

# Bluetooth Based Fire Detection and Robust Protection System By Using Arduino

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**Abstract** - One of the main issues, fire outbreak is dangerous and necessitates strict security and management to prevent the loss of people's lives and property. One of the precautionary measures to lower risk is the installation of automatic fire alarm detectors in critical areas. We have suggested a fire detection and protection system that uses temperature and gas-based two-step detection, together with a buzzer and personalized message fetched in case of fire. The water pump and extinguisher are turned on as part of the protective mechanism.

**Key Words:** Alarm systems, safety devices, DC motor, fire extinguishers, Bluetooth module, microcontrollers, smoke detectors, temperature sensors.

## 1. INTRODUCTION

Systems for detecting fire and gas are essential tools for safeguarding our residences, structures, workplaces, marketplaces, and other sites. A well-designed fire and gas device aims to detect threats from fire, flammable gas, and poisonous gas and, in some cases, automatically mitigate them. Proper detector placement is crucial when building a fire and gas system to ensure that surveillance is sufficient to detect risks at their early stage and prevent escalation. These three components' rates of ascent are used by the fire detection algorithm to determine whether a fire is present. The smoke sensor serves as a fire alarm and provides a mechanism to detect smoke. A heat detector is the earliest type of automated fire detection device. They respond either when the monitoring element reaches a certain fixed temperature or at a predetermined rate of change in temperature. Devices can be incorporated to put out any potential fires and protect neighboring areas from their impacts. A fire and gas system typically combines a gas detection system and a fire detection system. One sub-system for the utility or office/accommodation areas and another sub-system for the operational sections of the facility could be employed to create separation.

## 2. LITERATURE REVIEW

An effective fire and gas system is meant to identify and, in some situations, automatically reduce the risks of fire, flammable gas, and toxic gas.

To guarantee that coverage is sufficient to identify risks at their earliest stage and prevent escalation, proper detector placement is essential when designing a fire and gas system. The algorithm of fire alarm uses the rates of increase of three crucial elements to detect fire.

With the help of smoke sensors, we can identify smoke which can act as a fire alarming system. The earliest kind of automatic fire detection system is a heat detector [1].

The suggested device also has fire detection and suppression systems. We have proposed a system which includes various sensors like flame, smoke, temperature and smoke detector, extinguisher, transformer, various motors, siren, microcontroller etc. [2]

We have developed a miniature of fire-extinguisher that is based on an Arduino. A fire detection system that can pinpoint and extinguish a fire through real-time surveillance camera. The proposed system can be moved from its automated mode of operation by using a remote control to manually extinguish the fire. [3]

To detect whether there is a potential fire in the first stage, the system uses a temperature sensor to gauge temperature of room. The system will fetch an alert message to owner and to the fire department.

As soon as system detected temperature lesser than 45 °C, system will warn for risk of a blast/fire by fetching the concentration of liquify petroleum gas in the room by utilizing an LPG sensor. If the system notices that the liquify petroleum gas spreading rate room is nearly 225 ppm, it will automatically blow the siren as a warning of an explosion and send property owner a text message with relevant information about the probability of an explosion. [4]

## 3. METHODOLOGY

### 3.1 Proposed System

Due to the project's low cost of design, customers of all levels can buy one for safety reasons. So our prime motto of this research work is to come up with a fire alarm system that will keep an eye out for the presence of a lot of heat or gas and simultaneously sound an alert, cut off power to a short message service (SMS) alert to the building, and put out the

fire as a precaution to control the situation. Water and CO2 will be sprayed on the fire using extinguisher and motor.



Fig -1: Block Diagram including all essential parts of the fire detection and protection system.

### 3.2. System Infrastructure

The main components of proposed system are temperature sensor (LM35), Smoke detector (MQ6), Flame sensor Arduino NANO, jumper wires, relay, 5V water pump, 12V power supply, CO2 fire extinguisher, Buzzer, HC05 Bluetooth module, LCD display and Mobile phone. The next sections will explain the use of the various components in well-defined systems.

#### I. Detection System

Temperature and the amount of gas (measured in parts per million) in the air are the two key elements that aid in the detection of nearby fires. For the purpose of identifying anomalies in each factor, this system has a sensor.

##### A. Smoke Detection

MQ6 gas sensor is known as chemiresistor as it contains a material whose resistance value changes with change in amount of gas. It is robust and is used to detect gases like Alcohol, Propane, LPG, Smoke, Hydrogen, Carbon Monoxide, Methane and can give its concentration value.

##### B. Temperature Detection

LM35 temperature sensor is an analogue sensor which is linear in nature which means that for every degree increase in temperature the output of LM35 will raise by 10mV. So if the temperature is 33°C then the output for LM35 would be 330mV or 0.33V. It does not require external calibration or trimming to provide accurate results.

#### C. Fire Detection

A flame-sensor is a type of detector that is mainly designed for both detecting and reacting to the advent of a fire or flame. This sensor/detector can be built utilising a circuit and an electromagnetic receiver. This sensor can penetrate coatings like ice, water vapour, dust, and other materials since it uses an infrared flame flash technology. In our project, this sensor is used to generate a binary output that shows whether a flame is there or not. This sensor can detect flames at a distance of 100 metres from the light source that have wavelengths between 760 and 1100 nm.

#### II. Arduino

The system uses an Arduino NANO microcontroller. The microcontroller receives the input signal from the sensors first. The microcontroller then gathers it and performs the uploaded code's processing on it. The extinguishing system and the informing system are then given the output signal so they can take the appropriate action to control the environment in the event of abnormal circumstances.

#### III. Extinguishing System

The outcome of the Arduino NANO is fetched to the extinguishing system which mainly has 2 elements

- i) CO2 Fire extinguisher and
- ii) Water Pump

##### A. CO2 fire extinguisher.

CO2 extinguishers uses carbon dioxide gas. CO2 gas is a nonconductive and noncorrosive gas that suppresses the oxygen which is required for a fire to spread and grow. CO2 is held in a high-pressure liquid state in these extinguishers. The fires that start from an ignition source and flammable liquids are more easily suppressed by CO2 extinguishers. This is only triggered when abnormal condition is detected by Arduino NANO.

##### B. DC Pump Motor-

The pump motor is used to take water from a tank and spray it in the affected area as and when it receives the signal from the Arduino NANO. This requires a higher power supply so an additional power supply of 12V along with a relay is used.

#### IV. Informing System

There are 3 elements of the informing system

- i) Buzzer,
- ii) LCD display and
- iii) HC05 Bluetooth Module.

### A. Buzzer

An Arduino buzzer also known as piezo buzzer is used. It functions like a tiny speaker to which an Arduino can be connected directly. You can modify the frequency and sound to suit your preferences. If a user is nearby and the system senses an abnormal state or a fire, the buzzer will begin to beep and alert them.

### B. LCD Display

Liquid Crystal Display uses liquid crystals in its primary form of operation and shows them on a flat panel. Here it will show us the exact values of temperature and gas level in parts per million at all times.

### C. DHC05 Bluetooth Module

Bluetooth Module is a straightforward serial port protocol module which is designed for creating transparent and serial wireless communications. Bluetooth Module (HC-05) is an enabler for wireless communication since it acts as a Master device or Slave device. Serial port of bluetooth module is combination of V2 plus EDR i.e., acronym of enhanced data rate, and it is qualified & includes 2.4GHz radio transceiver transmitter, receiver and baseband. The user will get a notification on his Bluetooth-enabled mobile phone once the temperature and gas readings in this system exceed baseline levels.

The fire sensor, LM35, MQ6, an LCD display to show the readings, and the HC05 Bluetooth module have all been linked to the Arduino Nano. Our protective mechanism, which consists of a DC motor and an extinguisher push mechanism, has been connected to a power supply for operation via a relay.

### 3.3. System Implementation

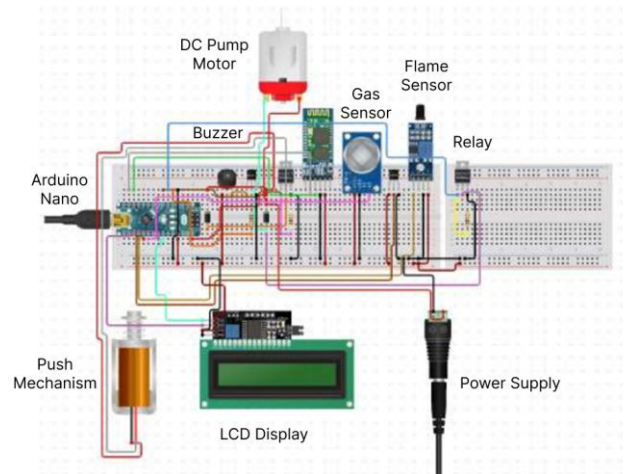


Fig -3: Circuit Diagram showing the connections

### 3.4. Implementation Steps

#### I. Detection Phase

- A. The LM35 sensor measures the temperature in a specific room, and if it is greater than normal, or 45 °C, an alarm is set off.
- B. A room's LPG gas level is checked by a MQ6 sensor, and if it is found to be more than 200 ppm, this indicates an abnormally high level of gas in the air.
- C. The flame sensor uses an infrared flame flash technology, which enables it to pass through coatings like ice, water vapor, and dust. If the flame intensity is between 750 and 1100 nm, the flame sensor is turned on.

#### II. Protection Phase

- A. When a fire happens, it activates the CO2 gas/fire extinguisher and sprays it till it extinguishes itself.
- B. A fire extinguisher has a limited amount of capacity, so when it runs out, the mechanism activates a DC motor and continues the extinguishing operation until assistance arrives.

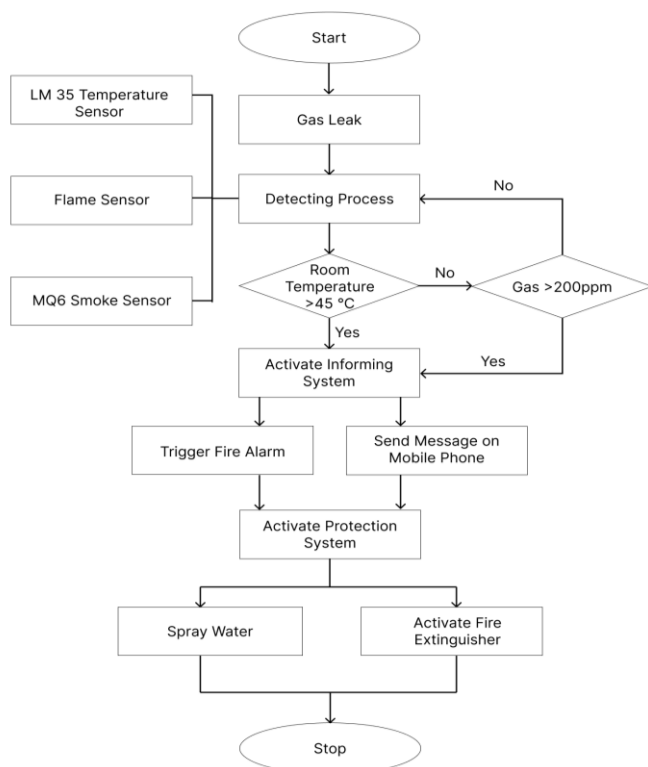


Fig -2: Flow Diagram showing the main steps involved in detecting and extinguishing fire using our project.

### III. Informing Phase

- A. The system notifies the user of an anomalous circumstance by delivering a notification via the Arduetooth software application to the user's mobile phone using the Bluetooth module.
- B. The technology informs the person by emitting a loud beep sound if they are in vicinity.

### 4. RESULTS AND DISCUSSION

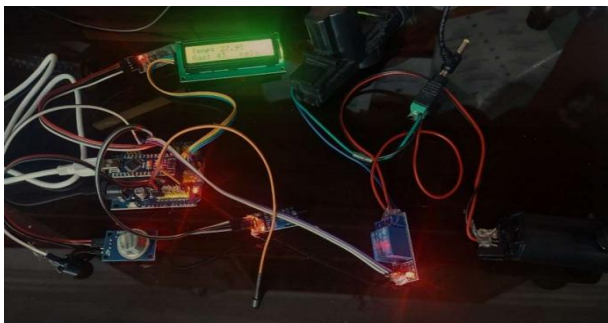
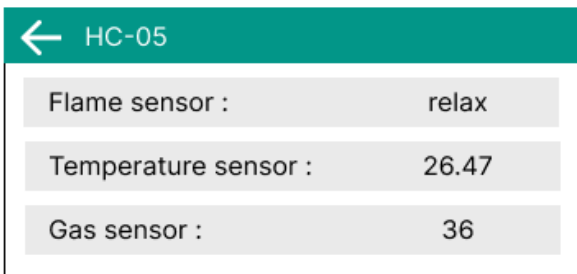


Fig -4.1: System in normal conditions

Our system's hardware and connections can be seen in a relaxed state in the image above. The sensors are entirely operational, and readings are shown on an LCD screen.



← HC-05	
Flame sensor :	relax
Temperature sensor :	26.47
Gas sensor :	36

Fig -4.2: Output on the mobile phone for normal conditions

The figure above shows relevant reading on a mobile device that has the Arduetooth application installed.

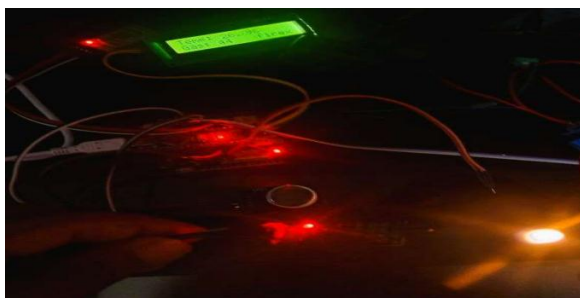
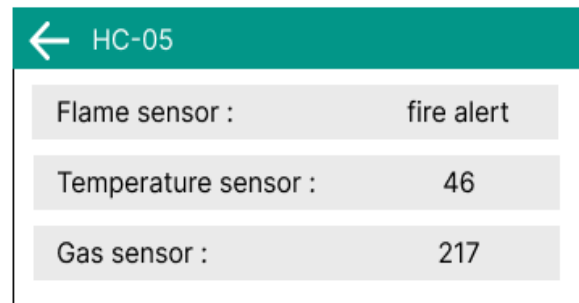


Fig -4.3: System in case of fire

The response that our system provides when it is triggered by our sensors, and how the actuators respond to it.



← HC-05	
Flame sensor :	fire alert
Temperature sensor :	46
Gas sensor :	217

Fig. 4.4 Output on the mobile phone in case of fire

The user's access to real-time information via mobile application when fire is detected by the flame sensor.

### 3. CONCLUSION

The use of multiple sensors in our project increases the reliability of the system. The buzzer sounds an alarm when it detects certain abnormal conditions, such as a temperature increase above 45 degrees Celsius or an increase in the amount of gas in the air exceeding 200 parts per million (ppm). The user is alerted to the current situation and a potential fire outbreak at the same time by our associated application Arduetooth. When the CO2 in the fire extinguisher runs out, the DC motor starts spraying water to put out the fire until outside assistance can arrive. This ensures total security in case of various types of fires. Currently, we are using BT module, so the range of our application is limited. In our future work we will be implementing the same system using GSM module. Furthermore, we would be scaling up our project using a hydraulic push mechanism and increasing the power of the DC Pump.

### REFERENCES

- [1] Tun, May Zaw, and Htay Myint. "Arduino Based Fire Detection and Alarm System Using Smoke Sensor." International Journal of Advances in Scientific Research and Engineering 06, no. 04 (2020): 89-94. doi:10.31695/IJASRE.2020.33792.
- [2] Habib, Md & Khan, Naureen & Ahmed, Koushik & Kiran, Mahbubur & Asif, A.K.M. & Bhuiyan, Mohaiminul & Farrok, Omar. (2019). Quick Fire Sensing Model and Extinguishing by Using an Arduino Based Fire Protection Device. 10.1109/ICAEE48663.2019.8975538.
- [3] Raju, Joyal & Mohammed Sulthan, Sheik & Paul, Johaan & John, Georgy & Nair, Dinanath. (2017). Development and implementation of arduino microcontroller based dual mode fire extinguishing robot. 1-4. 10.1109/ITCOSP.2017.8303141.

- [4] Suwarjono, Suwarjono & Wayangkau, Izak & Istanto, Teddy & Rachmat, Rachmat & Marsujitullah, Marsujitullah & Hariyanto, Hariyanto & Caesarendra, Wahyu & Legutko, Stanislaw & Glowacz, Adam. (2021). Design of a Home Fire Detection System Using Arduino and SMS Gateway. Knowledge. 1. 61-74. 10.3390/knowledge1010007.
- [5] Sowah, Robert & Ofoli, Abdul & Krakani, Selase & Fiawoo, Seth. (2014). Hardware module design of a real-time multi-sensor fire detection and notification system using fuzzy logic. 2014 IEEE Industry Application Society Annual Meeting, IAS 2014. 1-6. 10.1109/IAS.2014.6978415.
- [6] <https://www.projectsof8051.com/arduino-fire-alarm-system-using-temperature-and-smoke-sensor-with-android-connectivity>
- [7] <https://create.arduino.cc/projecthub/pranavmadhavar/am/automatic-fire-extinguisher-5610e7>
- [8] <https://blog.koorsen.com/what-is-a-co2-fire-suppression-system-and-how-does-it-work>