

Fire Fighting Robot

- Aim**

To design and build an autonomous fire-fighting robot that can detect fire using IR sensors, avoid obstacles, stop at a safe distance, and extinguish fire using a water-spraying mechanism controlled by Arduino Uno.

- Components Required**

Component	Quantity
Arduino Uno	1
IR Sensors (Fire detection)	3
Ultrasonic Sensor (HC-SR04)	1
L298N Motor Driver	1
DC Gear Motors + Wheels	4
Servo Motor (Nozzle control)	1
Water Pump Motor	1
Relay Module	1
Rechargeable Li-ion Batteries (18650 or similar)	3
Chassis (Robot body)	1
Jumper Wires	As needed
Mini Water Tank + Pipe	1
Battery Holder/Case	1
Switch	1
Breadboard or PCB	1

• Objectives

- To build a robot that can detect fire using IR sensors.
 - To stop the robot at a safe distance from the fire using an ultrasonic sensor.
 - To extinguish the fire by activating a water pump and rotating the nozzle via a servo.
 - To avoid obstacles during movement using ultrasonic sensing.
 - To run entirely on battery power and function autonomously without manual control.
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• Methodology

1. Sensing Fire:

IR sensors are used to detect the presence of fire by sensing infrared radiation.

2. Distance Control & Obstacle Avoidance:

An ultrasonic sensor is mounted on the front of the robot to measure the distance to any object (including fire source). It helps the robot stop approximately 2 inches before reaching the fire and avoids obstacles.

3. Movement:

DC gear motors controlled by the L298N driver are used for robot mobility. Arduino controls the direction and speed.

4. Extinguishing Fire:

When fire is detected and the robot is at a safe distance, Arduino triggers the relay to turn on the water pump. The servo rotates the nozzle to spray water over a wider area.

5. Power Supply:

The entire system is powered by three lithium-ion rechargeable batteries—separately managing power to Arduino and motor drivers.

• Procedure

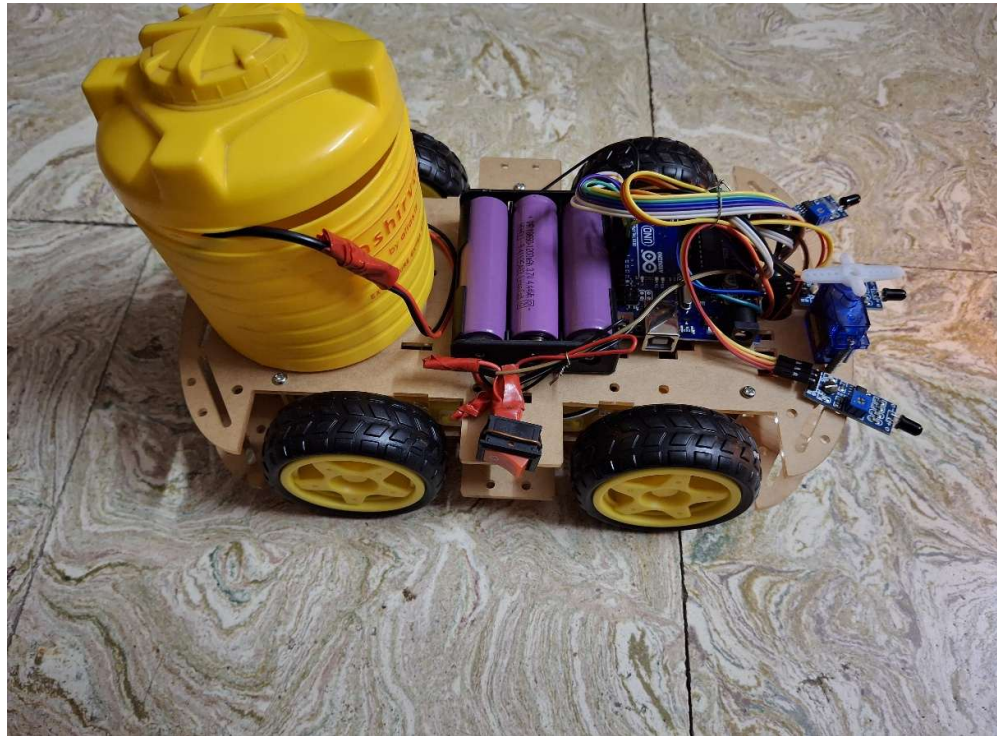
1. Assemble the robot chassis and mount all hardware components (Arduino, sensors, pump, battery pack, etc.).
2. Connect:
 - IR sensors to digital pins for fire detection.

- Ultrasonic sensor to trigger and echo pins for distance measurement.
 - Motors to L298N driver and then to Arduino.
 - Servo motor to a PWM pin.
 - Water pump to relay, and relay to Arduino.
3. Upload the code to the Arduino to:
 - Continuously read IR and ultrasonic sensor data.
 - Move forward until fire is detected.
 - Stop 2 inches before the fire.
 - Activate water pump and rotate servo.
 4. Test the robot by placing a small fire source (e.g., candle) and observing its detection and extinguishing behavior.
 5. Make adjustments to improve accuracy or range if needed.
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• Conclusion

The developed fire-fighting robot successfully detects fire using IR sensors, approaches safely using ultrasonic distance sensing, and extinguishes the flame with a water spray mechanism. It also avoids obstacles and functions completely autonomously. This project demonstrates how embedded systems and automation can be integrated for disaster management applications, especially in fire-prone environments.

• Assembled Robot Hardware



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- **Fire-Fighting Robot Prototype**

