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Fire Detection System USING Flame Sensor

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1. Abstract

This project presents an automated fire detection system that utilizes a flame sensor and a buzzer to detect and alert about fire hazards. The system is designed to enhance safety by identifying fire in its early stages and notifying users with an alarm. When a flame is detected within a predefined range, the system triggers a buzzer, providing an immediate warning and stop the fire by sprinkling water on it.

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2. Introduction

Fire safety is a critical concern in residential and commercial environments. This project focuses on designing a cost-effective fire detection solution using basic electronic components. The proposed system uses a flame sensor to detect fire and a buzzer for an auditory alert. The primary objective is to enable quick response times and minimize fire-related risks.

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3. Objective

- To detect fire using a flame sensor and alert with a buzzer.
- To enhance safety by providing an early warning system and stop fire.
- To design a reliable and cost-efficient fire detection solution.

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4. Components Used

The following hardware and software components were used in the system:

Hardware:

1. Flame Sensor

2. Microcontroller (e.g., Arduino Uno)
3. DC Motor Pump
4. Buzzer
5. Resistors and Connecting Wires
6. Breadboard or PCB **Software:**

1. Arduino IDE for programming the microcontroller

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5. Working Principle

The system operates as follows:

1. The flame sensor detects fire by monitoring infrared light emitted by flames.
2. If the sensor detects fire, it sends a signal to the Arduino.
3. The Arduino processes the signal and activates the buzzer and for an alert and the pump to start sprinkling water.

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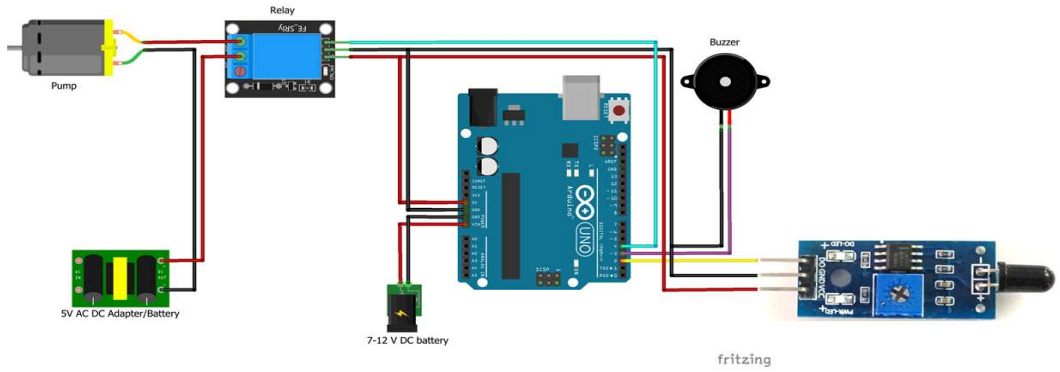
6. Circuit Diagram

A well-labelled circuit diagram can be added here to show the connections between components.



7. Code Implementation

The system was programmed in C using the Arduino IDE. Below is the implemented code for the system:

```
#include <Arduino.h>


#define SENSOR_PIN 2

#define BUZZER_PIN 3

#define RELAY_PIN 4

#define SPRINKLER_START_DELAY 200  //5 seconds

#define SPRINKLER_ON_TIME 3000      //3 seconds Sprinkler on time

const int trigPin = 9;  // Trigger pin of ultrasonic sensor

const int echoPin = 8;  // Echo pin of ultrasonic sensor

const int waterLevelThreshold = 10;


unsigned long previousTime = millis();


void setup()

{

  pinMode(RELAY_PIN, OUTPUT);

  pinMode(SENSOR_PIN, INPUT);

  pinMode(trigPin, OUTPUT);
```

```
  pinMode(echoPin, INPUT);
}

void loop()
{
  //If there is fire then the sensor value will be LOW else the value will be HIGH
  int sensorValue = digitalRead(SENSOR_PIN);

  //There is fire
  if (sensorValue == LOW)
  {
    analogWrite(BUZZER_PIN, 50);                    //Turn on buzzer

    if (millis() - previousTime > SPRINKLER_START_DELAY)  //We will wait for few seconds before sprinkler can be started once fire is detected.
    {
      digitalWrite(RELAY_PIN, LOW);                 //Relay is low level triggered relay so we need to write LOW to switch on the light
      delay(SPRINKLER_ON_TIME);                     //Keep sprinkler on for sometime.
```

```
  }
}
else
{
  analogWrite(BUZZER_PIN, 0);
  digitalWrite(RELAY_PIN, HIGH);
  previousTime = millis();
}
  digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);

// Measure Echo Pulse Duration
long duration = pulseIn(echoPin, HIGH);

// Calculate Distance (in cm)
int distance = duration * 0.034 / 2;
```

```
  // Print distance to Serial Monitor
  Serial.print("Distance: ");
  Serial.print(distance);
  Serial.println(" cm");


  // Check if water level is below threshold
  if (distance >= waterLevelThreshold) {
    // Activate siren-like behavior
    for (int i = 0; i < 5; i++) { // Repeat 5 times
      digitalWrite(BUZZER_PIN, HIGH); // Buzzer ON
      delay(200);                 // Wait 200ms
      digitalWrite(BUZZER_PIN, LOW);  // Buzzer OFF
      delay(200);                 // Wait 200ms
    }
  } else {
    digitalWrite(BUZZER_PIN, LOW); // Turn off buzzer if water level is
below threshold
  }
  delay(500); // Delay for stability
}
```

8. Results and Observations

- The flame sensor accurately detects fire within a specific range.
- The buzzer and LED effectively alert users when fire is detected.
- The system responds immediately, ensuring timely warnings and pump start to sprinkle water.

9. Advantages

- Early detection of fire hazards.
- Cost-effective and easy to implement.
- Can be used in homes, offices, and factories.

10. Limitations

- The sensor's range may be affected by environmental conditions like smoke or excessive light.
- Requires continuous power supply for optimal functioning.

11. Future Enhancements

1. **IoT Integration:** Monitor fire detection remotely using a mobile app.
2. **Improved Sensors:** Use advanced sensors to differentiate between fire and false positives.

12. Conclusion

The Fire Detection System using a flame sensor and buzzer provides an efficient and reliable solution for fire safety. This project demonstrates the potential of simple electronic systems to

significantly reduce fire-related risks. With further enhancements, this system can become a vital part of modern safety infrastructures.
