

# Fire Extinguisher Robot

Shreya Dange<sup>1</sup>, Achal Battulwar<sup>2</sup>, Kirti Chandawar<sup>3</sup>, Shreya Besekar<sup>4</sup>, Prof. Manisha More<sup>5</sup>  
*Rajiv Gandhi College of Engineering, Research & Technology, Chandrapur*

**Abstract:** *Fire incidents pose significant threats, causing loss of life and property damage. Firefighters often encounter high-risk environments, such as nuclear plants and petroleum refineries, where hazards are particularly pronounced [1]. Technological advancements now allow the development of firefighting robots that can minimize human risk by autonomously detecting and extinguishing fires [2]. This paper presents an autonomous firefighting robot that utilizes ultrasonic and flame sensors to detect obstacles and fire, enabling remote operation. Results show that the robot accurately detects fire and avoids obstacles, offering a safer firefighting solution.*

**Keywords:** *Arduino UNO, Flame sensor, Motor Driver, Water pump.*

## 1. INTRODUCTION

One of the most important parameters in fire disaster is life, i.e. lives lost in saving someone else's life. It is sometimes impossible for fire-fighters' personnel to access the site of a fire because of explosive materials, smoke, and high temperatures. A fast response to detect the fire can avoid many disastrous things. From the given statistics (Fig.1), it is observed that fire can take place at domestic as well as at industrial level. A normal spark can generate a massive fire breakout. Not only the lives of industrial people but also the lives of domestic people are at risk because of poor fire management systems. Fire can take many lives and can injure many people for their lifetime. But it can be avoided using proper fire controlling methods. Fig-1: Causes of Fire Accidents

For such environments, a fire-fighting robot is proposed. In today's generation, a lot of robots are proposed and designed to remove the human factor from dangerous and deadly work. The use of robots is becoming very common that safely completes the labour-intensive or deadly work for human beings. A Fire Extinguishing Robot is based on IOT Technology. In the Fire Extinguishing robot, we intend to build a system that could extinguish a small flame by sensing and moving to the location itself. It will automatically detect the fire with the help of flame sensors. Once it detects the fire breakout location, it navigates itself accordingly to reach the fire source and extinguishes the fire by using built-in fire extinguishing systems. For fire detection, it is using

three flame sensors. First one for the left direction, second one for the forward direction and third one for the right direction. The fire extinguishing system will get activated when the fire detection system detects fire. It then reaches the breakout point and the water pump will start ejecting the water when it detects fire. The key features of this system is to provide surveillance of fire so that major fire accidents can be prevented and loss of human lives gets minimized.

## 2. PROBLEM FORMULATION

Fire disaster is one of the dangerous problems that can lead to heavy loss both financially and by taking lives. Sometime it becomes difficult for fighters to access the site of a fire because of explosive materials, smoke, and high temperatures. Such situations risk the lives of fire fighters too. In such environments, fire-fighting robots can be useful. This Fire Extinguishing Robot is based on IOT Technology. In the Fire Extinguishing Robot, we intend to build a system that could extinguish a small flame by sensing and moving to the location itself. Sometime delay in the arrival of fire fighters leads to numerous consequences. The Fire Extinguishing robot continuously monitors the environment and extinguishes it without delay.

## 3. METHODOLOGY

The theme of this paper is to automatically sense the environmental fire and extinguish it without human intervention. The methodology is divided into three parts. The first part is on the design structure, followed by hardware description and finally on the programming design. All these three parts were assembled together and experiments were then performed to build a system that can extinguish the fire that was carried out.

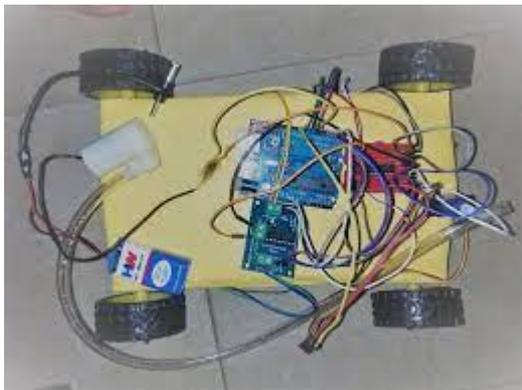
### 3.1 Design Structure

In this section, the prototype of the robotic system is presented, in which it consists of IR flame sensors, servo motors, submersible water pump, motor driver, mini breadboard, BO motors, rubber wheels, processor, and communication module for

exchanging data between the fire-fighting robot and Arduino software. Fig 2 shows the basic prototype of our firefighting robot. The robot carries four main functions: First, it initializes itself i.e. its sensors gets initializes as the power is supplied. Second, robot sense the surrounding environment (for instance for the level of temperature) and identify the fireplace. Third, robot sends the navigating information and starts to navigate itself towards the fireplace. Fourth, finally the robot starts to extinguish the fire with the help of servo motors and submersible water pump.



Fig-3: Arduino UNO



3.2 Hardware Implementation

The hardware part is one of the crucial parts in the development of firefighting robot. It includes Arduino UNO, IR flame sensors, servo motors, submersible water pump, motor driver, mini breadboard, BO motors, and rubber wheels. Fig 3 shows the block diagram of firefighting robot which consists of three IR flame sensors as the input of the system. Arduino UNO is used as a micro-controller that connects other components. L293D Motor driver is used to drive motors and is capable of running two DC motors (Left DC motor and Right DC motor) at the same time.

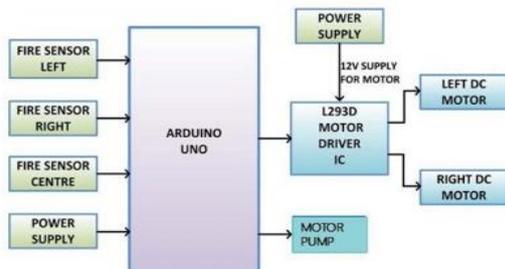


Fig-2: Block Diagram of Fire Fighting Robot

### 3.3 HARDWARE USED:

#### 1. ATmega328P IC(Arduino UNO):

Fig 3. Shows the Arduino UNO board. It is basically a micro-controller kit that is used to get data from peripheral devices (sensors, motors, etc.). The Arduino UNO Micro-controller board is based on the ATmega328P IC. The ATmega328P is good platform for robotics application which makes robot to extinguish fire in real time. Arduino UNO board consist the sets of digital and analog pins that may act as an interface to various expansion boards and other circuits. It contains everything needed to support the microcontroller.

#### 2. IR Flame Sensor:

Fig 4 shows the IR Flame Sensor. The IR flame sensor senses the environment and detects the presence of fire or flame. The module is based on the IR receiver and basically detects the presence of flammable and harmful gases likes nitrogen, hydrogen, carbon mono oxide. The signal detection capacity is adjustable. The robot contains three flame sensors.

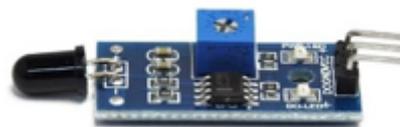


Fig-4: IR Flame Sensor

#### 3. L293D Motor Driver:

Fig 5 shows the L293D Motor Driver. L293D is a Motor Driver or Motor Driver IC which is responsible for the movement of DC motor on either direction. L293D is a 16-pin IC through which we are able to run two DC motors simultaneously in any direction.



Fig-5: L293D Motor Driver



Fig-8: BO Motor

#### 4. Servo Motors:

Fig 6 shows the Servo Motors. Servo Motors are electronic devices that are mainly used for providing specific velocity and acceleration.



Fig-6: Servo Motor

#### 5. Submersible Water Pump:

Fig 7 shows the Submersible Water Pump. Submersible Water Pump is ideal for making automatic watering system using Arduino. The water pump is an important part of the robot as it will pump water to extinguish the fire.



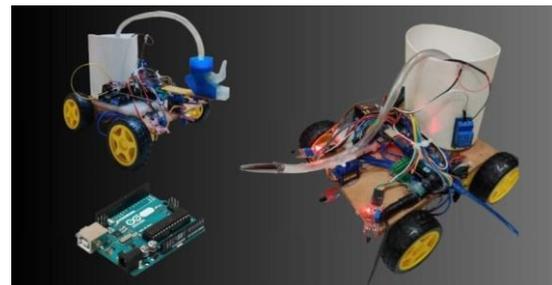
Fig-7: Submersible Water Pump

#### 6. BO Motors:

Fig 8 shows the BO Motor. BO Motor is a dual shaft motor having 300rpm. It converts electrical energy into mechanical energy. It is the replacement to our metal gear DC motors. Our robot uses four dual shaft motors.

#### 4. RESULT DISCUSSION

Fire Fighting Robot has developed to reduce human life lost and to develop such a device that automatically sense fire and extinguish it without human intervention. In this the fireplace is detected using the IR Flame sensors and are connected to Arduino UNO, which control the movement of Motor drive that helps the robot to reach the fireplace and extinguishes it with the pumping mechanisms. In the industry if any fire accident occurs, there is a need of person to monitor continuously and rectify it. In this process if any time delay takes place irreparable loss occurs in industry. The firefighting robot continuously monitors the surrounding and helps in extinguishing the fire. Fig 11 shows the overall prototype of Fire Fighting Robot.



#### 5. CONCLUSION

This model of Fire Extinguishing Robot aids to share out the burden of fire fighters in firefighting task. Our project aims to build a real time firefighting robot which moves in a constant speed, identify the fire and then extinguish it with the help of pumping mechanism. The detection and extinguishing was done with the help basic hardware components attached with the robot. Firstly, IR Flame sensors are used for the detection of fire. Secondly, BO Motors and Rubber wheels are used to navigate the robot to reach the fireplace. Finally, the robot extinguishes the fire with the help of submersible water pump and servo motors.

#### 6. REFERENCES

- [1] Tawfiqur Rakib, M. A. Rashid Sarkar, “Design and fabrication of an autonomous firefighting robot with multi sensor fire detection using PID controller”, ICIEV Volumn 23 issue-1 JUNE 2016.
- [2] Saravanan P. ,Soni Ishawarya, “Android controlled intergrated semi-autonomous firefighting robot”, Ineternational journal of innovative science Engg. and Technology 2015.
- [3] S. Jakthi Priyanka,R. Sangeetha, “Android controlled firefighting robot”,Ineternational journal of innovative science Engg. and Technology ,Volumn 3, 2017.
- [4] Nagesh MS, Deepika T V , Stafford Michahial, Dr M Shivakumar, “Fire Extinguishing Robot”, International Journal of Advanced Research in Computer and Communication Engineering, Vol. 5, Issue 12, December 2016
- [5] Sushrut Khajuria, Rakesh Johar, Varenyam Sharma, Abhideep Bhatti, “ Arduino Based Fire Fighter Robot”,International Journal of Scientific Engineering and Research (IJSER),Volume 5 Issue 5, May 2017
- [6] Khaled Sailan, Prof. Dr. Ing. Klaus- Dieter Kuhnert “Obstacle avoidance strategy using fuzzy logic steering control of amphibious autonomous vehicle”, International journal of innovative science Engg. and Technology ,Volumn 2, 2015
- [7] J Jalani1 , D Misman1 , A S Sadun1 and L C Hong1,“Automatic fire fighting robot with notification”,IOP Conference Series: Materials Science and Engineering, Volume 637, The 3rd International Conference on Robotics and Mechantronics (ICRoM 2019) 9–11 August 2019, Sabah, Malaysia