Design and Development of Fire Extinguisher Robot

Rageeni Dawale[1], Prachi Dudhe[2], Satyajeet Borate[3], Aadesh Deshmukh[4], Mr. Sugat Pawar[5]

[1,2,3,4,5] Electronics and Telecommunication, AISSMS's Institute of Information Technology, Maharashtra, India
Corresponding Author: Rageeni Dawale (rageenidawale@gmail.com)

Article Information	ABSTRACT
	Around 10 thousand fire mishaps are recorded each year, with the number of deaths being quite significant. Fire extinguishing becomes a major concern as the involvement of humans to extinguish fires may lead to further casualties. It is also important that we make sure that small fires are extinguished before they lead to larger accidents. This paper describes the design and development of a fire-extinguishing robot using the Internet of Things. The firefighting robot will be able to detect fires and extinguish them effectively. The robot will use sensors to detect any sight of fire. It will notify the user using the Blynk app and the user will be able to navigate the robot and pump water on the site. This robotic system can be highly useful in protecting industrial or residential property by detecting and extinguishing the fire before it reaches a dangerous level.

1. INTRODUCTION

The main reason we need a firefighting robot is to douse fire mishaps and extinguish fires at an initial stage, thus preventing huge infrastructure damage and saving lives. The lack of fire-fighting talents among the general population raises the prospect of a massive disaster. When addressing a fire, two factors are critical: speed, and safety. When a fire develops, it becomes difficult for firemen to assess the situation without risking their lives.

Access to the fire-affected area is often impossible for firefighter personnel. As a result, firefighters' quickness and safety are called into doubt. A firefighting robot, on the other hand, can assist in overcoming this issue. We can use a firefighting robot as an alternative to firemen as it is immune to smoke and can be used to detect and extinguish the fire at a very early stage - which might be difficult to perform with human competence.

We, the students of AISSMS's Institute of Information Technology, Pune have proposed a system that is a wireless manually controlled smart firefighting robot that can be controlled by the user remotely using an android application using the Internet of Things.

The robot is equipped with various sensors that can detect flame and higher temperature and extinguish the fire (if any) by pumping water using a servo motor using an inbuilt water tank. With the use of the servo motor, we can ensure that water is sprayed only on the site of the fire and not elsewhere thus allowing us to save water and making it an efficient choice.

2. LITERATURE SURVEY

Jong-Hwan Kim [1] (2016) submitted a paper on "Feature Selection for Intelligent Firefighting Robot Classification of Fire, Smoke, and Thermal Reflections Using Thermal Infrared Images" where they built a humanoid robot that can locate the fire which is not in view of the robot. They used smoke sensors to detect smoke and an infrared camera that can produce thermal images to give an accurate site of the fire. The humanoid has been tested for various types of fires caused by different objects, hence having a range of different temperatures. With the use of all these features, the humanoid can extinguish fires of any scale effectively.

Md. Anowar Hossain [2] (2011) presented a paper on "Design and Implementation of an IoT Based Firefighting and Affected Area Monitoring Robot" built a model using the Internet of Things that was both manual and automatic, which could detect the fireplace using a gas sensor that detects the presence of flammable gases. The use of flame sensor, gas sensor, IR sensor, temperature, and humidity sensor has been done. Infrared sensors are used to detect human presence at the site. The robot can navigate itself to the site of the fire but the user can control it using a joystick too. All the data captured by the robot is sent to the cloud using wifi for future investigation.

Md. Mahmudul Hasan [3] (2020) submitted a paper on "A multi-sensor-based fire-fighting robot with wireless control and visual system" developed an android app for a system that is autonomous and can be controlled manually as well. This model used flame sensors and ultrasonic sensors to sense the fire. Arduino has been used to process the data detected from the sensor and uses motors to navigate to the site and extinguish the fire. A wifi module was used to command through the server which made it possible to control the device from anywhere in the world. The use of multiple sensors makes this model efficient at detecting fires. This model has proposed the use of potassium carbonate that has proved to be an alternative to the use of water to extinguish fires.

S. Kavitha [4] (2021) presented a paper on the "Fire Fighting Robot" which built a model that was both autonomous and manual. The paper presented a device that uses ARM7, a wifi module (Node-MCU) for mobile communication, and BLYNK/TCP for mobile control. Applications used for the development of this project were Flash Magic and embedded C.

Arthi Udayakumar [5] (2018) submitted a paper on "Multipurpose Robotic Car Using Arduino Based On IoT" built a robot that senses fire, harmful gases, and also detects humans. It is an Arduino-based model that uses the Internet of Things. It has used the concept of a global system for mobile communication (GSM). This robot has been made specifically for places like coal mines where there are chances of poisonous gas leaks. As this robot can detect the presence of humans, it makes it easier to rescue any humans that might be trapped at the site of the accident.

Teh Nam Khoon [6] (2012) presented a paper on "Autonomous Fire Fighting Mobile Platform" which discussed a model that used obstacle avoidance techniques and uses various sensors that can lead the robot to the precise location of the fire and extinguish it.

Sandip Gupta [7] (2017) submitted a paper on "Manually Controlled Enhanced Wireless Intelligent Fire Fighting Robot" built a robot that can detect a flame, temperature, and humidity. It can also determine the distance between the obstruction and the robot. The robot can then extinguish the fire (if present) with the help of a DC fan. The robot uses a raspberry pi as its main controller. A webcam is installed in the model so that the view can be monitored by the user. When the fire is detected, the robot navigates itself and extinguishes the fire using a servo motor and a pump. The user is notified about the fire through Gmail or the Telegram app (mobile application).

3. METHODOLOGY

IR sensors are used to measure the heat of an object as well as to detect the motion and track of fire to be extinguished. These sensors will show a change in voltage which will be recorded by the Wi-Fi module. Wi-Fi module is used to control the fire-extinguishing robot through the Blynk app. Using this app, we can control the robot from anywhere in the world. The buzzer is used in the robot which gives out an alarm whenever the fire extinguishing robot senses the possibility of fire to alert people about the fire. The user will control the robot and move it to the site of the fire. DC motors are used to drive the robotic fire extinguishing car to follow the track of the fire.
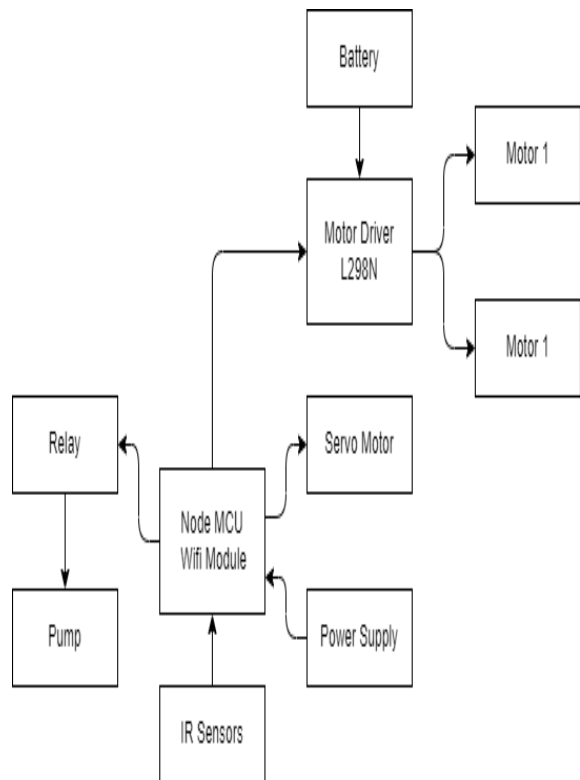

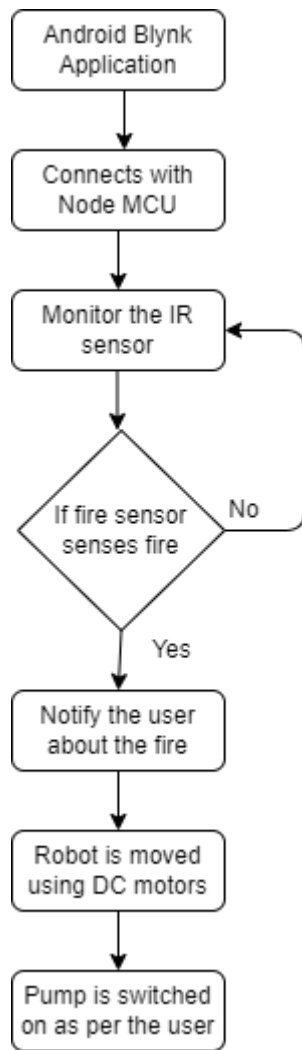**Fig. 1.** Block Diagram of the Fire-extinguishing Robot

Fig. 2 Flowchart of the Fire-extinguishing Robot

The pump is used to spray water at the site to extinguish the fire. This water pumping module is used for maintaining the proper flow of water as the water is sprayed on the fire site throughout the extinguishing of fire and makes sure no water is wasted.

5. CONCLUSION

Various models of the fire-extinguishing robot have been proposed to date. The fire-extinguishing robot proposed in this paper uses the Internet of Things, which makes it capable of being operated remotely. After successful implementation of the proposed robot, the model will be able to sense fire and notify the user about it. The user will then navigate the robot to extinguish the fire using the mobile application. The fire-extinguishing robot can assist in extinguishing fires and also reduce the number of casualties that happen every year.

REFERENCES

[1] A.Q.M. Sazzad Sayyed, Md. Tasnimul Hasan, Shakib Mahmood, Abdul Rakib Hossain, "Autonomous Fire Fighter Robot Based on Image Processing", *Conference Paper June 2019*.

[2] Md. Anowar Hossain, Himaddri Shakhar Roy, Md. Fazlul Karim Khondakar, Md. Hasib Sarowar, Md. Azad Hossain, "Design and Implementation of an IoT Based Firefighting and Affected Area Monitoring Robot", *January 2021*

[3] Md. Mahmudul Hasan, Nayeem Al-Tamzid Bhuiyan, "A multi-sensor-based firefighting robot with wireless control and visual system", *Recent Research in Science and Technology 2020, 12: 06-13*

[4] S. Kavitha, Krishnarajendra Sagar, Mohamed Tousif, Nishanth C.R, Likith. V, "Fire Fighting Robot", *International Journal of Innovative Science and Research Technology, Volume 6, Issue 5, May – 2021*

[5] Arthi Udayakumar, "MULTIPURPOSE ROBOTIC CAR USING ARDUINO BASED ON IoT", *Conference Paper · March 2018*

[6] Teh Nam Khoon, Patrick Sebastian, Abu Bakar Sayuti Saman, "Autonomous Fire Fighting Mobile Platform", *International Symposium on Robotics and Intelligent Sensors 2012 (IRIS 2012)*

[7] Sandip Gupta Farogh Ahmad S. Sundar and Shanmugasundaram M., "MANUALLY CONTROLLED ENHANCED WIRELESS INTELLIGENT FIRE FIGHTING ROBOT", *Asian Research Publishing Network (ARPN), VOL. 12, NO. 21, NOVEMBER 2017*

[8] MONISHA.A, PRABHA.R, SURUTHI.V. P, SWATHI SURIYANARAYANAN, M. AASHA, "AUTOMATED FIRE FIGHTING ROBOT", *International Journal of Soft Computing and Artificial Intelligence, Volume-7, Issue-1, May-2019.*

[9] Sumitra Motade, Aditi Suresh Bidwai, Komal Jaysing Kale, Ankita Mahadev Mahajan, "FIRE FIGHTING ROBOT USING ANDROID APPLICATION", *Volume 4 Special Issue 11 ICCEME 2019-2020.*

[10] Nandakumar S, Sanjay Sagar, Subash R, Vishal Vaitheeshwaran R. K, Dr. S. Uma Maheswari, "Automated Fire Fighting Robot", *International Journal of Innovative Science and Research Technology, Volume 3, Issue 4, April– 2018.*