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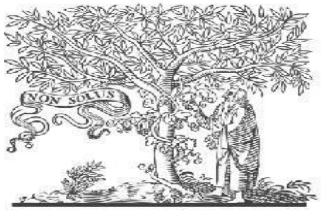

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10.48047/IJIEMR/V12/ISSUE04/194

Title AUTONOMOUS FIRE EXTINGUISHER
Pages: 1500-1506

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AUTONOMOUS FIRE EXTINGUISHER

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Abstract

In recent years, there has been an increasing demand for autonomous robots that can be deployed to fight fires in hazardous environments. This paper presents the design and implementation of an autonomous fire-fighting robot that uses an Arduino Uno R3 microcontroller, Adafruit motor driver, HCSR04 ultrasonic sensor, 3 flame sensors, 2 motors for wheels and castor wheel on front, 1 water pump, and 1 servo motor with HCSR04.

The robot is designed to navigate through hazardous environments and locate fires using the flame sensors. Once a fire is detected, the robot uses the ultrasonic sensor to determine the distance to the fire and approaches it. The robot then activates the water pump to extinguish the fire.

To move around, the robot uses two motors for the wheels and a castor wheel on the front to ensure stability and manueverability. The servo motor is used to adjust the angle of the ultrasonic sensor, allowing the robot to detect fires at different heights.

The robot's behaviour is controlled using an Arduino Uno R3 microcontroller, which processes the sensor data and controls the motor driver and water pump. The system is designed to operate autonomously, requiring minimal human intervention.

Experimental results demonstrate that the robot is capable of successfully navigating through hazardous environments, detecting and extinguishing fires. The proposed system presents a promising solution for fire-fighting in hazardous environments.

Keywords: Arduino Board, Flame sensor, Ultrasonic sensor, Servo motors, DC motors, Code.

Introduction

The proposed system presents a promising solution for fire-fighting in hazardous environments. The robot can replace human firefighters in hazardous environments, reducing the risk of injury and death. The robot can also be deployed in areas that are difficult to access, such

as confined spaces and high-altitude locations, making it an effective tool for fighting fires.

In this project, we propose the design and implementation of an autonomous fire-fighting robot that uses an Arduino Uno R3 microcontroller, Adafruit motor driver, HCSR04 ultrasonic sensor, 3 flame sensors, 2 motors for wheels and castor wheel on front, 1 water pump, and 1 servo motor with HCSR04. The robot is designed to be fully autonomous, requiring minimal human intervention. Experimental results demonstrate that the robot is capable of successfully navigating through hazardous environments, detecting and extinguishing fires.

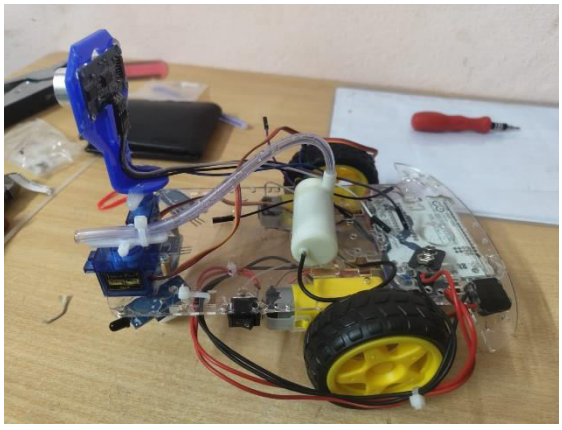

Fig. Autonomous Fire Extinguisher

Ultrasonic Sensor

An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

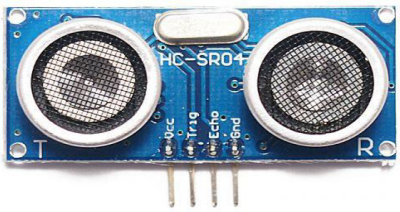

Fig. Ultrasonic Sensor

Arduino UNO R3

The Arduino Uno R3 is a microcontroller board based on the ATmega328P microcontroller. The Arduino Uno R3 is powered by an external power source connected to the board's DC power jack or through the USB port. It has 14 digital input/output pins, six of which can be used for pulse-width modulation (PWM) output, and six analog input pins. Additionally, it has a 16 MHz quartz crystal oscillator, a reset button, and several built-in LEDs for indicating power and status.

The board can be programmed using the Arduino Integrated Development Environment (IDE), which is an open-source platform that provides an easy-to-use interface for writing and uploading

code to the board.

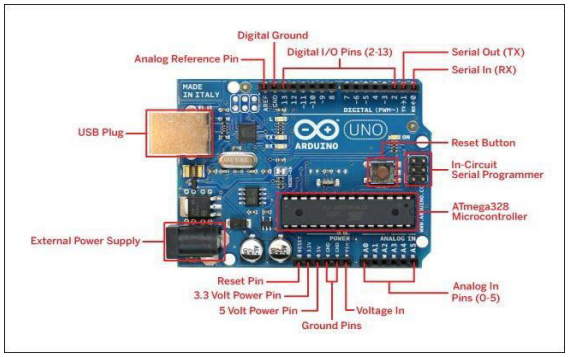

Fig. Arduino UNO R3

Adafruit Motor Driver

The Adafruit Motor Driver is a motor control board that allows you to control motors using a microcontroller such as an Arduino or Raspberry Pi. The board is designed to be easy to use and can control up to four DC motors or two stepper motors. The Adafruit Motor Driver board is based on the TB6612FNG motor driver chip, which can handle a maximum current of 1.2A per channel (3A peak). The board has a range of features, including built-in protection against overheating, overcurrent, and undervoltage. It also has a PWM frequency of up to 100kHz, which allows for smooth and precise motor control.

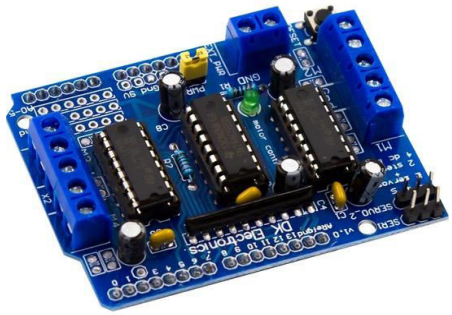

Fig. Adafruit motor driver

IR Flame Sensor

A Flame Sensor module or Fire Sensor module is a small size electronics device that can detect a fire source or any other bright light sources. This sensor basically detects IR (Infrared) light wavelength between 760 nm – 1100 nm that is emitted from the fire flame or light source. The flame sensor comes with a YG1006 Phototransistor sensor which is a high speed and high sensitivity. Two types of IR Infrared Flame Sensor Module available in the market one having three pins (D0, Gnd, Vcc) and another one having four pins (A0, D0, Gnd, Vcc) both are can be easily used with Arduino and other microcontrollerboards.

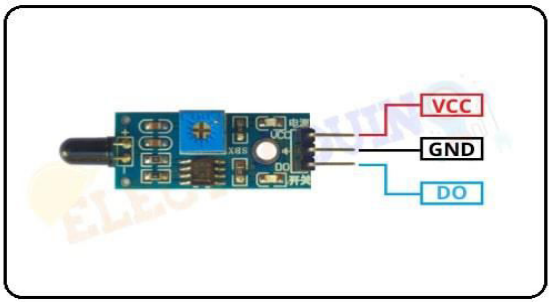

Fig.IR flame sensor

Servo motors

Servo motors can be used in autonomous fire extinguishers to control the direction and angle of the extinguisher nozzle. The servo motor can be attached to the nozzle and used to move it up and down, left and right, or in any other direction required to target the fire. In an autonomous fire extinguisher system, the servo motor can be controlled by a microcontroller or other control system. The control system can receive input from sensors such as heat

detectors or smoke detectors to determine the location and size of the fire, and then use the servo motor to position the extinguisher nozzle in the most effective location.

Fig. Servo motor

System implementation

The implementation of an autonomous fire extinguisher project can involve several components and subsystems, including sensors, control systems, extinguishing agents, and mechanical components such as servo motors.

Sensors: The system can use various sensors such as heat detectors, smoke detectors, or flame detectors to detect the presence and location of a fire. These sensors can be connected to a microcontroller or other control system.

Control system: The control system can receive input from the sensors and use algorithms to determine the location and size of the fire. Based on this information, the control system can activate the servo motors to move the extinguisher nozzle in the correct direction and angle.

Extinguishing agent: The extinguishing agent can be stored in a tank or container and released through the nozzle. Depending on the type of fire, the system may use different types of extinguishing agents, such as water, foam, or carbon dioxide.

Mechanical components: The system can use mechanical components such as servo motors to control the movement of the extinguisher nozzle. The servo motors can be connected to the control system and activated based on the location and size of the fire.

Power source: The system requires a reliable power source to operate. This can be a battery or a mains power supply, depending on the requirements of the project.

Prerequisites

Knowledge of fire safety principles: It is important to have a good understanding of fire safety principles, including the different types of fires, how they spread, and the various methods used to extinguish them.

Knowledge of electronics and programming: Autonomous fire extinguisher projects require a solid understanding of electronics and programming. This includes knowledge of microcontrollers, sensors, and actuators, as well as proficiency in programming languages such as C or Python.

Familiarity with mechanical systems: The project may require the use of mechanical components such as motors, pumps, and valves, so it is important to

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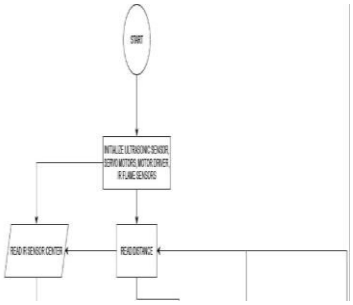
have some familiarity with mechanical systems and how they work.

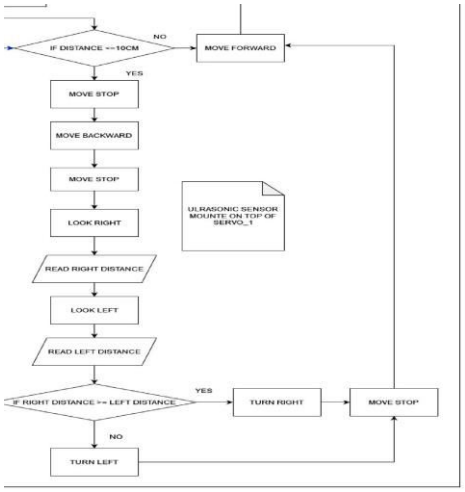
Safety considerations: Safety is a top priority when working with fire extinguishers and other fire-related equipment. It is important to follow all safety guidelines and regulations, and to take appropriate precautions to minimize the risk of injury or property damage.

Budget and resources: Autonomous fire extinguisher projects can require significant resources, including materials, components, and tools. It is important to have a realistic budget and to plan accordingly to ensure that all necessary resources are available.

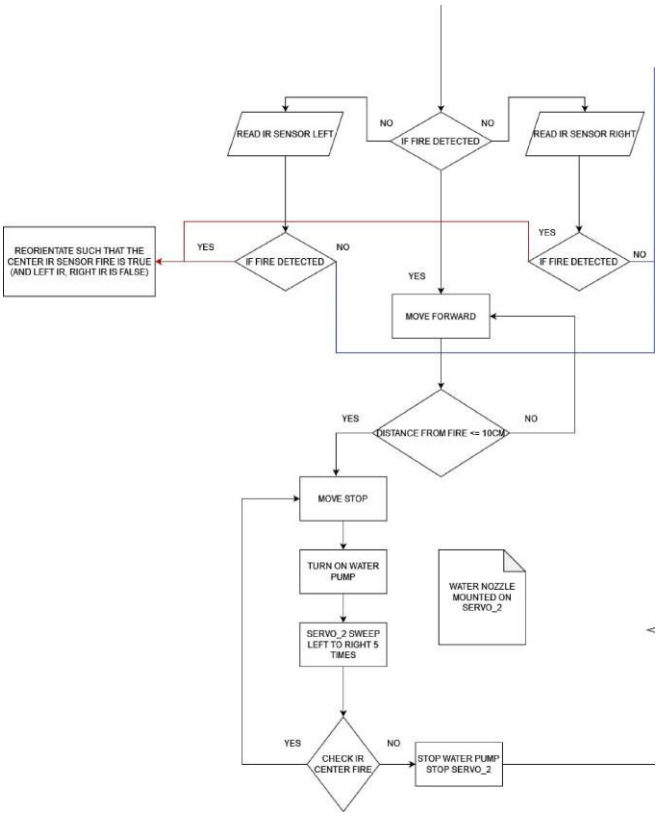
Flow chart for initializing:



Flowchart for obstacle avoiding :



Flow chart for sensing fire:



Case study

The goal of the project is to build an autonomous fire extinguisher robot that can detect and extinguish fires in a safe and efficient manner. The robot is equipped with infrared flame sensors that can detect the presence of flames, an Adafruit motor driver that controls two DC motors for movement, ultrasonic sensors for obstacle detection, and two servo motors that aim the fire extinguisher nozzle.

The Arduino Uno serves as the main control unit for the robot, receiving input from the sensors and issuing commands to the motors and servo motors. The robot is programmed to move towards the flame using the DC motors and the ultrasonic sensors to avoid obstacles. When the flame is detected by the infrared sensors, the robot stops and aims the fire extinguisher nozzle using the servo

motors. The nozzle is then activated to extinguish the flame using water or another extinguishing agent.

To ensure the safety of the robot and any nearby humans, the robot is equipped with several safety features. For example, it can detect the presence of humans using the ultrasonic sensors and adjust its behavior accordingly. The robot is also programmed to move away from the flame if it cannot extinguish it after a certain period of time, to avoid causing further damage.

The project requires knowledge of electronics, programming, and mechanical systems, as well as an understanding of fire safety principles and safety considerations when working with fire extinguishers. Testing and validation of the system should be performed to ensure that it is effective and safe to use in real-world scenarios.

Overall, an autonomous fire extinguisher project using infrared flame sensors, an Adafruit motor driver, ultrasonic sensors, two servo motors, and an Arduino Uno has the potential to be an effective and efficient way to detect and extinguish fires, potentially saving lives and property in the event of a fire.

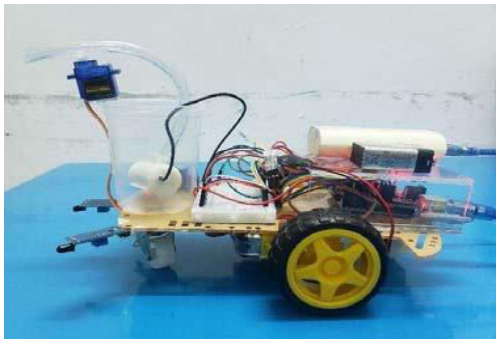
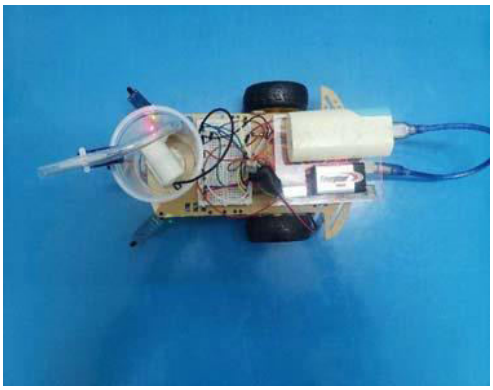


Fig. Autonomous fire extinguisher



Conclusion

In conclusion, the Autonomous fire extinguisher project has the potential to be a valuable addition to fire safety measures. By using advanced sensors, algorithms, and mechanical components, the project aims to detect and extinguish fires in a safe and efficient manner, potentially saving lives and property.

The project requires a range of technical skills, including knowledge of electronics, programming, and mechanical systems, as well as an understanding of fire safety principles and safety considerations when working with fire extinguishers. Additionally, testing and validation of the system should be performed to ensure that it is effective and safe to use in real-world scenarios.

While the project is still in the research and development stage, it has the potential to be further developed and deployed in real-world scenarios. With the continued advancements in technology, the potential for autonomous fire extinguishers to become a common tool in

firefighting cannot be ignored. Overall, the Autonomous fire extinguisher project represents a promising development in the field of fire safety and has the potential to make a significant impact in the future**.**

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