AUTONOMOUS FIRE FIGHTING ROBOT USING ARDUINO

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ABSTRACT

In the dynamic realm of technology, robots are playing increasingly pivotal roles, especially in high-risk scenarios. Our mission involves crafting an autonomous firefighting robot, proficient in independently detecting and suppressing indoor fires using carbon dioxide. This endovour directly tackles the inherent dangers associated with firefighting, prioritizing human life protection and elevating the efficiency of rescue operations. Although some fire departments already employ robots, persistent challenges in size, weight, cost, and performance warrant a holistic approach

Keywords: Firefighting robot, Risk, Protection, Remote Control, Heat Detection & Autonomous Navigation.

1. INTRODUCTION

A state-of-the-art fire-fighting robot, designed for effective firefighting in hazardous or hard-to-reach areas, relies on the renowned IoT capabilities of an ESP32 microcontroller. The robot allows for remote control and monitoring. Equipped with flame and smoke sensors using a multi-sensor approach, it identifies infrared radiation from flames and detects airborne smoke. Upon fire detection, the robot autonomously activates a water pump, directing a precise water stream to extinguish the fire. Mobility is achieved through DC motors with a motor driver, while a servo motor controls the water nozzle for accurate water stream direction. Governed by the ESP32 microcontroller, the robot provides precise control over its actions. Operational flexibility is a key feature, enabling manual control through the Blynk app for remote accessibility. Alternatively, it can be programmed to follow predefined paths, showcasing adaptability in diverse fire scenarios. In summary, these fire-fighting robots represent a significant technological advance, leveraging IoT capabilities for enhanced firefighting in challenging environments, equipped with sensors and actuators for fire detection and remote control.

2. PROBLEM STATEMENT

- Fire disaster is one of the dangerous problems that can lead to heavy loss both financially and by taking lives. Sometimes 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 self-detection Technology.
- In 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. PROPOSED SYSTEM

HARDWARE COMPONENTS :

Arduino UNO: A Microcontroller is a compact device with a processor, storage and configurable input/output devices on a single integrated circuit. We'll be using the Arduino UNO board, which combines a microcontroller with all the extras needed to quickly create and debug projects. The ATmega3288based UNO is a microcontroller board.

Fig-2: Arduino Uno

It has,

4 Digital input/output pins,

6 Analog inputs,

16MHz Quartz crystal,

USB connector,

Power jack,

ICSP header,

and Reset button.

Ultrasonic Sensor : The Transducer's sonic waves would be absorbed by an object and returned to the transducer. The time it takes for the ultrasonic sensor to transition from emitting to receiving sound waves is proportional to the distance between the object and the sensor

Fig-3: Ultrasonic Sensor

Hard surfaces are the strongest reflectors of sonic waves, and may be solids, granules, liquids, or powder. The distance can be calculated precisely and without touch using an ultrasonic sensor. It could be anywhere from 2cm to 3m long.

Flame Sensor (IR) :A flame sensor is the most sensitive to normal light of any sensor. This sensor senses flame if the light source emits a wavelength between 760nm and 1100nm.The detection angle would be 60o and can be achieved from 100cm. This sensor's output is either an analog or digital signal. The infrared flame flash method is used by this sensor

Fig-4: Flame Sensor

It has four pins :

1. Voltage Supply (Vcc),
2. Ground pin (GND),
3. Analog output (About),
4. Digital output (Do).

Temperature Sensor (LM35): The temperature sensors in the LM35 series are accuracy integrated circuits temperature sensors with a linearly proportional output voltage to Celsius scale value. The Temperature can be measured more precisely than with a thermistor

Fig-5: Temperature Sensor (LM35)

The sensor circuitry is fully sealed and is not exposed to the elements. due to oxidation The LM35 produces a higher output voltage than thermocouples, so it might not be necessary to amplify the output voltage. It calibrates in Celsius with a 0.5°C precision guarantee and a measurable range of 55°Cto+150°C.

4. IMPLEMENTATION

Working : Autonomous firefighting robots operate through a combination of advanced sensing, decision-making algorithms, and mechanical action. The process typically begins with the robot's sensors scanning the environment for signs of fire, including heat signatures and smoke. Once a fire is detected, the robot's artificial intelligence algorithms analyze the data to determine the fire's location, size, and potential hazards. Based on this analysis, the robot autonomously plans a firefighting strategy, considering factors such as the accessibility of the fire, the presence of obstacles, and the availability of resources. The robot then moves towards the fire using its mobility system, which could be wheels, tracks, or legs, navigating through debris and obstacles as necessary. Throughout the operation, the robot maintains communication with human operators, providing updates on its progress and receiving commands or adjustments as needed. Once the fire is extinguished or brought under control, the robot may continue to monitor the area for potential flare-ups or hazards, ensuring that the firefighting operation is comprehensive and effective. Overall, the working principle of autonomous firefighting robots involves a seamless integration of sensing, decision-making, and action to combat fires autonomously and efficiently.

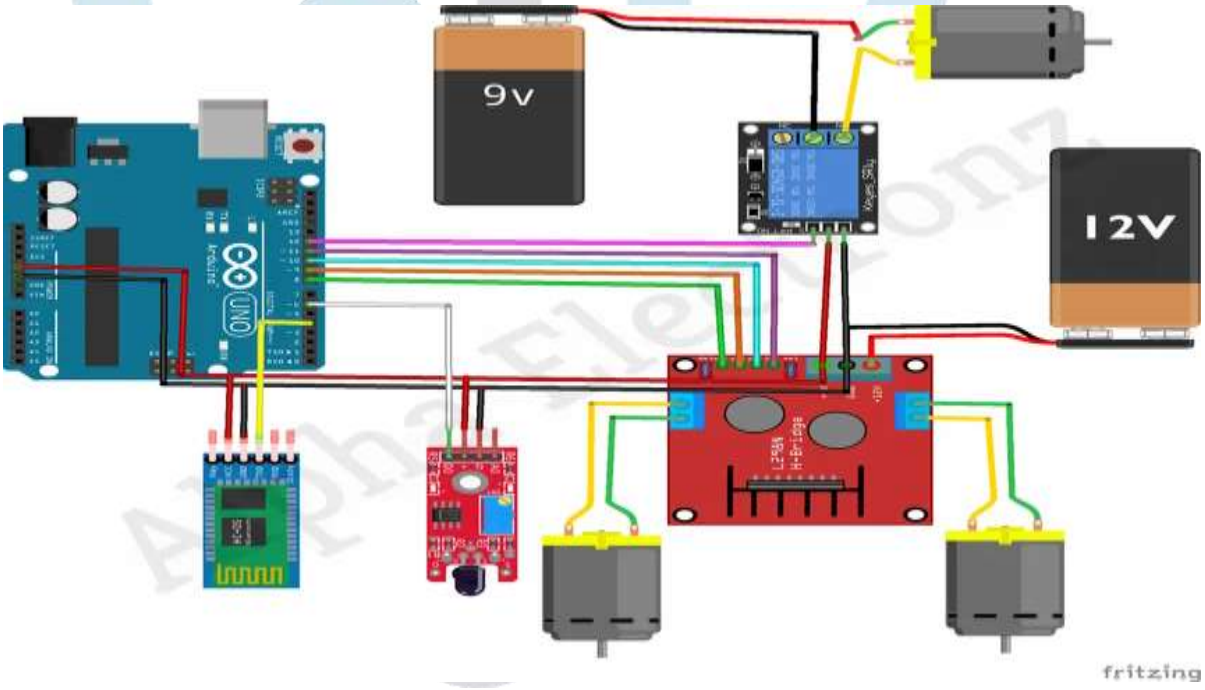

Fig-6: Circuit Diagram of Proposed System

Future Scope :

The firefighting robot will have future scope that it can work with firefighters, which greatly reduce the danger of injury to victims. It is an innovative work in the field of robotics that operates towards a sensible and obtainable access to save the lives and prevents the danger to property.

Result and 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

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 were 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.

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