# Automatic Fire Fighting Robot Car using Arduino

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**Abstract -** Fire incident is a disaster that can potentially cause the loss of life, property damage and permanent disability to the affected victim. Major fire accidents do occur in industries like nuclear power plants, petroleum refineries, gas tanks, chemical factories and other large-scale fire industries resulting in quite serious consequences. Thousands of people have lost their lives in such mishaps. Therefore, this project is enhanced to control fire through a robotic vehicle. With the advancement in the field of Robotics, human intervention is becoming less every day and robots are used widely for purpose of safety. In our day to day life fire accidents are very common and sometimes it becomes very difficult for fireman to save human life. In such case firefighting robot comes in picture.

***Key Words***: Firefighting Robot; IR Distance sensor; Flame sensor; OV7670 Camera Module; Arduino mega2560; DC motor; Driver module

## 1.INTRODUCTION

The introduction of a fire fighting robot car involves the development of advanced robotic systems designed to combat fires autonomously. These robots are equipped with various sensors, actuators, and firefighting mechanisms to detect, navigate, and extinguish fires effectively. Firefighting robots can take different forms, such as vehicles with water cannons, foam sprayers, or CO2 gas dispensers, and are capable of operating remotely or autonomously. They are equipped with cameras and sensors to detect fires, navigate through hazardous environments, and even perform search-and-rescue operations. The primary goal of these robots is to enhance firefighting safety and efficiency by replacing or assisting human firefighters in dangerous situations. Firefighting robots offer advantages like operating in hazardous environments, real-time fire monitoring, and access to locations where human intervention is challenging. These robots play a crucial role in firefighting, especially in scenarios where human lives Monica P Suresh; V R Vedha Rhythesh; J Dinesh [4] A basic design of robot that can fight fires at an affordable cost could prove to be boon in fighting domestic fires, till help arrives. The robot developed consists of three elements which is the hardware, electronic interfacing circuits, and software program. The robot has four battery operated motor (BO motor). This firefighting robotic system is capable of detecting and extinguishing fire. These robots can be made to roll into places where it is not safe for humans to enter. Time is of essence when it comes to fighting fires as even a few minutes' delay can turn small fires into raging inferno.at risk or in inaccessible areas. The introduction of fire fighting robot cars marks a paradigm shift in firefighting capabilities, offering a versatile and reliable solution for a wide range of applications. From urban fires to industrial incidents, forest wildfires to building collapses, these robots are poised to revolutionize the way we approach fire suppression and rescue operations.

As we delve deeper into the capabilities and potential of fire fighting robot cars, it becomes evident that they represent not just a technological advancement, but a beacon of hope in the ongoing battle against fire-related disasters. In this introduction, we will explore the key features, benefits, and implications of these remarkable machines, shedding light on their transformative impact on firefighting practices worldwide.

## 2. LITERATURE REVIEW

Krishan Arora; Harshit Kumar; Rohit Raj Singh [1] Firefighters risk their lives to save vulnerable people in the event of a fire. Firefighting robot designs have been proposed to reduce the loss of life for firefighters and citizens. Furthermore, currently used firefighting methods are inadequate and inefficient. In real life, fire hazards are unpredictable. It is better to extinguish the fire while it is small.

M. Mahalakshmi; V. Kokila; R. JeyaPreetha; S. Sankarakumar [2] It is a wellknown fact that, fire can spread quickly in the presence of flammable materials. There is a significant risk of the destruction of entities and lives. Furthermore, there is a chance that the firefighters, who are exposed to fire will get permanent injuries. Hence, to reduce the impact of fire on firefighters, this research study has developed a fire fighting vehicle, which will automatically extinguish a fire in the event of any firer-elated accident. When the flame sensors detect a fire, a signal will be sent to Arduino.

Sabari L Uma Maheshwari; R. Mohamed Atheeq [3] Most of the hearth accidents occurring in industries like nuclear energyplants, crude refineries, gas tanks, chemical factories and different large-scale fire industries, lead to serious consequences. With the advancement in the field of Robotics, human intervention is lowered each day and robots are used widely for the purpose of safety. Firefighting is a crucial however dangerous occupation. A firefighter should be able to reach the fire promptly and safely to extinguish it, avoiding further harm and reducing fatalities.

Monica P Suresh; V R Vedha Rhythesh; J Dinesh [4] A basic design of robot that can fight fires at an affordable cost could prove to be boon in fighting domestic fires, till help arrives. The robot developed consists of three elements which is the hardware, electronic interfacing circuits, and software program. The robot has four battery operated motor (BO motor). This firefighting robotic system is capable of detecting and extinguishing fire. These robots can be made to roll into places where it is not safe for humans to enter. Time is of

essence when it comes to fighting fires as even a few minutes' delay can turn small
fires into raging inferno.

Kalaivani AP Perumal; Musab A. M. Ali [5] have investigated that Fire fighter robot is a machine developed by humans to guard human live, because the accidents happening
during the fire extinguishing process is uncountable. This robot main function is to detect fire and move towards the fire automatically to extinguish it from a safe distance using
water. This robot's movement and behavior will be fully controlled by a programmable raspberry pi. This robot which will be in a form of vehicle will move right, left, front and back to detect and extinguish the fire. This fire fighter robot will also have a thermal camera and an infrared camera mounted over it.

## 3. HARDWARE AND SOFTWARE USED

**Hardware :**

- Arduino Uno
- Motor Driver
- Flame Sensor
- Dc Motor
- Water Pump
- Servo Motor
- Photo Diode

**Software :**

- Arduino IDE

## 4. METHODOLOGY

### 4.1 Working :

The firefighting robot car is designed to autonomously detect, navigate to, and extinguish fires. The key features and working principles are:

The robot is equipped with flame sensors, smoke sensors, and other detectors that can identify the presence and location of a fire.
The robot uses GPS, lidar, and other sensors to map its environment and navigate autonomously to the fire location. It can move towards the fire without human intervention.

The robot has a water tank, pump, and nozzle system that can spray water to extinguish the fire. Some models may also use foam or CO2 to combat the flames

While the robot can operate autonomously, it can also be controlled remotely by human operators. Cameras and sensors on the robot provide real-time feedback to the operators.

The robot is designed to withstand high temperatures and operate in hazardous environments, reducing the risk to human firefighters. It can access areas that are difficult or dangerous for people to reach.

Coordination with Human Firefighters: The robot is intended to work in conjunction with human firefighters, providing additional firefighting capabilities and reducing the overall risk. It can be deployed to the scene ahead of human responders the firefighting robot car leverages advanced sensors, autonomous navigation, and specialized firefighting equipment to detect, approach, and extinguish fires without endangering human lives. It is a valuable tool for enhancing the safety and effectiveness of firefighting operations.

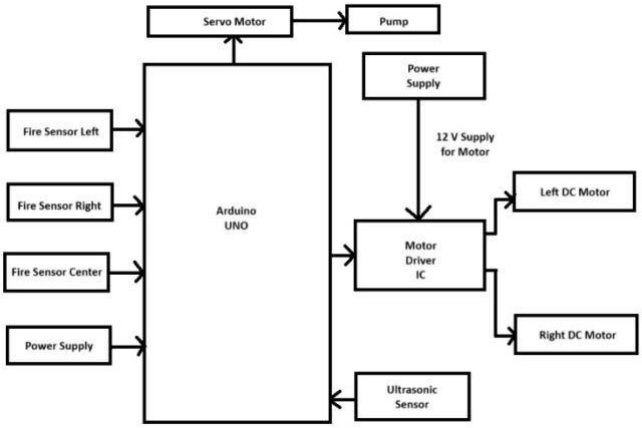


Fig.4.1.1 Block Diagram of Fire Fighting Robot

### 4.2 Flowchart

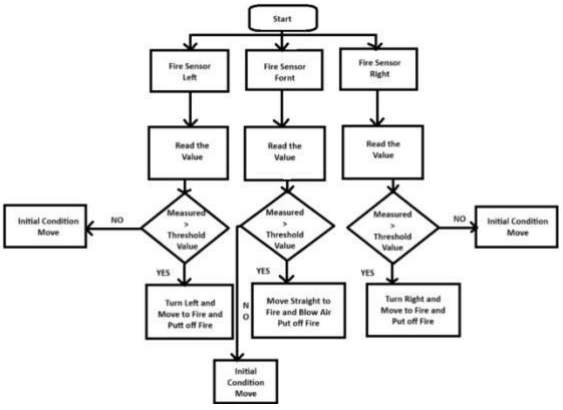


Fig.4.2.2 Flowchart of Fire Fighting Robot

The flow starts by initializing the ports of components. First the power supply should be on to the circuit and three sensorsare there one on middle and remaing two on right and
left side of chassis whenever the fire is occurred the respective value is read by the sensors when fire is occurred the voltage becomes zero and chassis is moved to the respective and Fire Fighting Robot Department of Electronics & Telecomm. Engg.20 put off fire whenever there is no fire then there is no input is occurred occurred voltage is more than 0 volts and the initial condition is move to other direction
The firefighting robot car operates based on a closed-loop control system. It uses various sensors to detect obstacles and flames in its surroundings. When an obstacle or flame is detected, the robot identifies the type of hazard using sensor data processing algorithms.
If a flame is detected, the robot navigates autonomously towards the fire location using path planning algorithms and simultaneous localization and mapping (SLAM) techniques. Once at the fire, the robot activates its fire extinguishing

system, which may include water cannons, foam sprayers, or CO2 gas dispensers.
The robot continuously monitors the fire status using thermal imaging cameras and flame sensors. If the fire is extinguished, the robot returns to its starting position. If the fire persists, the robot continues its extinguishing efforts.
If an obstacle is detected, the robot avoids the obstacle using obstacle avoidance algorithms and sensor fusion techniques. It then resumes its search for flames.
The robot's autonomous navigation is achieved through the use of GPS, lidar, and other sensors that map the environment and plan the optimal path.
The robot's movements are controlled by servo motors and wheels.
The robot is designed to withstand high temperatures and operate in hazardous environments. It can access areas that are difficult or dangerous for human firefighters to reach.
The firefighting robot car is intended to work in coordination with human firefighters, providing additional firefighting capabilities and reducing the overall risk. It can be deployed to the scene ahead of human responders to assess the situation and begin extinguishing efforts.

## 5. RESULT & DISCUSSION

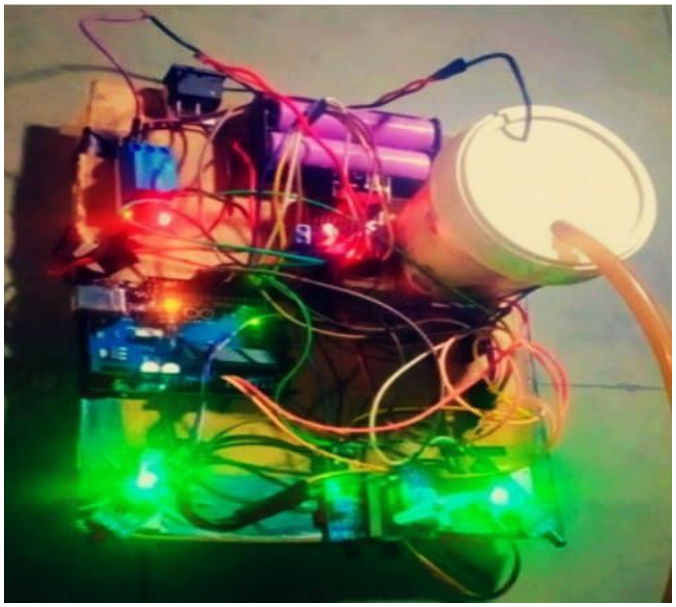

Fig.5.1 Result of Fire Fighting Robot

The results of our fire-fighting robot project showcase its effectiveness in detecting
and localizing fires using integrated sensors, including flame sensors, infrared sensors, and smoke detectors. The robot autonomously navigated through simulated fire scenarios, effectively avoiding obstacles while reaching fire locations efficiently, thanks to advanced algorithms for path planningand obstacle avoidance. Upon detecting fires, the robot deployed extinguishing agents with precision, utilizing
servo-controlled nozzles to suppress flames while minimizing water wastage. Extensive testing validated the robot's robust performance and reliability across various indoor and outdoor environments, with minimal downtime observed. Safety
protocols and fail-safe mechanisms were implemented to ensure safe operation,
while the modular design allows for scalability and future enhancements based on
feedback from testing sessions and user evaluations

## 6. ADVANTAGES AND APPLICATIONS

### 6.1 Advantages

The smart helmet offers several advantages that contribute to enhanced safety and convenience for motorcycle riders:

- Enhanced Safety: Fire-fighting robot cars reduce the risk to human firefighters by autonomously navigating hazardous environments, entering confined spaces, and approaching intense fire zones without exposing human lives to immediate danger.
- 24/7 Availability: Unlike human firefighters who require rest and downtime, fire-fighting robot cars can operate continuously, providing round-the-clock monitoring and response capabilities to mitigate fire hazards and prevent escalation.
  Using GPS, the smart helmet tracks rider location in real-time, ensuring accurate help arrives swiftly in emergencies.
- Equipped with sensors for early fire detection and autonomous navigation systems, robot cars can respond swiftly to fire incidents, minimizing response times and preventing the spread of flames
  before they become uncontrollable.
- Robot cars can access hard-to-reach or dangerous areas, such as burning buildings, industrial facilities, or forested terrain, where human intervention may be limited or restricted due to structural instability, chemical hazards, or environmental conditions
- By autonomously assessing the severity of fire incidents and deploying targeted firefighting measures, robot cars optimize the use of firefighting resources, such as water, foam, or dry chemical agents, reducing wastage and enhancing operational efficiency.

### 6.2 Applications

- In large industrial complexes where fires can be intense and
- hazardous, firefighting robot cars can navigate through tight spaces and harsh environments to reach the source of the fire quickly. They can carry firefighting equipment such as water cannons, foam sprayers, or dry chemical extinguishers to suppress the flames effectively.
- In densely populated urban areas, navigating fire trucks through traffic can be challenging and time consuming. Fire fighting robot
- Firefighting robot cars equipped with sensors and cameras can be used for search and rescue operations in environments with low visibility, such as dense smoke-filled buildings. They can help locate and identify trapped individuals, providing crucial information to rescue teams.
- In remote areas or rugged terrains prone to wildfires,

firefighting robot cars can be deployed for early detection and suppression. Equipped with thermal imaging

- They can patrol designated areas autonomously, detecting and extinguishing small fires before they escalate.

## 7. CONCLUSION& FUTURE SCOPE

### 7.1 Conclusion :

In conclusion, the development of fire-fighting robots represents a significant advancement in the field of firefighting and emergency response. These autonomous machines offer the potential to revolutionize fire suppression operations by providing enhanced efficiency, safety, and effectiveness. The research and development efforts discussed in this paper have highlighted the key components and technologies involved in the design of fire-fighting robots. These include advanced sensor systems for fire detection, intelligent navigation algorithms for autonomous movement, and multifunctional firefighting mechanisms for flame suppression.By integrating these technologies, fire-fighting robots can autonomously navigate through hazardous environments, detect fires with precision, and effectively extinguish flames, reducing the risks faced by human firefighters. By leveraging advanced technologies and continuous research, we can enhance the efficiency, effectiveness, and safety of fire suppression operations, ultimately saving lives, protecting property, and minimizing the devastating impact of fires on society. Continued research and collaboration in this field will contribute to the ongoing improvement and development of fire-fighting robots, leading us towards a safer and more resilient future.

### 7.2 Future Scope :

The Future Scope of Smart Helmet are given below:

- Future fire fighting robot cars are likely to become more autonomous, capable navigating complex environments and making real-time decisions based on sensor data and artificial intelligence algorithms. This could involve advanced path planning to optimize fire fighting strategies and adapt to dynamic fire conditions.
- Researchers may focus on improving the mobility and versatility of fire fighting robot cars, enabling them to traverse challenging terrains such as rough terrain, stairs, or rubble more effectively. This could involve the development of advance locomotion mechanisms, such as articulated legs or tracked systems, to enhance manoeuvrability.
- Researchers may explore the concept of collaborative robotics, where fire fighting robot cars work together with other robotic systems, drones, or human fire fighters to coordinate fire fighting efforts more effectively. This could involve the development of communication and coordination protocols to facilitate seamless collaboration between different agents.

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