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ITGALPURA, RAJANUKUNTE, BENGALURU - 560064

SCHOOL OF ENGINEERING

A PROJECT REPORT ON

"FIRE & SMOKE, GAS DETECTOR WITH ALARM SYSTEM"

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE COURSE

INNOVATIVE PROJECT - ARDUINO USING EMBEDDED C

(CSE 1002)

SUBMITTED BY

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ABSTRACT

A fire alarm circuit is a simple circuit that detects a fire and sounds a siren or activates a buzzer. Fire Alarm Circuits are critical equipment for detecting fires in a timely manner and preventing harm to people and property.

Fire Alarm Circuits and Smoke Sensors are security system components that aid in the detection and prevention of harm. It is mandatory to install fire alarm systems and smoke detectors in commercial buildings such as workplaces, movie theatres, shopping malls, and other public locations.

There are many expensive and sophisticated Fire Alarm Circuits available as stand-alone devices, however, we created a simple Fire Alarm Circuit utilizing common components such as an MQ2 smoke sensor and a flame sensor.

The primary goal of a fire alarm system is to offer early warning of a fire so that people can be evacuated and prompt action can be taken to minimize or eliminate the fire's effects. Detectors or a manual call point can be used to set off the alarm (Remotely).

1. HARDWARE, SOFTWARE, AND TOOLS USED

1.1 MQ2 GAS SENSOR: MQ2 gas sensor is an electronic sensor used for sensing the concentration of gases in the air such as LPG, propane, methane, hydrogen, alcohol, smoke, and carbon monoxide.

MQ2 gas sensor is also known as chemiresistor. It contains a sensing material whose resistance changes when it comes in contact with the gas. This change in the value of resistance is used for the detection of gas. MQ2 is a metal oxide semiconductor-type gas sensor.

Concentrations of gas in the gas are measured using a voltage divider network present in the sensor. This sensor works on 5V DC voltage. It can detect gases in the concentration of range 200 to 10000ppm.

1.2 FIRE SENSOR: This tiny Flame sensor infrared receiver module ignition source detection module is Arduino compatible and use to detect flame or wavelength of the light source within 760nm~1100nm also useful for Lighter flame detect at the distance of 80cm.

Greater the flame, the farther the test distance. It has the Detect angle of 60 and very sensitive to the flame spectrum. It produces the one-channel output signal at the D0 terminal for further processing like an alarm system or any switching system. The sensitivity is adjustable with the help of blue potentiometer given on the board.

1.3 ARDUINO UNO: The Uno R3 is an open-source microcontroller board based on the ATmega328 chip. This Board has 14 digital input/output pins, 6 analog input pins, an Onboard 16 MHz ceramic resonator, a Port for USB connection, an Onboard DC power jack, An ICSP header, and a microcontroller reset button. It contains everything needed to support the microcontroller.

Using the board is also very easy, simply connect it to a computer with a USB cable or power it with a DC adapter or battery to get started.

The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip.

Instead, it features the Atmega16U2Atmega8U2 up to version R2) programmed as a USB-to-serial converter. While the UNO can be powered via the USB connection or with an external power supply, the power source is selected automatically

1.4 BUZZER: Apply 3V to 5V to this piezo buzzer module and you'll be rewarded with a loud 2KHz BEEP. Unlike a plain piezo, this buzzer does not need an AC signal. Inside is a piezo element plus the driver circuitry that makes it oscillate at 2KHz. The piezo buzzer is 5V TTL logic compatible and Breadboard friendly pin spacing. This buzzer is ideal when you need to fit a buzzer in a small place.

It has its own built-in drive circuit. It offers low current consumption. Used in manufacturing applications such as laptops, alarms, pagers, etc.

1.5 LED: The light-emitting diode (LED) is today's most energy-efficient and rapidly-developing lighting technology. Quality LED light bulbs last longer, are more durable, and offer comparable or better light quality than other types of lighting.

1.6 ARDUINO SOFTWARE (IDE): The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

1.7 TINKERCAD TOOL: Tinkercad is an open-source and free web-based online collection of software tools and it only requires an internet connection and a web browser. Tinkercad provides us with easy 3D design creation, code block programming, and electronic circuit simulation.

2. BLOCK DIAGRAM & DESCRIPTION

2.1 Arduino is connected to fire and smoke sensor, sensors are connected to voltage divider circuit in series with a variable resistor, which is used to change sensitivity. When these sensors detect smoke, gas, or fire, the sensor resistance changes as a result voltage and resistivity changes, which can be read by the microcontroller, as a result, Arduino turns on the buzzer and led.

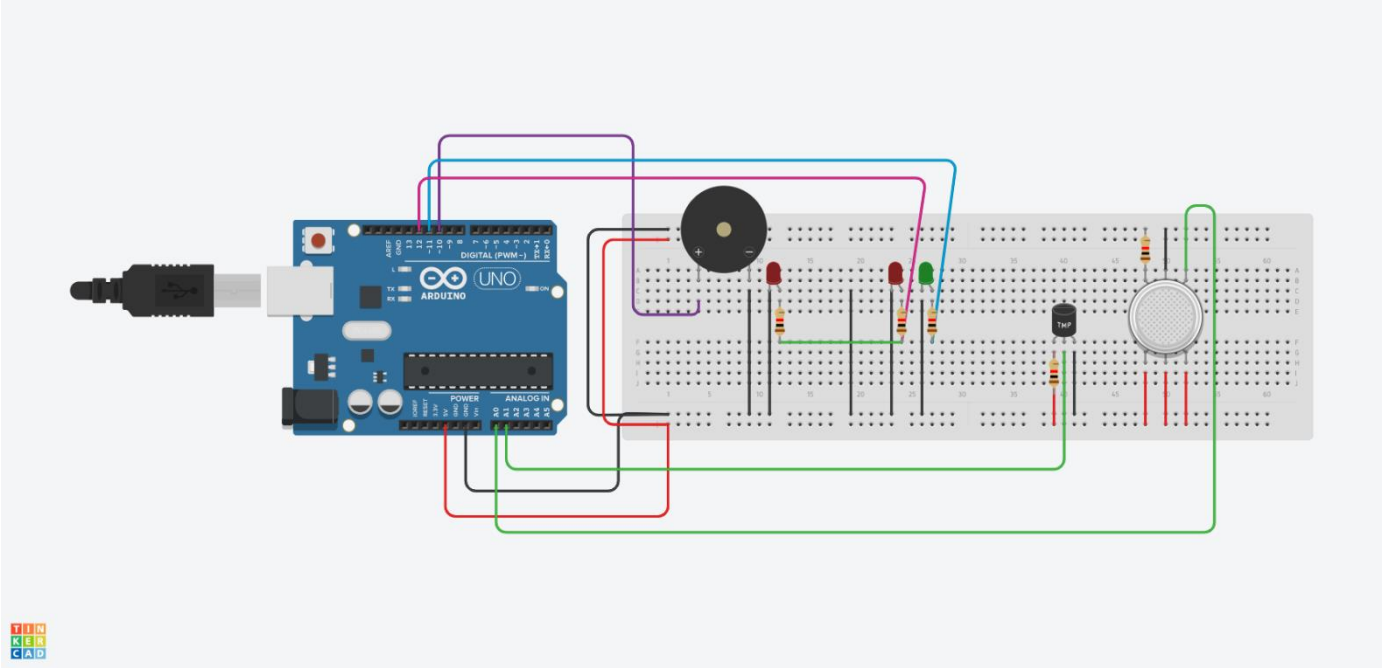

Fig 1. Tinkercad circuit diagram

LINK: https://www.tinkercad.com/things/8PtHo59Sd5r-fire-and-smoke-ipc-97/editel?sharecode=qJLFFjZr09xbiQEQfz3_mdMyAdwqmnLF4U38QPmWXgA

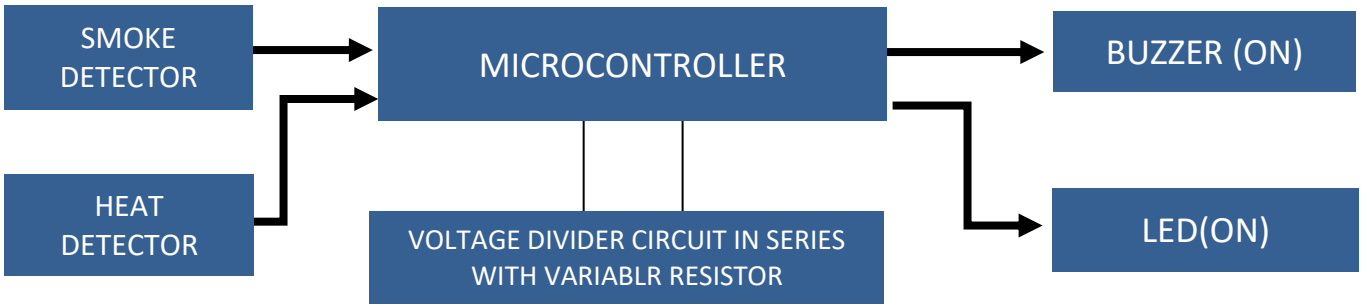

Fig 2. Flow Chart of Program Execution

- Arduino is connected to **a fire and a smoke sensor with an alarm system**.
- The sensor is connected to a voltage divider circuit in series with a **variable resistor.**
- The variable resistor is used to **change sensitivity.**
- When flammable gaseous and fire elements come into contact with the **sensor, as it detects.**
- As a result, the sensor's resistance changes.
- The voltage across the sensor changes as the resistance changes and this value can be read by a **microcontroller**.
- **ARDUINO turns on the buzzer and LED.**

2.2 THE PINS ARE TO BE CONNECTED SUCH AS:

MQ2 SENSOR

SIGNAL ANALOG -A0
GEN AND VCC-5V

FLAME SENSOR

SIGNAL ANALOG -A1
GEN AND VCC-5V

RED LED-DIGITAL PIN- 11 & 12
BUZZER- DIGITAL PIN -10

3. RESULT

3.1 SYSTEM IMPLEMENTATION:

In this work, an attempt has been done to design a fire and smoke alarm system using a Temperature sensor, MQ2 sensor, and Microcontroller for efficient use of electricity. It will help to reduce the wastage of electricity, save lives, reduce the percentage of accidents and reduce the waste of electrical appliances. The results obtained from the measurement have shown that the system performs well under all the conditions. The main objective of this project has been to design a circuit that detects fire or smoke and consequently triggers an alarm. These objectives were met since the system works effectively.

Fire outbreak is a major concern in homes, offices, industries, etc. It is dangerous and requires high security and control to control the destruction of lives and property. One of the preventive measures to avoid the danger is to install an automatic fire and smoke alarm detector at vulnerable locations, hence the Arduino-based fire alarm detection and control system was proposed. Our model is capable of detecting fire and smoke in a given environment triggers a Buzzer (alarm) and determines the intensity of the fire.

Research has been carried out using the MQ2 gas sensor, which is a media to provide input to the Arduino(microcontroller). The results that are inputted from the sensor provide information to Arduino at the location. in the event of unnatural condition (increase in temperature, gas, and smoke detected) Arduino will process the data to produce an output in the form of an alarm sound and alerts the residents if the heat exceeds the standard room temperature limit that has been determined. This mechanism is a faster solution to finding out the potential for a fire to occur in a building/house.

This system presented the development of a fire and smoke alarm system using the Arduino UNO. This system undoes the need for a person to monitor the area. The monitoring will be done with the help of a sensor. This system is low-cost, efficient, and based on the instruments reliable as well as durable.

If no fire or smoke is detected then the temperature is at optimum condition and the area is safe, That is the critical or threshold temperature for a flame sensor is 100k and the optimum frequency for the MQ2 gas sensor is 200 ppm. The critical frequency can be varied depending on the dimensions of the area or a room.

Fig 3. Final Model Image

4. CHALLENGES FACED

4.1 INSTALLATION AND PLACEMENT: The installation of smoke gas and fire detectors varies depending on the locality. However, some rules and guidelines for existing homes are relatively consistent throughout the developed world. FOR EXAMPLE, Canada and Australia require a building to have working smoke detectors on every level. There are two types of placements.

- MULTI-LEVEL
- SINGLE LEVEL

4.2 GAS CONCENTRATION: Higher the gas concentration faster and quick output signals are generated, similarly lower the gas concentration input signals are pulsating and the improper output signals are produced, which may create false signals to be generated.

4.3 FIRE RETARDANT MATERIALS:

- PERLITE BOARDS
- CORRIBOARD
- CALCIUM SILICATE
- SODIUM SILICATE

The other factors are, as the fire and smoke that spread within a building can be affected by various factors such as GEOMETRY**, DIMENSION LAYOUT, AND USAGE OF BUILDING.**

CONCLUSION

Fire incidents pose significant risks to lives and property, especially in densely populated areas where prompt response is crucial. This research aims to develop a prototype system for quick detection of fires and gas leaks in homes. The system uses temperature and gas sensors to monitor room conditions and alerts homeowners and firefighters through alarms and text messages. In 10 test trials, the system successfully detected temperature changes and gas leaks, triggering alarms and sending notifications as designed.

Fire outbreaks are a major concern in various settings and require robust security measures. Installing an automatic fire alarm detector, such as an Arduino-based system, can help mitigate these risks. The system developed is cost-effective, user-friendly, and adaptable to different environments, including homes, hotels, and factories. It uses the LM35 temperature sensor to detect heat and sends alerts via GSM, allowing for quick preventive actions.

This project aimed to design a fire alarm system using temperature sensors and a microcontroller to enhance safety and reduce electricity wastage. The system effectively detects high temperatures, triggers alarms, shuts off the building's mains, and can extinguish fires. Testing confirmed its reliable performance in real-world conditions, proving it can promptly notify homeowners and emergency services to minimize losses and prevent fatalities.