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Fire Fighting Robot

Chithrashree K S[1], Harish E[2], Kiran R D[3], Madan S N[4], Akshatha R Hegde[5]

[1,2,3,4]*BE Final Year Students Visvesvaraya Technological University*
[5]*Assistant ProfessorDepartment of Electrical and Electronics*
Don Bosco Institute of Technology, Bangalore, Karnataka

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ABSTRACT
A firefighting robot is an advanced robotic system designed to assist in extinguishing fires in hazardous environments. These robots are equipped with a range of sensors and tools, such as water cannons, and flame detectors, as well as obstacle detection sensors like ultrasonic sensors. They are designed to be highly manoeuvrable and able to navigate through complex and hazardous environments, such as small cable rooms, server rooms, and household applications.These sensors enable the robot to detect and navigate around obstacles while working to suppress the fire. The robot's obstacle detection system uses advanced algorithms and software to quickly and accurately detect obstacles and create a map of the surrounding environment. The use of a firefighting robot with obstacle detection can help improve the safety and effectiveness of firefighting operations by reducing the risk of injury or death to human firefighters and increasing the speed and efficiency of the firefighting process.

KEYWORDS: Ultrasonic sensor, Flame sensor, Arduino(uno), Servomotor, Motor driver, Water pump, 4 wheel, Battery (12v).

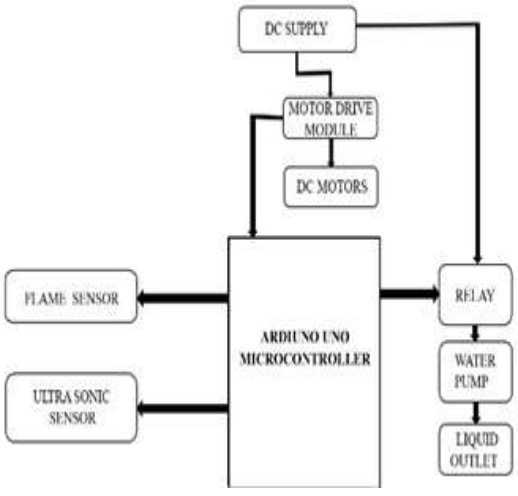
I. INTRODUCTION

Fire is one of the most destructive and dangerous hazards faced by humanity. Firefighters are often called upon to extinguish fires in hazardous environments, such as burning buildings and industrial sites, where the risks to human life are significant. However, firefighting can be a highly challenging and risky task, and sometimes, it may be difficult for human firefighters to access the site of the fire or navigate through complex and hazardous environments.To address these challenges, firefighting robots have been developed that are equipped with a range of sensors and tools to help detect and combat fires. Additionally, obstacle detection sensors such ultrasonic sensors enable these robots to navigate around obstacles and move through complex and hazardous environments while minimizing the risk of damage to the robot or the environment.

In this context, the use of a firefighting robot with obstacle detection can help improve the safety and effectiveness of firefighting operations, by reducing the risk of injury or death to human firefighters and increasing the speed and efficiency of the firefighting process. This paper aims to explore the various features and benefits of a firefighting robot using obstacle detection, highlighting how this technology can help revolutionize firefighting operations.

Different types of sensors have been used in this firefighting robot which is as follows- Ultrasonic sensor, flame sensor.

Arduino is the main component with the help of which the robot is controlled. The sensor will send the signal to the arduino after sensing the fire then the arduino will give the instruction to the robot and then the robot will extinguish the fire with a water.



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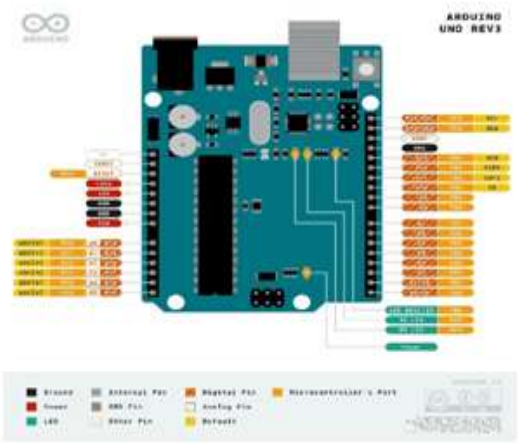
II. PARTS DESCRIPTION

A. Arduino

Arduino Uno is a microcontroller board that is based on the ATmega328P microcontroller. It is an open-source hardware and software platform that is widely used by hobbyists, students, and professionals in a variety of projects ranging from simple to complex. The board has 14 digital input/output pins, six analog inputs, a USB connection, a power jack, an ICSP header, and a reset button.



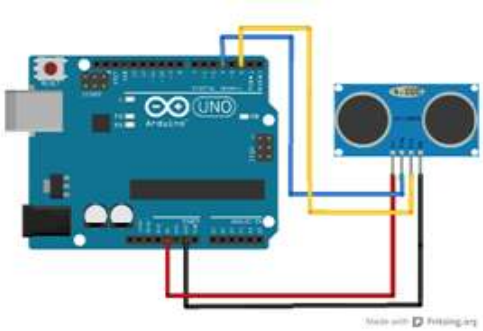
B. Five Channel Flame sensor

A five-channel flame sensor is an electronic component that is used to detect the presence of flames or fire. It typically contains five individual infrared sensors that detect different wavelengths of light emitted by flames. These sensors are designed to be highly sensitive and can detect even small flames or fires from a distance.

The detection range of the five channel flame sensor may vary depending on the specific model, but most sensors have a detection range of up to several meters. The sensors are also designed to be resistant to false alarms caused by other sources of infrared radiation, such as sunlight or light bulbs.

C. Ultrasonic Sensor

An ultrasonic sensor is a device that is used to measure the distance between the sensor and an object by emitting high-frequency sound waves and then receiving their echoes. The sensor sends out a sound wave at a specific frequency, typically above the range of human hearing, which travels through the air and bounces off any nearby objects. The sensor then measures the time it takes for the sound wave to travel to the object and back, and uses this information to calculate the distance between the sensor and the object.



Arduino and ultrasonic sensor connection diagram

D. Motor Driver

The L298N motor driver is a popular integrated circuit (IC) that is used to control the speed and direction of DC motors. The L298N motor driver can be controlled by a microcontroller or other digital logic circuits.

It provides a simple interface that allows the user to control the direction and speed of the motor using only two digital inputs per motor. The IC can also be used to provide current limiting, thermal protection, and over-voltage protection to ensure the safety and longevity of the motor. It can operate within a voltage range of 5V to 35V.

Working

The robot is equipped with a flame sensor and an ultrasonic sensor as its primary input devices. The flame sensor is designed to detect the presence of flames, while the ultrasonic sensor uses sound waves to detect the distance to nearby objects.

Fire Fighting robot is a robotic system designed to detect and extinguish fires autonomously. It utilizes a flame sensor and an ultrasonic sensor to detect the presence of flames and obstacles, respectively, in its environment. Here's a step-by-step explanation of how the robot would work:

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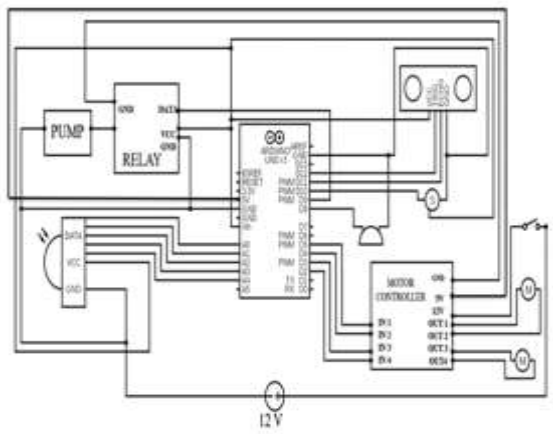
Fire Detection: The flame sensor, typically an infrared sensor, is used to detect the presence of flames. It can detect the heat emitted by flames and trigger the robot to take action. When the flame sensor detects flames, it sends a signal to the Arduino uno microcontroller indicating the presence of fire.

Obstacle Detection: The ultrasonic sensor which emits high-frequency sound waves and measures the time taken for the sound waves to bounce back, is used to detect obstacles in the robot's path. It can detect objects or walls that are in close proximity to the robot. It sends a signal to the Arduino uno microcontroller indicating the presence of obstacle.

Navigation: The robot's control system processes the signals from the flame sensor and ultrasonic sensor to determine the location of the fire and the presence of obstacles. It then uses this information to navigate towards the fire while avoiding obstacles.

Extinguishing the Fire: Once the robot reaches the fire, it can use various mechanisms to extinguish it. For example, it use a water spray or a fire extinguishing agent to put out the flames. Extinguishing fire using a relay and fluid pump typically involves using an automatic fire suppression system that uses a network of pipes, nozzles, and a fluid pump to deliver a fire extinguishing agent to the affected area. The system is activated by a relay, which detects the presence of heat or flames and triggers the fluid pump to activate and begin delivering the extinguishing agent.

Autonomous Operation: The robot is designed to operate autonomously without human intervention, relying on the inputs from the flame sensor and ultrasonic sensor to detect and extinguish fires.



Circuit Diagram

Advantages

- Improved Efficiency
- Minimization of ecological consequences
- Financial loss can be reduced
- A threat to a human life can be reduced
- Increased safety

Disadvantages

- Technical Limitation
- Limited range for detection of obstacles

CONCLUSION & FUTURE SCOPE

The development and implementation of fire-fighting robots equipped with obstacle detection systems offer significant benefits in firefighting operations. These robots are designed to navigate through hazardous environments and provide valuable support to human firefighters. The obstacle detection technology plays a crucial role in ensuring the safe and efficient movement of these robots.By incorporating obstacle detection capabilities into fire-fighting robots, several advantages are realized. Firstly, these robots can autonomously identify and navigate around obstacles, reducing the risk of collisions and potential damage to both the robot and the environment. This capability allows them to operate effectively in complex and unpredictable fire scenes, where debris, furniture, or structural damage may obstruct their path.Secondly, obstacle detection systems enable robots to gather real-time data about the surrounding environment.Fire-fighting robots may evolve to become more autonomous in their firefighting operations. With advanced obstacle detection systems, they can not only navigate around obstacles but also actively engage in fire suppression activities. This could involve using robotic arms or specialized tools to extinguish flames, apply fire-retardant substances, or perform targeted cooling operations.

Future fire-fighting robots should be designed to withstand harsh conditions and maintain functionality in extreme temperatures, high humidity, and challenging terrains. They should be built with durable materials and have protective features to ensure their reliability and longevity in demanding firefighting environments. The future may see the development of fire-fighting robot teams that can collaborate and coordinate their efforts. These robots can share information about obstacles, fire conditions, and their locations to optimize their movements and actions. By working together, they can cover larger areas, perform specialized tasks, and enhance overall firefighting efficiency.

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