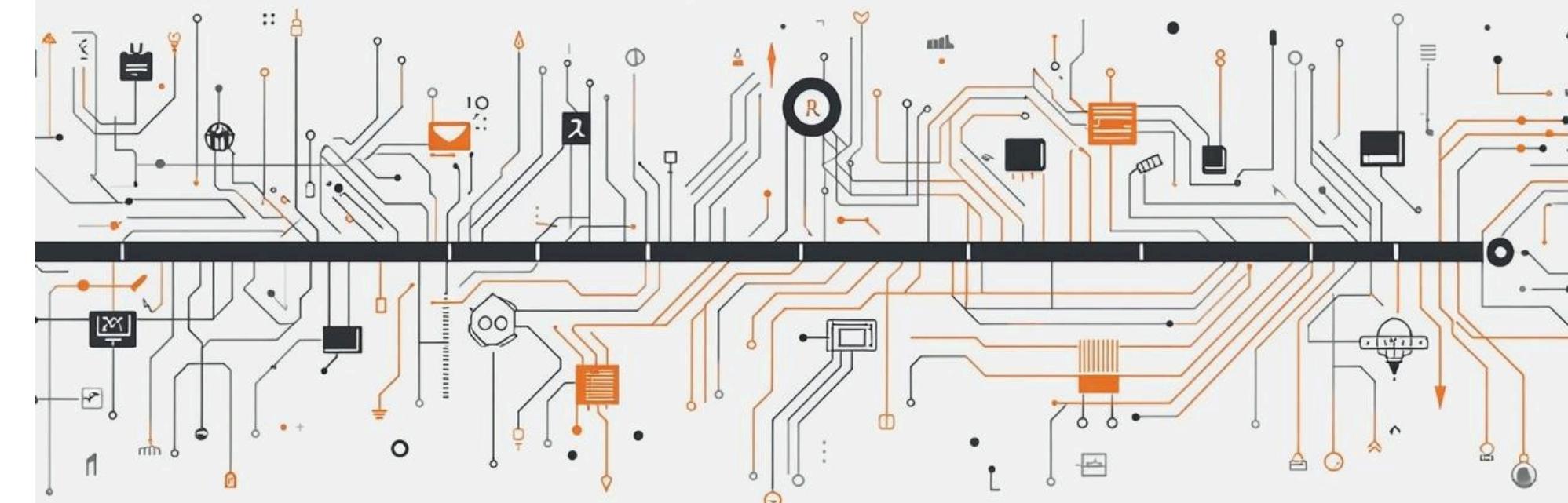


# Project Overview

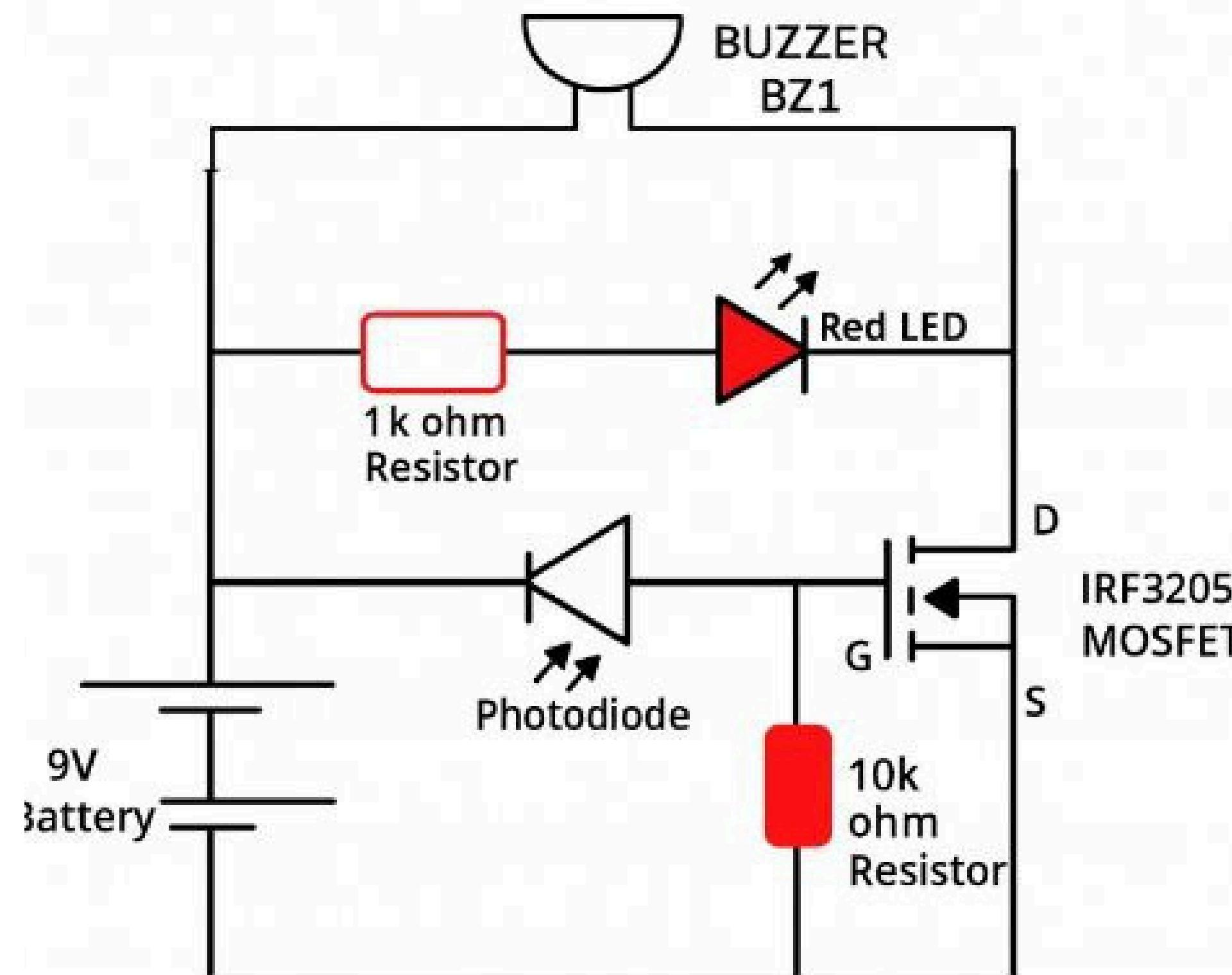
- Designed a **Fire Alarm Circuit** using an **IRF3205 MOSFET**.
- Uses a **photodiode** to detect changes in light caused by fire.
- The circuit activates **a buzzer and LED** when fire is detected.
- Powered by a simple **9V battery**, making it portable and low-cost.
- Includes **1 kΩ and 10 kΩ** resistors for current limiting and MOSFET gate biasing.
- Implemented on a **breadboard** as part of the Electronic Devices project.
- The project demonstrates understanding of **MOSFET switching, light detection, and basic circuit design**.



# Components Required

1. IRF3205 MOSFET
2. Photodiode
3. Red LED
4. Buzzer
5.  $1\text{ k}\Omega$  Resistor
6.  $10\text{ k}\Omega$  Resistor
7. 9V Battery
8. Breadboard
9. Jumper Wires (Male-to-Male)

# Circuit Schematic Overview



Fire Alarm Circuit Diagram

# Components explanation

Our motion sensor circuitry designs several electronic components which is already explained briefly. A detail information is given below:

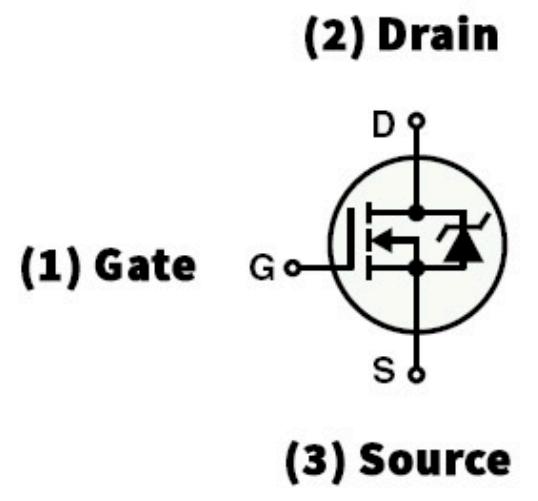
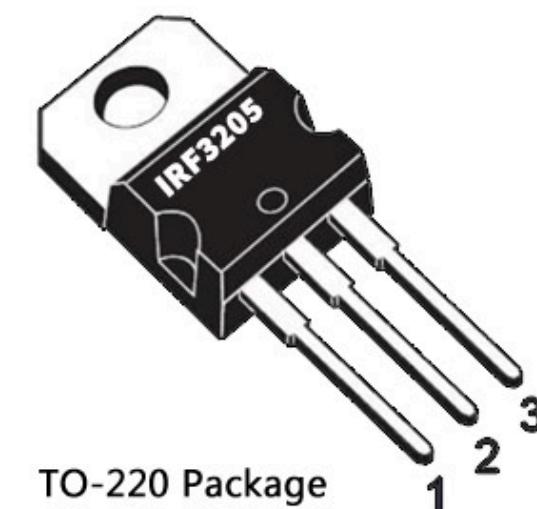
## 1. MOSFET – IRF3205

- The IRF3205 is an **N-channel** power MOSFET used for switching high current loads.
- It is widely used in power circuits because it can handle **high current** and has **low on-resistance**, which reduces heat and power loss.
- Works in **enhancement mode**, meaning it turns ON when sufficient voltage is applied at the gate.

## IRF3205 Pinout

### Key Features

- **Type:** N-Channel MOSFET
- **Voltage Rating:** ~55V
- **Current Rating:** Tens of amperes
- **Low R\_DS:** ( Very low on-state resistance for efficient switching



## Terminals

- **Gate (G)**: Controls the MOSFET. A positive voltage turns it ON.
- **Source (S)**: Connected to ground or negative terminal.
- **Drain (D)**: Load is connected here; current flows when MOSFET is ON.

## Working Principle

- When voltage is applied to the Gate, the MOSFET allows current to flow from Drain → Source.
- When the gate voltage is removed, it stops conduction.
- Used for switching, control, and power delivery circuits.

## Applications

- Power switching circuits
- Motor control
- Power supplies
- Battery-powered circuits and alarms

## Important Considerations

- The gate requires a proper drive voltage to fully turn ON
- High current handling means heat dissipation may be required (heat sink in large circuits)

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## Why We Used IRF3205 (and Not Another MOSFET)

### ✓ 1. High Current Handling

- IRF3205 can handle very high current (up to 110A).
- Although our fire alarm requires a small current, using a high-current MOSFET ensures better reliability and safe operation.

### ✓ 2. Very Low On-Resistance

- $R_{ds}$  is extremely low (~8 milliohms).
- This means: Less heat, Better efficiency, Faster switching

### ✓ 3. Easily Available

- IRF3205 is commonly available and cheap in markets → making it ideal for student projects.

### ✓ 4. Works Perfectly at 5–9V Circuits

- Our fire alarm uses a 9V battery.
- IRF3205 turns ON properly with this voltage.

## Can We Use Other MOSFETs?

Yes, you can also use **IRFZ44N**.

- IRFZ44N is also an N-channel MOSFET suitable for switching applications.
- It has slightly higher on-resistance and lower current rating than IRF3205, but still works well in low-power alarm circuits

## 2. Photodiode

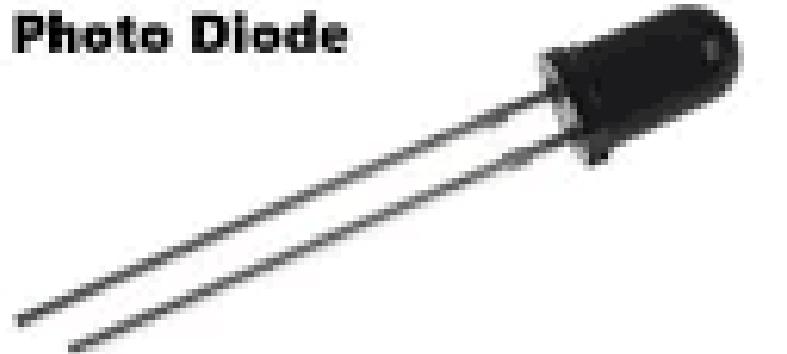
A photodiode is a semiconductor device that generates a current or voltage when exposed to light. It's a type of diode designed to function in the reverse bias condition, where its primary function is to convert light energy into electrical current or voltage.

### Structure:

- **P-N Junction:** Similar to regular diodes, a photodiode consists of a P-N junction. When light strikes this junction, it generates electron-hole pairs.
- **Construction:** Photodiodes are designed to be sensitive to light, and they're usually enclosed in a protective housing with a transparent window to allow light to enter.

### How it Works:

- **Light Absorption:** When photons (particles of light) strike the photodiode's semiconductor material, they provide enough energy to create electron-hole pairs in the P-N junction.
- **Electric Field:** The P-N junction in the photodiode creates an electric field. This field causes the electrons and holes created by the absorbed photons to move in opposite directions.



- **Current Flow:** Due to the electric field, the electrons move towards the N-type region, and the holes move towards the P-type region, resulting in a flow of current.

## Types:

- **Avalanche Photodiode (APD):** This type of photodiode operates in a manner where the generated electron-hole pairs are accelerated by a high electric field, resulting in an avalanche effect and higher sensitivity.
- **PIN Photodiode:** These photodiodes have an intrinsic (I) region placed between the P and N regions, allowing for better performance in terms of speed and sensitivity compared to standard photodiodes.

## Photodiode Type Used in Your Fire Alarm

✓ It is a **PIN Photodiode (Passive type)**

The normal small black/transparent photodiode used on breadboards is always a PIN-type photodiode.

## Why It Is NOT an APD (Avalanche Photodiode)

APDs are:

- Expensive
- Require high voltage (50–200V) bias
- Used in advanced communication systems
- Not available as low-cost lab components

Since our circuit is running on a 9V battery, an APD would not work at all.

### 3. LED (Red LED)

- Used as a visual indicator when fire is detected.
- Emits red light when current flows through it.
- Requires a resistor to prevent damage.



### 5. Buzzer

- Provides audio alarm when the MOSFET switches ON.
- Operates from the 9V battery.
- Alerts the user immediately during fire detection.



### 6. 1 kΩ Resistor

- Used for current limiting for the LED.
- Protects LED from excessive current.



### 7. 10 kΩ Resistor

- Used as a pull-down resistor for the MOSFET gate.
- Ensures the MOSFET remains OFF when no signal is present.
- Prevents false triggering from noise.



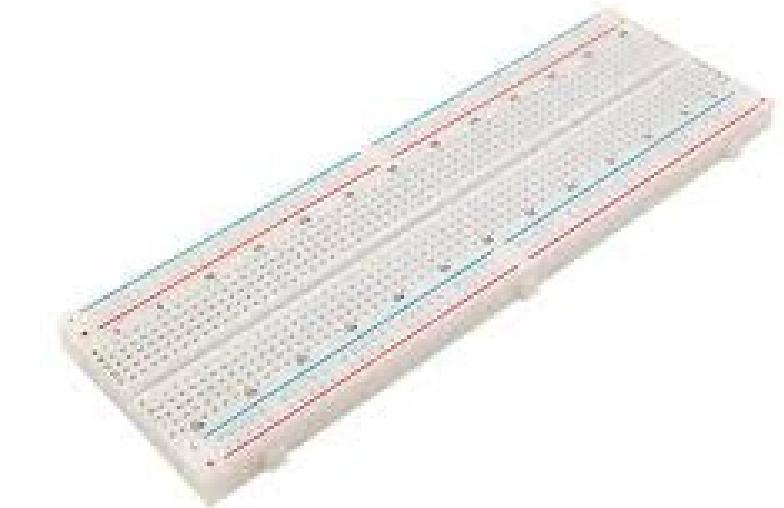
## 6. 9V Battery

- Provides the power supply to the entire circuit.
- Portable and commonly used in student electronics projects.



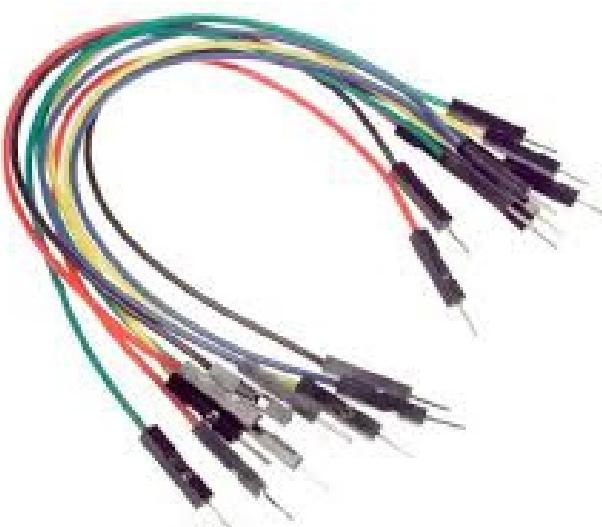
## 7. Breadboard

- Used to build and test the circuit without soldering.
- Easy to modify connections.



## 8. Jumper Wires (Male-to-Male)

- Used for interconnecting components on the breadboard.
- Carry signals and power between MOSFET, photodiode, LED, and buzzer.



# Theory of Fire Alarm System

## 1. Power Supply Activation

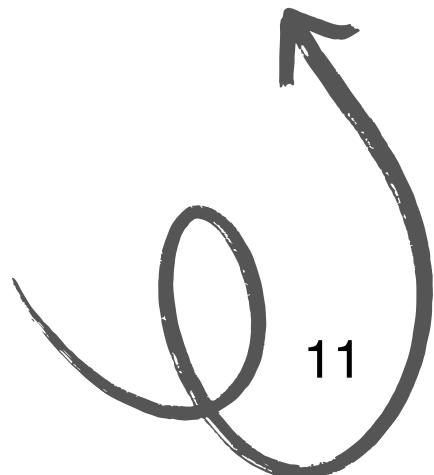
- The 9V battery powers the entire circuit.
- All components (photodiode, MOSFET gate circuit, LED, buzzer) get ready for operation.

## 2. Photodiode Receives Light Normally

- Under normal conditions (no fire), the photodiode receives ambient light.
- In this state, the photodiode has low resistance.
- It pulls the MOSFET gate voltage low, keeping the MOSFET OFF.

## 3. MOSFET Remains OFF in Normal Condition

- Since the gate voltage is low, the IRF3205 (enhancement mode) does not conduct.
- Drain → Source path is open (no current).
- LED and buzzer remain OFF.



## **4. When Fire Occurs, Light Intensity Increases**

- Fire produces intense light and sometimes smoke which changes the photodiode's environment.
- The photodiode's resistance increases sharply when strong light falls on it.

## **5. Increased Photodiode Resistance Raises Gate Voltage**

- As the photodiode resistance increases, less current flows to ground.
- This causes the Gate voltage of the MOSFET to rise.
- Gate receives sufficient  $V_{gs}$  (4–9V) to turn ON the MOSFET.

## **6. MOSFET IRF3205 Turns ON**

- IRF3205 is an N-channel enhancement MOSFET, so it switches ON when gate voltage increases.
- It now creates a closed path from Drain → Source.
- Current starts flowing through the load.

## **7. LED Turns ON**

- As the MOSFET conducts, current flows through the LED, causing it to glow.
- This gives a visual indication of fire detection.

## **8. Buzzer Activates**

- The buzzer also receives current through the MOSFET's conducting channel.
- It starts beeping loudly, giving an audio alarm to warn about fire.

## **9. Alarm Continues Until Light Level Returns to Normal**

- As long as fire (or intense light) is present, photodiode resistance stays high.
- Gate voltage stays high → MOSFET remains ON → Buzzer + LED stay ON.

## **10. When Danger is Gone**

- Light level decreases → Photodiode resistance drops again.
- Gate voltage goes low due to the 10k pull-down resistor.
- MOSFET switches OFF → Alarm stops.

## APPLICATIONS

- Home fire detection
- Small laboratories and classrooms
- Electronic safety projects
- Battery-powered emergency alert systems
- Basic smoke/light detection demonstrations
- Low-cost DIY alarm systems

## ADVANTAGES

- Alerts people quickly during a fire
- Helps prevent property damage
- Reduces risk of injury or loss of life
- Works even during power failure (battery)
- Very low maintenance
- Easy to install in small rooms/homes

## LIMITATIONS

- Detects only light/fire, not smoke or heat
- Limited sensitivity in bright ambient light
- Range depends on photodiode placement
- False triggers possible with strong external light
- Not suitable for industrial fire detection
- Requires manual reset after alarm

# Future Enhancements for Fire Alarm

- Add smoke sensor (MQ-2) for more accurate fire detection
- Use temperature sensor (LM35 / DHT11) to detect heat rise
- Add GSM module to send SMS alerts during fire
- Include Wi-Fi/IoT to monitor fire status on mobile apps
- Use a microcontroller (Arduino) for smarter decision-making
- Add battery backup & charging circuit
- Improve sensitivity adjustment using a potentiometer
- Add relay to automatically cut power during fire
- Use buzzer with siren sound for louder alerts
- Design a compact PCB instead of a breadboard