

## Automatic Fire Extinguishing Robot

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### Abstract

*In today's world there are a lot of fire accidents which happens in various places such as home, food industries, steel industries, chemical industries and so on. These fire accidents cause many losses which includes infrastructural loss, economical loss and also human loss, which must be taken into consideration to provide a better solution. This paper proposes a model where a fire extinguishing robot is framed in which it moves forward and backward to detect the fire. The robot is also developed in such a way that it can climb the stairs as well. Once the fire is detected it moves toward the fire automatically and extinguishes the fire by spraying water on it. The system is also designed to climb the steps, so that it can also climb on any obstacles or move on bumpy areas. The robot is controlled by a programmable raspberry pi.*

**Keywords:** movement, climbing, detection, spraying, extinguishing

### 1. Introduction

In today's fast-growing technological world, it is hard for humans to do all the tasks every time on their own. Humans work in various sectors to revolutionize today's world. People cannot risk their life to do dangerous and crucial jobs always. Technologies are used to reduce human work and make their life comfortable. Robots are electro-mechanical devices which follow a set of instructions to make certain tasks automatically without much human intervention that has been assigned [1]. These systems contain manipulators, sensors and software all working together to do a task [2-4]. Robots are more commonly used in handling dangerous tasks [5]. This paper focuses on framing a robot that can be used to extinguish the fire in any location such as factories or homes.

### 2. Related works

Lakshay Arora et al (2015)[1] had the idea of controlling a robot through the cell phone by making a call. During the call period if a button is touched, a tone corresponds to the sound of button is heard at the body of robot. Dual-tone multiple-frequency (DTMF). Is the process used here. The robot performs according to the action given from the microcontroller.

E.V.Sivakumar et al (2016) [2] proposed the idea of controlling the robot through voice recognition. The robot has a camera fitted to view the scenario on the screen and make the movement through the user's voice. The quality of voice is a major issue here.

David Fernando et al (2019) [4] proposed extinguishing technology that extinguishes the fire without firefighters. Qrob is programmed to find the location of fire at a particular distance.

Mangayarkarasi et al [3] proposed the idea of Radio Frequency based remote sending user's instructions from end to end Radio Frequency signals which are captured by the receiver circuit. At client it interprets the commands transmitted.

Kristi Kosasih, E. Merry Sartika, M. Jimmy Hasugian, dan Muliady et al [6], proposed the Robot which can be moved towards the required direction according to the given voice command. This project describes a new economical solution of robot control systems.

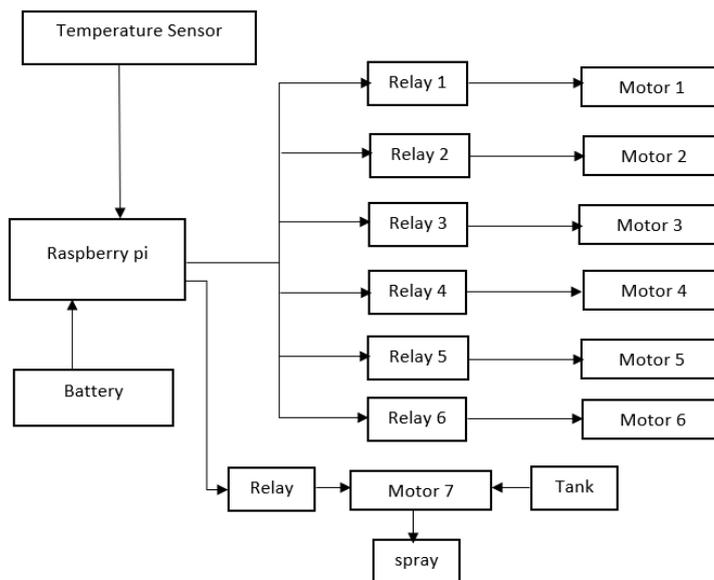
### 3. Existing method

The development in various sectors and the increase in industries causes fire accidents by mistake in various places. These accidents lead to a lot of losses for which precautions and an alternate solution has to be provided. In existing system, in case if there is an outburst of fire it would be intimated to the fire extinguishing service department. The service men have to come to the location and spray fire through pipes on the building. The water is sprayed only through the window and also in the existing system the fire sprinklers are used inside the building to extinguish the fire. This method is not feasible. The robot is controlled either through the mobile phone or with the help of a remote using camera[7].

### 4. Proposed method

This method proposes a system where a robot is framed to make it move towards the fire either forward or backwards or also move towards left or right, and extinguish the fire by spraying on it[8-11]. The robot carries a water tanker whose capacity is up to 5 litres is framed initially, which is placed on it. Also, the system is framed in such a way that it can climb the steps on carrying the water tank. It is programmed with the help of raspberry pi to find the location of fire at a particular distance[12]. The fire is turned off by spraying on the fire. This results in safety and a feasible process.

### 5. Working



**Figure 1. Block diagram of the process**

In this block there are seven motors used. Each motor is connected with a relay to provide the required amount of power. Motor 1, Motor 2, Motor 3 are considered to be on one side and Motor 4, Motor 5 and motor 6 are on the other side. Motor 3 and 6 are fixed whereas the shaft connecting the motor 1,2,4,5 are movable which is used to climb stairs. Raspberry pi is used to control the entire process. It gets input from the temperature sensor and operates accordingly. The motor 7 is used to pump water and is connected with a relay as well.

The fire might be surrounded in all directions, so it is necessary for the robot to move towards the left and right side. The fire can be detected using the temperature sensor which responds to the change in temperature. Depending on the temperature the system moves. The left side of the three wheels are made to be static at the same time the right side of the three wheels are made to move which results in the turning of the robot. The left of the three wheels are

considered to be series one, whereas the right side of the three wheels are considered to be series two. This results in the turning of the robot by sensing the fire. Relay is used for better performance. The electric motor switches are controlled by the relay.

**Table1. Components and their Specification**

Components	Specification
Motor	50 Rpm
Elbow pvc pipe	45 degree
Battery	12 volt
Relay	12 volt
Regulator IC	5V
Thermistor	NTC

**Table 2. Physical setup and their parameters**

Physical Setup	Parameters
Water tank capacity	2.5 Liters
Fire detection distance	35 centimetre
Step climbing Height	15centimetre(6inches)
Spraying distance	2 to 2.5 meters
Type of fire extinguished	Normal fire

**Table 3. Software and programming Language**

Requirements	Software Used
OS	Raspbian
Programming Language	Python

The Operating System used for the working of Raspberry pi B+ is Raspbian. The motor used here is 50 rpm (rotations per minute) which is effective to carry the water tank whose capacity is up to 3.5 liters. The two battery's capacity of 12V each are used for the operation of the six motors connected to it. An Regulator IC of 5V is used as the Raspberry pi B+ accepts an input voltage of 5V. In the use of 12 V relay, one end is connected to the 12V DC supply whereas the

other end is grounded. The elbow pipe of angle 45 degree is used which is the angle between the front leg and middle leg to ensure the climbing of step process. This design helps in climbing the stairs whose height is about to be 15cm(6 inches). Through the temperature sensor which is the NTC thermistor the fire can be detected up to a distance of 35cm. Once the fire is detected the robot is stopped and the water is sprayed up to a distance of 2.5 meters. When the supply voltage is other than the rated voltage, a set of relays sense the voltage variations and controls the load circuit with the help of circuit breakers.

Raspbian is the recommended operating system for normal use on a Raspberry Pi. Raspbian is a free operating system based on Debian, optimized for the Raspberry Pi hardware. Raspbian comes with over 35,000 packages, precompiled software bundled in a nice format for easy installation on your Raspberry Pi [13-14]. To use Raspbian it should be booted in the memory card and it can be connected to a computer instead of using CPU or it can be connected to the laptop using a VNC viewer. To create connection between laptop and raspberry pi VNC option should be enabled in it. Then connect to the system. The Raspbian contains more options and many programming languages. Python is one of the programming languages which can be used in Raspbian [14].

### 5.1. Step climbing process

The robot is framed in such a way that it can climb the stairs or to pass by any small obstacle [15]. The robot consists of six legs which are two front, two middle and two back legs. The system is designed in such a way that the front and middle legs are together. The front leg and the middle leg and attached together with the holes given using M4 nuts and bolts. The base plate is set at the top. The base plate consists of the main body. The processor is placed on the plate. The pair of legs are attached to each side using nuts and bolts. The six legs are attached to six motors to make the movement. The tyres of the wheels is designed to have a strong grip to ensure stability of the movement. The wheels are attached to each of the motors to ensure the proper moment and climbing of the robot. A series of male to male and male to female jumpers are taken, the one that fits between the two legs and fixed by using M3 nuts to the legs. standoffs are used to attach the motors to the skeleton. This will keep the legs stable. The powerhouse in our case is none other than the Battery. Connect the Lithium polymer Battery to VIN of revive.

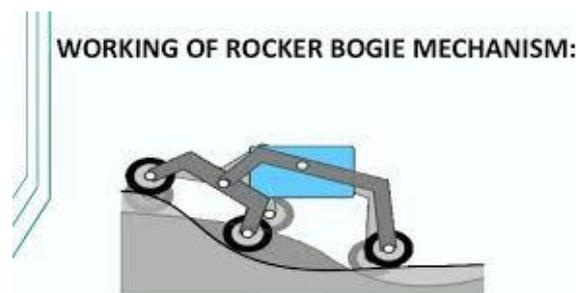
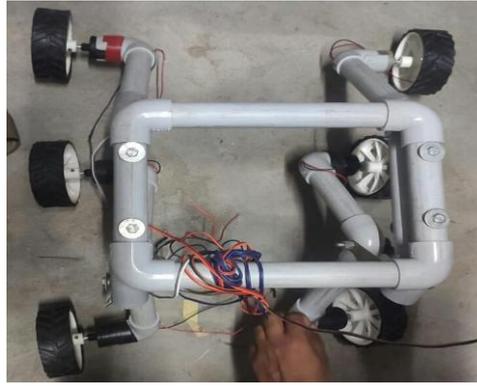


Figure 2. Model of movement of the robot

### 5.2. Movement

The robot has to be moved on its own during fire break out, so that it is effective at the situation. The movement is done by detecting the fire. It moves to the place where there is fire. The path which the robot takes depends on the tracking of fire and the movement is done using the gear motors. The movement toward a place is verified by outrageous warmth because of a flame. There is a chance that whenever there is a fire then the amount of warmth increases, which will be reduced by water to the fire. The flame detector is also used here which is used to detect and respond to the flame. The flame detector is used as it responds fastly and more accurately than heat or smoke detector. The input from the sensor is processed by raspberry pi.



**Figure 3. The setup for the movement of robot**

Figure 3 represents the base model for the system and the working process of the base is explained above.

### **6. Raspberry pi**

It is a small sized computer which is developed in the United Kingdom and widely used to learn Computer knowledge and in developing countries. The raspberry pi has come to a lot of versions. It has a USB port which is directly connected to the System on a chip (SoC)[14-15]. Each version of Raspberry pi work on different operating frequencies. Here Raspberry pi B+ is used.



**Figure 4. Raspberry pi B**

### **7. Extinguishing fire**

The robot carries a water tanker which is placed on it. The power motor which is used here is efficient enough to carry the load. A separate motor is fixed into the tank to pump the water out. Once the fire is detected, the robot does not move and all the other are made to become stable. The movement is stopped so that the water is sprayed from the required distance and to spray water for a longer time.

## 8. Result



**Figure 5. The fire extinguishing robot**

The output is gained as the robot moves automatically towards the front or moves left or right detecting the fire. The figure 5 is the developed system for the fire extinguishing process. Once the fire is detected the robot starts spraying on the fire from a safer distance. Both the process of extinguishing and detection is done at the same time which saves time and results in high effectiveness. The fire is turned off by spraying on the fire from a safer distance.



**Figure 6. Climbing process**

Figure 6 shows the system claiming the staircase which works under the concept of Rocker Bogie mechanism.

## 9. Conclusion

Thus, this robot helps in saving the firemen who risk their life each time which might cause death at any time. This helps in saving the interior property resulting in the best benefits. The automatic extinguishing of fire is successfully done with the cheap components that are available in the market such as Raspberry Pi, motor, thermistor and regulator IC. This also reduces the time of intimation and immediate action is taken at the exact time.

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