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# Python Program-Based Mobile Robot For Firefighting Application

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**ABSTRACT**

The most common and uncontrollable heavy loss that occurs in industries and many places is the accident due to fire. In some cases, the latest technologies prevent most fire accidents, like automatic fire extinguishers and water sprinklers. But still, there is no direct source of fighting the fire when it emerges. Also, most fire accidents can be prevented if a firefighter can extinguish the fire in the middle of the accidental areas. In this research, a robot is designed which runs on the python program. The robot can penetrate the fire and release the carbon-di-oxide, which can extinguish the fire. It detects fire accidents at the early stage and avoids accidents. With the help of this robot, the firefighting officer can fight against the fire and perform better to get rid of the fire. This robot will help prevent fire at factories that occurs due to accidents.

**Keywords**: Robot, Python, Sensor, fire extinguishing.

## 1. Introduction

Prevention of fire accidents is a major important concern in recent days. The accidents like fire in the industry can cost the lives of many living beings [1]. Also, the certificate of International safety standards is ensured by following proper safety considerations in the industry [2]. Fire accidents in the industry not only affect the industry but also damages the entire surroundings of a few kilometres [3].

Recently, automation has played a major role in providing the proper safety aspects in the industry [4]. Automatic temperature monitoring and taking the necessary actions for controlling the temperature play a key role in the safety aspects of automation [5]. This sophisticated monitoring is achieved with the blessing of the Internet of Things through the sensor [6]. With the sensors, the Robots are made to learn about the environment and can take preventive action without a human interface [7]. The obstacle in the robot's path is detected using the proximity sensor, and the program helps the robot move in a collision-free path. In industry, mobile robots save the idle time of the machinery and increase production time and cost [8]. Also, it reduces the workforce needed for performing complex operations. Recently, these autonomous robots are

employed to extingusish fire and improve the environment's safety [9]. In one research, a robot is developed to create an alarm and move around the various sections in the industry to communicate the fire accident.

In one research, a robot is operated using Bluetooth communication to reach the fire location [10]. The drawback of the system is the limited operation of Bluetooth coverage. The device effectively works within a 5-meter distance and is suitable for small applications, but the system may fail to provide the service in a larger area [11].

Recently, the internet of things has been developed, which can help the robot move automatically with the environment inputs about the environment. The surrounding details are provided by using the sensors placed on the robot[1], [12], [13]. In one research, an IOT-based fire signal is designed to notify the nearby police station and fire service office about the details of the fire. The robot functions without human involvement and is the achievement of the Internet of Things. In one research, fire accidents are predicted to avoid huge losses by detecting the harmful gas present in the environment. In this research, a robot is designed for fire extinguishing in industry. The robot is programmed using python to vary the speed of rotation of the robot's wheels [12]. The proposed robot has five characteristics: hardware layer, network communication layer, sensor layer, application and infrastructural layer [14]. The major objective of the robot is further represented in a bulletin below.

- Design and testing of an autonomous robot.
- Fire extinguishing uses the release of carbon dioxide gas into the atmosphere
- Helping the people at fire accidents.

The various sensors like gas, temperature and flame sensor, proximity, and Speed sensors are embedded within the robot to make the robot function autonomous. The proposed system works by input from the flame sensor. The information is sent to the Arduino board when the flame sensor and temperature sensor detects the fire and raises the temperature. The Arduino board sends the signal to the Raspberry Pi 4, and the python command operates the robot from the computer. After reaching the spot, the motor pumps the water and carbon dioxide gas is released to extinguish the fire.

## 2. System Architecture

The various temperature and flame sensors are placed at the various corners of the room to detect the fire and the temperature rise. When the flame sensor detects the input, that is when the fire is detected, the sensor communicates to the Ardunio processor using the Wifi module. After receiving the signal, the Arduino board is communicated to the Raspberry pi 4. The robot motor then activates the Raspberry pi. The Python program establishes the signal to reach the particular location. During the robot's movement, if there are any obstacles, it is detected by the IR sensor, and the robot moves in a way to avoid collision. After reaching the location, the robot releases the water from the pump and the carbon dioxide gas on the fire. In this way, the fire is eradicated. The working of the entire proposed system is shown in figure 1 as a block diagram. During the robot, the

instruction about the location and the temperature and flame intensity of the room is monitored from the local computer. Also, the obstacles to reaching the location are continuously monitored using the sensor on the computer.

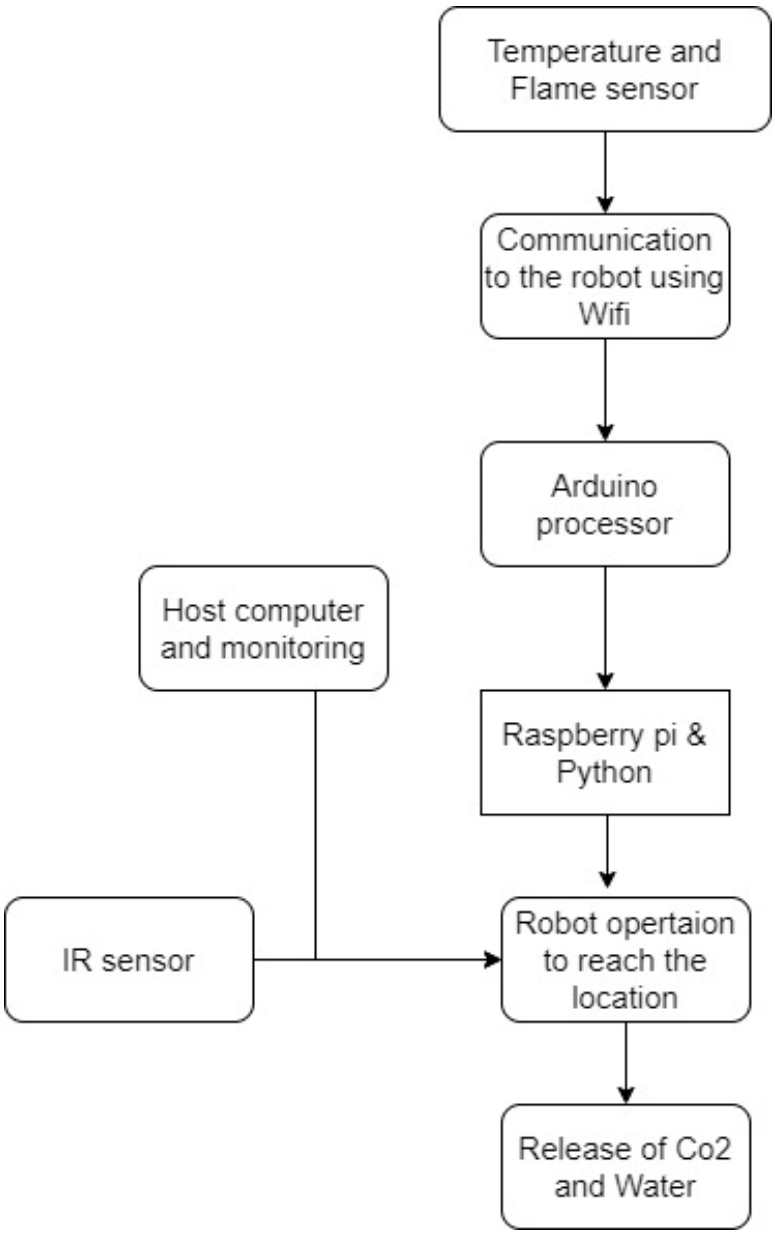


**Figure 1 working of the fire robot**

## 3. Implementation and testing

The temperature and flame sensor nodes are placed at different locations inside the room. The sensor transmits the signal to the Raspberry Pi 4 processor using the wifi module. When the fire has been detected, the signal from the sensor is transmitted to the Raspberry Pi. The robot is activated immediately to extinguish the fire within the signal received.

### 3.1 Various hardware and software requirements are needed for the system

The hardware and sensor components used in the system are temperature and gas sensors, an Arduino board, a Wifi module, Raspberry Pi 4, an IR sensor, a Servo motor for the robot movement and cables. The Arduino controller's main function is transmitting the sensor signal to the Raspberry Pi operating system. Figure 2 shows the fabricated prototype of the mobile robot with the inbuilt processor. The power source of a 5V rechargeable battery is attached to the robot. Figure 3 shows the sample python program used to run the servo motor of the mobile robot.

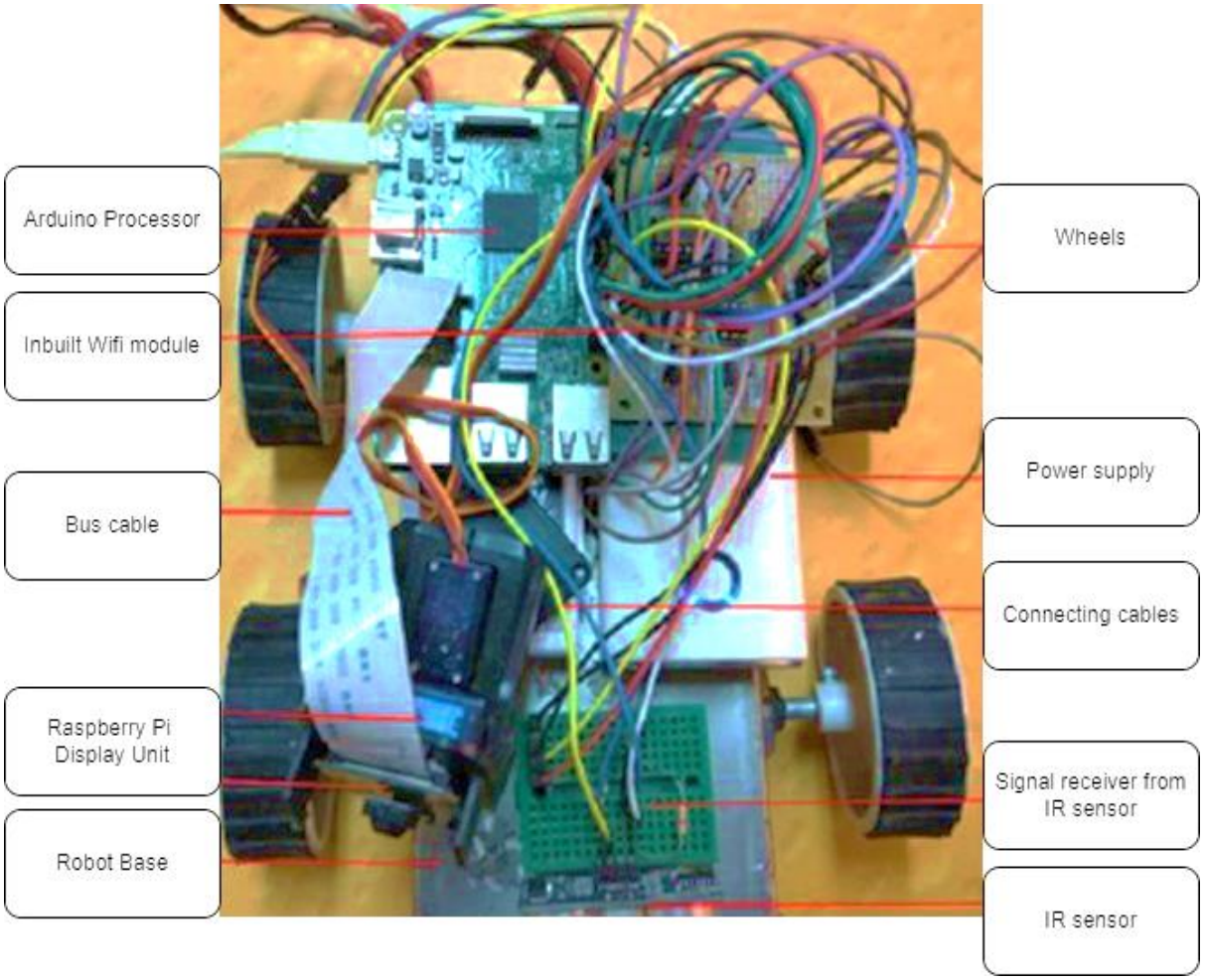


**Figure 2 Fabricated robot with the various components**

```
import RPi.GPIO as GPIO
import time

control = [5,5.5,6,6.5,7,7.5,8,8.5,9,9.5,10]

servo = 22

GPIO.setmode(GPIO.BOARD)

GPIO.setup(servo,GPIO.OUT)
# in servo motor,
# 1ms pulse for 0 degree (LEFT)
# 1.5ms pulse for 90 degree (MIDDLE)
# 2ms pulse for 180 degree (RIGHT)

# so for 50hz, one frequency is 20ms
# duty cycle for 0 degree = (1/20)*100 = 5%
# duty cycle for 90 degree = (1.5/20)*100 = 7.5%
# duty cycle for 180 degree = (2/20)*100 = 10%

p=GPIO.PWM(servo,50)# 50hz frequency

p.start(2.5)# starting duty cycle ( it set the servo to 0 degree )


try:
while True:
for x in range(11):
p.ChangeDutyCycle(control[x])
time.sleep(0.03)
print x

for x in range(9,0,-1):
p.ChangeDutyCycle(control[x])
time.sleep(0.03)
print x

except KeyboardInterrupt:
GPIO.cleanup()
```

**Figure 3 Python program for the operation of servo motor**

The nodes of 10 temperature and flame sensors are placed in a room of 20*20 feet. The signal from each sensor is transmitted continuously to the Arduino processor using the Wifi module. After receiving the signal, Ardunio communicates to the Raspberry Pi 4 to operate the servo motor using the python program (sample code shown in figure 3).

The robot is directed to the particular location where the fire accident occurred using the IR sensor as an input to detect the obstacle. After reaching the location, the high-pressured carbon monoxide gas is delivered to the fire to extinguish. Along with the gas, higher pressure water is transmitted to the accidental area to extinguish the fire. The proposed robot is tested with the fire scenario and operates with higher efficiency.

## CONCLUSION

In the present research, the fire accidental prevention robot is designed with a simple circuit with higher efficiency. The various components used for the research are temperature and gas sensors, an Arduino board, a Wifi module, Raspberry Pi 4, an IR sensor, a Servo motor for the robot movement and cables. The robot is built and tested with the components in the fire operating condition. The robot immediately responds to the sensor input and reaches the location more accurately. This kind of simple robot is useful in industries to avoid fire accidents. Integration of certain machine learning and computational intelligence frameworks, as well as additional sensors, may be included in future work to improve the system's performance accuracy. The use of machine learning techniques to forecast fire accidents will greatly improve the effectiveness of this IoRT system.

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