Industrial Fire Safety System

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Motivation:

Fires can have catastrophic effects on industrial buildings, underscoring the pressing need for efficient fire safety measures. Conventional approaches are frequently insufficient to handle the particular difficulties presented by industrial settings. We seek to reduce risks, save lives, and guarantee operational continuity by creating cutting-edge solutions that make use of AI, IoT, and data analytics. Our goal is to promote resilience in industrial operations across the globe.

ABSTRACT:

This industrial safety system project aims to decrease the damage caused by fire outbreaksin industries due to leakage in petroleum, chemicals, and kerosene oil, which results in human loss and property damage. It is important to have a system in every place that can keep locations secure and appropriately give an alert in case of an emergency. It can also send the information to the Occupational Safety (OSH) team so that they can save and help the people in the workplace.The Arduino System us built in such a way that it can detect **Ammonia,Sulphur,Benzene,Carbon dioxide**,and other harmful gases and smoke using **MQ-135 gas sensor** and fire using a flame sensor,while the **DHT-11** sensor is used to record temperature and humidity. If harmful gases get leaked the sensors get active and send the information to the **Arduino** and the **buzzer** gets active and the **LED bulb** glows and gives an alert to the people nearby.

INTRODUCTION:

Industrial safety system was developed to protect those working people from danger. The chemical reactions are protected by the industrial safety system , which also secure the environment and the plant itself. Over 4 million people worldwide pass away from injuries each year. In 2015, India reported 413,457 accidental injury-related fatalities. The manufacturing sector contributes significantly to injury morbidity and mortality. This project helps to reduce the risk to the workers working in the industry. If any harmful gas is leaking or a fire accident may happen then this device gives an alert to the worker so that they can save their lives. The main advantage of this industrial safety system project is that accidents can be avoided, and immediate action is taken by the people

Literature Review:

1. Ashmore (1992): Method: Analyzed industrial fire prevention and protection methods. Output: Identified key strategies for enhancing fire safety in industrial settings.

2. Mcquaid (1991): Method: Provided an overview of industrial fire problems. Output: Highlighted common challenges and areas for improvement in industrial fire safety practices.

3. Chalapathi Rao (2023): Method: Developed industrial safety systems using embedded systems technology. Output: Proposed innovative solutions for enhancing safety in industrial environments.

4. Hollingum (2001): Method: Explored flame sensor technology. Output: Reviewed the functionality and applications of flame sensors for fire detection.

5. Mazher (2022): Method: Developed an SMS-based gas leakage and fire detection alert system. Output: Presented a novel system for early detection and alerting of gas leaks and fire incidents.

6. Doshi (2021): Method: Implemented an IoT-based fire and gas monitoring system. Output: Demonstrated the effectiveness of IoT technology in monitoring and managing fire and gas hazards.

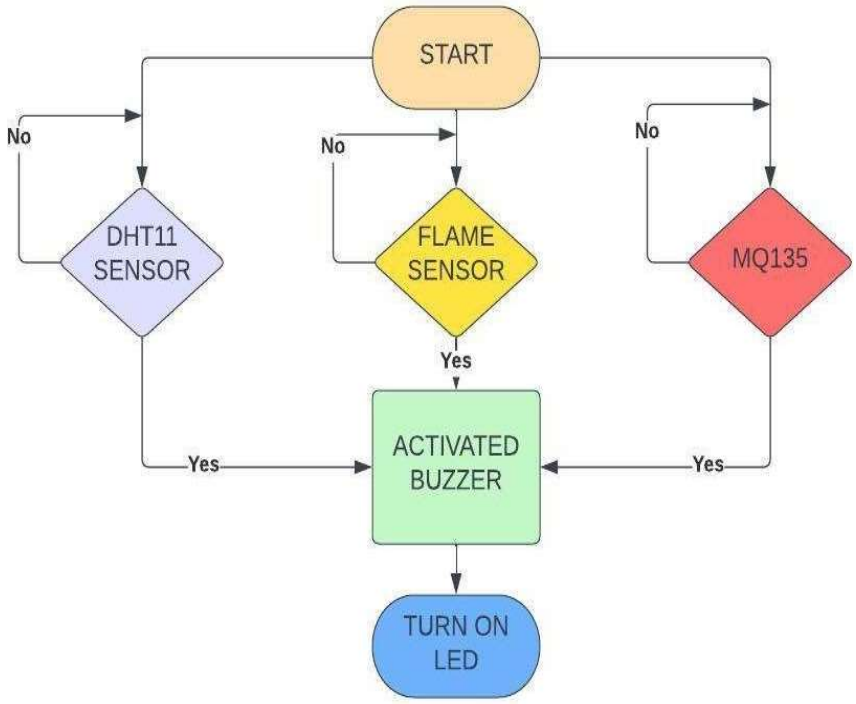
7. Mehta and Reddy (2015): Method: Designed a fire and gas detection system. Output: Described the architecture and functionalities of a comprehensive detection system for industrial applications.

8. Morchid(2024): Method: Explored applications of IoT and sensor technology for enhancing food security and agricultural sustainability. Output: Identified benefits and challenges of using IoT and sensors in agriculture.

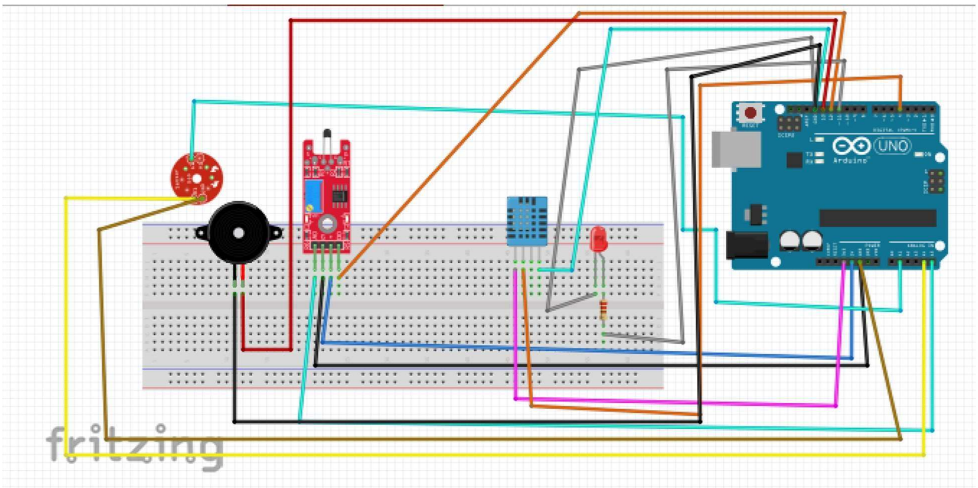
9. Morchid(2021): Method: Designed and realized a fire safety system using Arduino Uno. Output: Presented a practical implementation of a fire safety system for monitoring and controlling sirens.

10.Morchid(2022): Method: Implemented a fire safety system for smart farms using gas and flame sensors. Output: Demonstrated the application of sensor technology for fire detection and management in agricultural settings.

FLOWCHART DIAGRAM OF THE PROJECT SETUP:



CIRCUIT DIAGRAM SETUP:



ARDUINO IDE CODE:

```
#include <SimpleDHT.h>
#define MQ135 A5 //smoke sensor pin connecetd to pin A0 of Arduino Uno
#define BUZZER_PIN 12 //buzzer pin connecetd to pin 8 of Arduino Uno
#define LED 8 //LED pin connecetd to pin 9 of Arduino Uno
#define flamePin A4
#define DHTPin 2
#define DHTTYPE DHT11 // DHT 11
#define GAS_THRESHOLD 200
#define TEMP_THRESHOLD 20
SimpleDHT11 dht;
int Flame = HIGH;
int value1; //integer value is define to store the output of MQ135 sensor
int value2;
void setup()
{
pinMode(MQ135, INPUT); //Set MA3 as INPUT device
pinMode(BUZZER_PIN, OUTPUT); //Set Buzzer as INPUT device
pinMode(LED, OUTPUT); //Set LED as INPUT device
pinMode(flamePin, INPUT);
Serial.begin(9600);
}
void mq135() {
value1 = analogRead(MQ135); // reads the analog value from smoke sensor
Serial.println(value1);
if ( value1 > GAS_THRESHOLD ) //if smoke is detected
{
digitalWrite ( LED , HIGH ); // turns the LED on
digitalWrite(BUZZER_PIN,HIGH); // turns the buzzer on
}
else {
digitalWrite(LED, LOW); // turns the LED off
digitalWrite(BUZZER_PIN,LOW); // turns off
}
delay (500);
}
void flamesensor()
{
Flame = digitalRead(flamePin);
if (Flame== LOW)
{
```

```
digitalWrite(BUZZER_PIN, HIGH);
digitalWrite(LED , HIGH);
}
else
{
digitalWrite(BUZZER_PIN, LOW);
digitalWrite(LED , HIGH);
}
}
void loop(){
// Read data from DHT11 sensor
byte temperature = 0;
byte humidity = 0;
if (dht.read(DHTPin, &temperature, &humidity, NULL)) {
Serial.print("Read DHT11 failed.");
delay(1000);
return;
}
int gasValue = analogRead(MQ135);
// Print temperature, humidity, and gas values
Serial.print("Temperature: ");
Serial.print((int)temperature);
Serial.print(" *C, Humidity: ");
Serial.print((int)humidity);
Serial.print(" %, Gas Value: ");
Serial.println(gasValue);
// Check if the gas level is above the threshold
if (gasValue > GAS_THRESHOLD) {
// Blink LED and trigger buzzer
digitalWrite(LED, HIGH);
digitalWrite(BUZZER_PIN, HIGH);
delay(500); // Adjust the dura  on of the alarm as needed
digitalWrite(LED, LOW);
digitalWrite(BUZZER_PIN, LOW);
}
// Check if the temperature is above the threshold
if (temperature > TEMP_THRESHOLD) {
// Blink LED and trigger buzzer
digitalWrite(LED, HIGH);
digitalWrite(BUZZER_PIN, HIGH);
delay(500); // Adjust the dura  on of the alarm as needed
digitalWrite(LED, LOW);
digitalWrite(BUZZER_PIN, LOW);
}
// Delay before the next loop
delay(2000); // Adjust the delay based on your applica  on
}
```

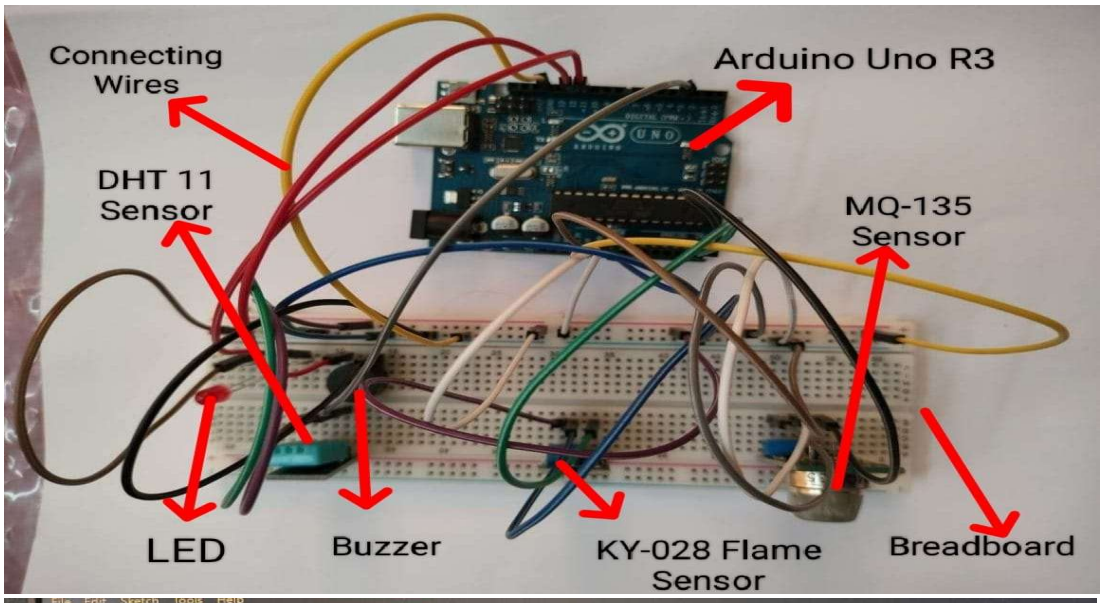
Components Required:

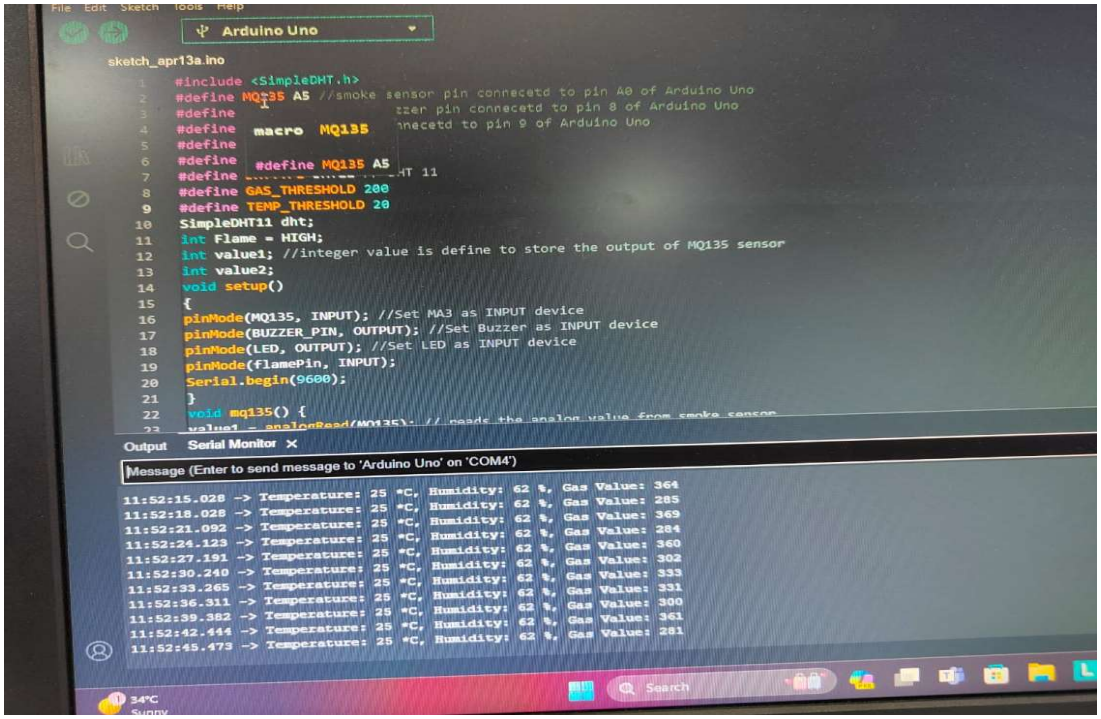
1. Hardware Component

- Arduino UNO R3
- DHT11 Sensor-To detect temperature and humidity
- MQ135 Sensor Module-To detect industrial gases
- Flame Sensor Module-To detect presence of an open fire
- Buzzer-To alert with a noise
- Connecting Wires
- Breadboard
- LED

2. Software Components

- **Arduino IDE**





WORKING PRINCIPLE:

The setup employs an Arduino Uno R3 with a flame sensor, DHT11 sensor for temperature/humidity, and MQ 135 sensor for gas levels. The Arduino reads sensor data, processes it to detect flames, measure temperature/humidity, and assess gas concentration. If a flame is detected, the LED blinks and the buzzer sounds. Gas levels trigger warnings too. The system continuously monitors and adjusts outputs based on real-time data, providing a comprehensive environmental monitoring and alert system for fire, temperature, humidity, and gas levels in the surroundings.

RESULT:

Our industrial fire safety technology is incredibly effective. It finds flames rapidly and assists in putting them out promptly using the buzzer and led. It's really beneficial that it can identify fires early on. The device works efficiently under the threshold values set by us so.

CONCLUSION:

Finally, our experiment demonstrates how implementing smart technology can reduce the risk of fire in industrial settings. Our solution is prepared for usage in actual warehouses and factories, where it can assist keep everyone safe and avoid fires. We aim to further improve it and find ways to lower its cost of use so that it can be utilized in a variety of industrial settings in the future.

Cost (in Rupees)

- Arduino uno- 610
- Flame sensor- 85
- MQ135- 175
- DHT11- 125
- Buzzer- 15
- LED- 1
- Resistor- 5
- Breadboard- 65
- Jumper- 20

Total Cost: Rs.1101

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[7]B. R. Mehta and Y. J. Reddy, "Fire and gas detection system," Industrial Process Automation Systems, pp. 217–235, 2015.

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