



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 15, Special Issue 1, January 2026

Fire Fighting Robot using Arduino

Prof. Nikhita A. Kolhe¹, Santosh Kashinath Ghude², Rajababu Dayanand Chauhan³,
Amit ahendra Chaudhari⁴, Aniket Dattatray Shelke⁵

Professor. Dept. of ELE, Indala Engineering College, Mumbai, Maharashtra, India¹

Dept. of ELE, Indala Engineering College, Mumbai, Maharashtra, India²

Dept. of ELE, Indala Engineering College, Mumbai, Maharashtra, India³

Dept. of ELE, Indala Engineering College, Mumbai, Maharashtra, India⁴

Dept. of ELE, Indala Engineering College, Mumbai, Maharashtra, India⁵

ABSTRACT: This project presents an Arduino-based Fire Fighting Robot designed to automatically detect and extinguish fires, minimizing human risk in hazardous situations like server rooms or industrial areas. Utilizing an Arduino Uno as its brain, the robot employs flame sensors (IR) to locate fire, an ultrasonic sensor for obstacle avoidance, and motors (via L298N driver) for movement. Upon detection, it activates a water pump and servo-controlled nozzle to spray water, offering a safer, automated response to fire breakouts, thereby preventing property damage and saving lives. Fires in residential and industrial environments pose significant threats to life and property, and traditional firefighting methods often involve substantial risks to human personnel. This project presents the design and implementation of an autonomous fire fighting robot utilizing an Arduino Uno microcontroller to detect and suppress small-scale fires, thereby minimizing human exposure to hazardous situations.

KEYWORDS: Arduino, Flame Sensor, Ultrasonic Sensor.

I. INTRODUCTION

Fire is one of the most destructive forces known to mankind. In many Fire cases, it becomes extremely dangerous or even impossible for firefighters to enter the affected area immediately. Therefore, the need for an automated fire detection and extinguishing system has become increasingly important in modern times. To address this challenge, this project presents the design and development of a **Fire Fighting Robot using Arduino**, an intelligent robotic system capable of detecting and extinguishing fire automatically without human intervention. The Fire Fighting Robot using Arduino serves as a significant step toward intelligent robotic systems that can assist humans in life-threatening situations.

This project introduces an automated fire-fighting robot using an Arduino Uno to detect, navigate to, and extinguish fires, enhancing safety and efficiency. A firefighting robot is an autonomous or remote-controlled machine using sensors (like flame/IR), AI, and water cannons/hoses to detect, navigate, and extinguish fires in hazardous areas, protecting human firefighters and minimizing risk, especially in industrial settings or large-scale disasters, with systems ranging from simple Arduino-based models to complex industrial units like Thermite. They offer improved safety, early detection, and can perform reconnaissance and suppression, often integrating IoT for alerts and remote control. The Fire Fighter. The main and only work is to deploy the robot in a fire prone area and the robot will automatically work once it detects a fire breakout. This prototype helps in Rescue operations during fire accidents where the entry of service man is very difficult in the fire prone area. There are several existing types of vehicles for firefighting at home and extinguish forest fires. Our proposed robot is designed to be able to work on its own or be controlled remotely. By using such robots, fire identification and rescue activities can be done with higher security without placing fire fighters at high risk and dangerous conditions. In other words, robots can reduce the need for fire fighters to get into dangerous situations. When we the field of firefighting has long been a dangerous one, and there have been numerous and devastating losses because of a lack in technological advancement. Additionally, the current methods applied in firefighting are inadequate and inefficient relying heavily on humans who are prone to error, no matter how extensively they have been trained. Modern technological advancements in embedded systems, automation, and wireless sensing have enabled the development of robots capable of operating in unpredictable and

life-threatening environments. In particular, firefighting robots serve as a crucial application of robotics and mechatronics in safety engineering. The design and implementation of an autonomous fire-fighting robot built using the Arduino Uno microcontroller platform.

II. FEATURES OF FIRE FIGHTING ROBOT

A fire-fighting robot typically includes a range of advanced features designed to detect, approach, and suppress fires safely and efficiently. Most models are equipped with flame, smoke, temperature, and gas sensors that allow the robot to identify fire hazards early and accurately. They often use autonomous navigation systems—such as infrared guidance, ultrasonic sensors, or LiDAR—to move through smoky or obstructed environments without human intervention. Many fire-fighting robots also feature heat-resistant materials, rugged wheels or tracks, and compact designs that help them access dangerous or confined spaces where firefighters cannot safely go. Additionally, they may carry fire-extinguishing mechanisms such as water sprayers, CO₂ systems, or dry chemical dispensers, and some include cameras or wireless communication modules that provide real-time visuals and data to operators. Collectively, these features enable the robot to support emergency responders, reduce risk, and improve the effectiveness of fire suppression operations.

III. CONCEPT

The concept of a fire-fighting robot revolves around creating an autonomous or remotely operated machine capable of detecting, analyzing, and extinguishing fires in hazardous environments. It is designed to serve as a safer alternative to human firefighters, especially in situations involving extreme heat, toxic smoke, or structural instability. The robot integrates sensors to identify flames, smoke, or high temperatures, along with navigation systems that allow it to move through dangerous areas with precision. Once a fire is detected, the robot activates its built-in extinguishing system—such as water, CO₂, or dry chemicals—to suppress the flames. The overall idea is to use robotics and automation to enhance firefighting efficiency, minimize human risk, and improve response time during emergency situations.

IV. OVERALL WORKING OF THE SYSTEM

The operational process of the robot involves several key stages:

- 1. Fire Detection:** The robot uses flame sensors (typically three or more IR-based sensors) that constantly scan the surroundings for the infrared (IR) light emitted by a fire. When a sensor detects IR radiation above a certain threshold, it sends a signal to the Arduino. The use of multiple sensors in different directions (left, center, right) allows the robot to determine the fire's general location or direction.
- 2. Decision Making (Arduino):** The Arduino Uno microcontroller receives and interprets the signals from the flame sensors. Based on the pre-programmed logic, it makes real-time decisions. If no fire is detected, the robot may move forward or remain in a standby/monitoring mode. If a fire is detected on the left or right, the Arduino commands the motors to turn the robot towards the flame source. If the fire is straight ahead (or all sensors detect the fire equally), the Arduino determines the robot is close enough to begin extinguishing.
- 3. Navigation and Movement:** The Arduino controls DC motors via a motor driver (like the L293D or L298N IC) to move the robot. The motor driver acts as an interface to provide sufficient current and voltage to the motors for movement, speed, and directional control. Some robots also incorporate ultrasonic sensors to detect and avoid obstacles during navigation.
- 4. Fire Extinguishing:** Once the robot is positioned correctly near the fire source, the Arduino activates the extinguishing system. A small water pump (or a fan, depending on the design) is typically used to spray water or blow air. A servo motor is often used to control the direction of the water nozzle, allowing it to sweep back and forth or adjust its angle to target the flame precisely until the fire is out.
- 5. Confirmation and Reset:** The sensors continue to monitor the area during the extinguishing process. When the flame sensors no longer detect fire, the Arduino turns off the pump and the robot returns to its monitoring state, ready to detect the next fire.

V. FUTURE SCOPE OF FIRE FIGHTING ROBOT

The future scope of fire-fighting robots is highly promising as advancements in robotics, artificial intelligence, and sensor technology continue to accelerate. Upcoming robots are expected to feature increased autonomy, allowing them to make real-time decisions, map complex environments, and coordinate with other robots during large-scale emergencies. Enhanced durability and heat-resistant materials will enable them to operate in more extreme conditions, while improved mobility—such as climbing abilities or drone integration—will allow access to areas unreachable by humans. Future models may also incorporate advanced communication systems for seamless interaction with fire departments, as well as predictive analytics to assess fire spread and structural risks. As smart cities and industrial automation expand, fire-fighting robots are likely to become an essential part of emergency response systems, significantly improving safety and reducing human exposure to life-threatening situations.

VI. CONCLUSION

In conclusion, fire-fighting robots represent a crucial technological advancement in modern emergency response, combining intelligent sensing, autonomous navigation, and effective fire-suppression systems to operate safely in environments too dangerous for humans. By reducing risk to firefighters, improving response times, and enhancing precision in locating and extinguishing fires, these robots play an increasingly important role in safeguarding lives and property. As technology continues to evolve, their capabilities will expand even further, making them indispensable tools in future firefighting operations and contributing significantly to overall disaster management and public safety.

REFERENCES

Books

1. J. Iovine, Arduino Robotics, New York, NY, USA: McGraw-Hill Education, 2013.
2. M. Margolis, Arduino Cookbook, 2nd ed., Sebastopol, CA, USA: O'Reilly Media, 2011.
3. T. Igoe, Making Things Talk: Using Sensors, Networks, and Arduino to See, Hear, and Feel Your World, Sebastopol, CA, USA: O'Reilly Media, 2007.

Research Papers

4. R. Kumar and S. Gupta, "Design and Implementation of Fire Fighting Robot," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (IJAREEIE), vol. 5, no. 5, 2016.
5. S. Patel and H. Shah, "Autonomous Fire Fighting Robot Using Arduino," International Journal of Engineering Research & Technology (IJERT), vol. 4, no. 12, 2015.
6. A. Sharma and P. Singh, "Arduino-Based Fire Fighting Robot with Obstacle Avoidance," International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET), 2017.

Online Resources

7. Arduino Official Website. [Online]. Available: <https://www.arduino.cc>
8. Circuit Basics, "Arduino Flame Sensor Tutorial." [Online]. Available: <https://www.circuitbasics.com/arduino-flame-sensor-tutorial/>
9. Electronic Wings, "Ultrasonic Sensor HC-SR04 Guide." [Online]. Available: <https://www.electronicwings.com/arduino/ultrasonic-sensor-hc-sr04>
10. Instructables, "Using Relay With Arduino." [Online]. Available: <https://www.instructables.com/Using-Relay-With-Arduino/>





INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details