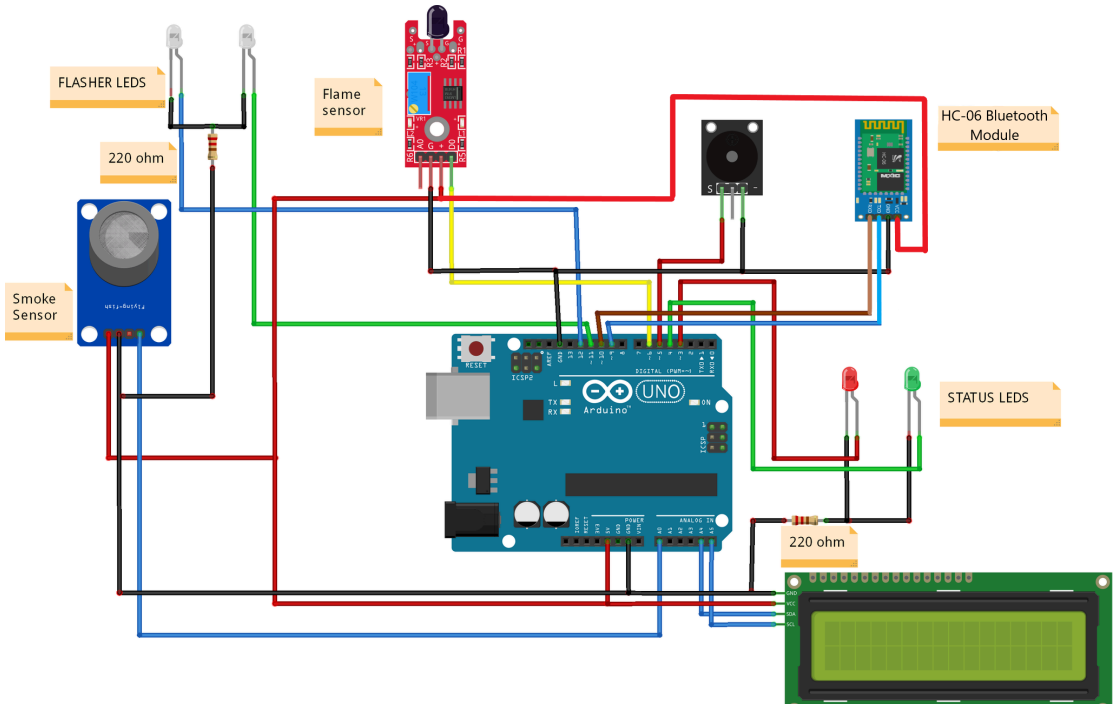
Display in which we'll waste about 8 Pins on our Arduino for the display to get working. An I2C adapter is directly soldered right onto the pins of the display. So all we need to connect are the I2C pins, which show a good library and little coding. The I2C is a type of serial bus developed by Philips, which uses two bidirectional lines, called SDA (Serial Data Line) and SCL (Serial Clock Line). Both must be connected via pulled-up resistors. The usage voltages are standard as 5V and 3.3V.

- **MQ-2 Gas & Smoke Sensor:** The MQ-2 Gas sensor detector module has a detection range of 300-10000 ppm. The gas sensor modules are always well known for their robust and simple construction and measures toxic gasses in very low concentrations. It is suitable for detecting H2, LPG, CH4, CO, Alcohol, Smoke, or Propane. Due to its high sensitivity and fast response time, measurements can be taken as soon as possible. The sensitivity of the sensor can be adjusted by the potentiometer. MQ-2 gas sensor using gas sensitive material is to clean air in the lower conductivity of stannic Oxide or tin oxide (SnO2). When the sensor when flammable gasses are present in the environment in which the conductivity of the sensor with an increasing concentration of combustible gas in the air increases.

Programming Languages

Arduino code is written in C++ with an addition of special methods and functions. C++ is a human readable programming language. When we create a 'sketch' (default name of Arduino code files), it is processed and compiled to machine language and the arduino will work as the code's instruction.

Connection with ICs



Data flow from sensors through ICs to I/O devices

1. **Sensor Data Acquisition:** The Flame sensor and MQ-2 sensor detect fire and smoke respectively, and generate analog or digital signals based on the detected levels. These signals are read by the Arduino UNO microcontroller through its digital or analog pins.

2. **Data Processing:** The Arduino UNO microcontroller processes the sensor data to determine the status of fire and smoke detection. This can involve comparing the sensor readings with predefined threshold values, performing calculations, or applying algorithms to determine the level of danger or triggering conditions for the alarm and alert.

3. **Output Control:** Based on the processed sensor data, the Arduino UNO controls the output devices, such as the LED (Red), Passive Buzzer, and LCD display, to provide the desired responses. For example, when fire or smoke is detected, the Arduino UNO will turn on the LED (Red) to indicate an alert, activate the Passive Buzzer to sound the alarm, and display the alert messages on the LCD display.

4. **Bluetooth Communication:** The Arduino UNO communicates with the Bluetooth module HC06 using serial communication (e.g., UART) to send notification messages to

a connected mobile device. The Arduino UNO sends data or commands to the Bluetooth module, which then transmits the data wirelessly over Bluetooth to the mobile device.

5. **Mobile Device Notification:** The Bluetooth module HC06 on the Arduino UNO sends the notification messages to the connected mobile device. The mobile device should have a Bluetooth-enabled app or software that can receive and display the notifications sent by the Arduino UNO. The app or software on the mobile device will provide visual or audible alerts, such as displaying a message, playing a sound, or vibrating, to notify the user about the detected fire or smoke.

6. **User Interaction:** The user can interact with the gas leakage detector through the LCD display, LED (Red), and Passive Buzzer. The LCD display shows the alert messages, the LED (Red) indicates the alert status, and the Passive Buzzer produces the alarm sound. The user can acknowledge the alert and take appropriate actions, such as evacuating the area, contacting emergency services, or addressing the cause of the gas leakage.

Estimated cost analysis

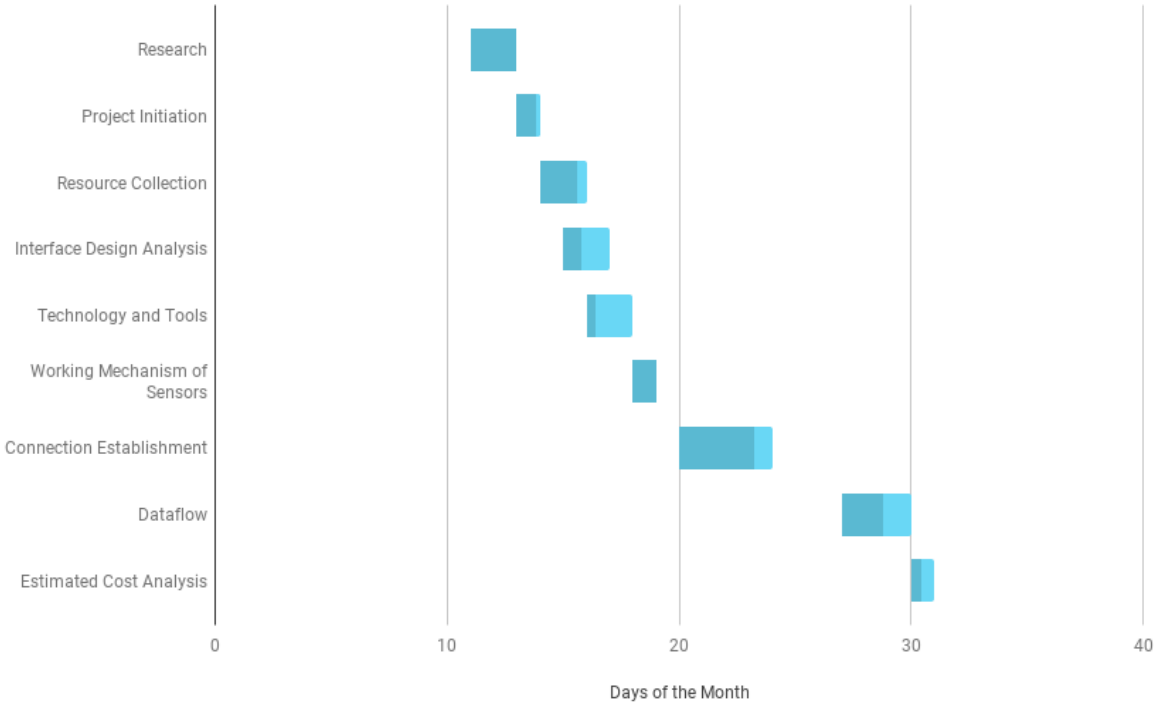
Component	Quantity	Price (Tk)
Arduino Uno R3	1	790.03
Flame Sensor	1	55
MQ-2 Gas & Smoke Sensor	1	149
16x2 Serial LCD Module	1	385
LED (Red and Green)	8	15
220 Ohm 1/4W Resistor	20	15
Jumper wire	40	100
Passive Buzzer 5V	1	15
Bluetooth Module	1	315
Breadboard (400Pin)	1	80

Responsibilities of each member

Name	Responsibility
Jannatul Ferdoush	Introduction Working mechanism of Sensors Application Area Programming Languages Technology and tools
Sartaj Emon Prattoy	Estimated cost analysis Data flow from sensors through ICs to I/O devices Connection with ICs
Raiyan Bin Gaffar	Estimated cost analysis Data flow from sensors through ICs to I/O devices Connection with ICs
Md. Imamul Mursalin Sujoy	Working mechanism of Sensors Technology and tools Programming Languages Workplan (Gantt Chart) Conclusion

Md. Asif Rahman	Estimated cost analysis Data flow from sensors through ICs to I/O devices Connection with ICs

Workplan (Gantt Chart)



Conclusion

Fire detection system is a well-known project in our country. As we have gone through many incidents of fire in homes, restaurants, garments, shops and many more. When the fire starts it just burndown everything that comes In Front of it. This project will help to lessen the loss in fire

incidents. Moreover, it is cost efficient as well. Everyone can buy it at a very low cost and apply it in their home, Garment's factory, shop, restaurant etc. While the fire detection system using Arduino and sensors designed in this project was effective in detecting fires, there are still opportunities for improvement. For example, the system can be integrated with a fire suppression system to automatically extinguish fires, or it can be connected to a cloud-based system for remote monitoring and management. Overall, the fire detection system using Arduino and sensors is a critical safety system that can be easily implemented in various settings to prevent fires and save lives.

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