FIRE DETECTION AND EXTINGUISHING

INTRODUCTION

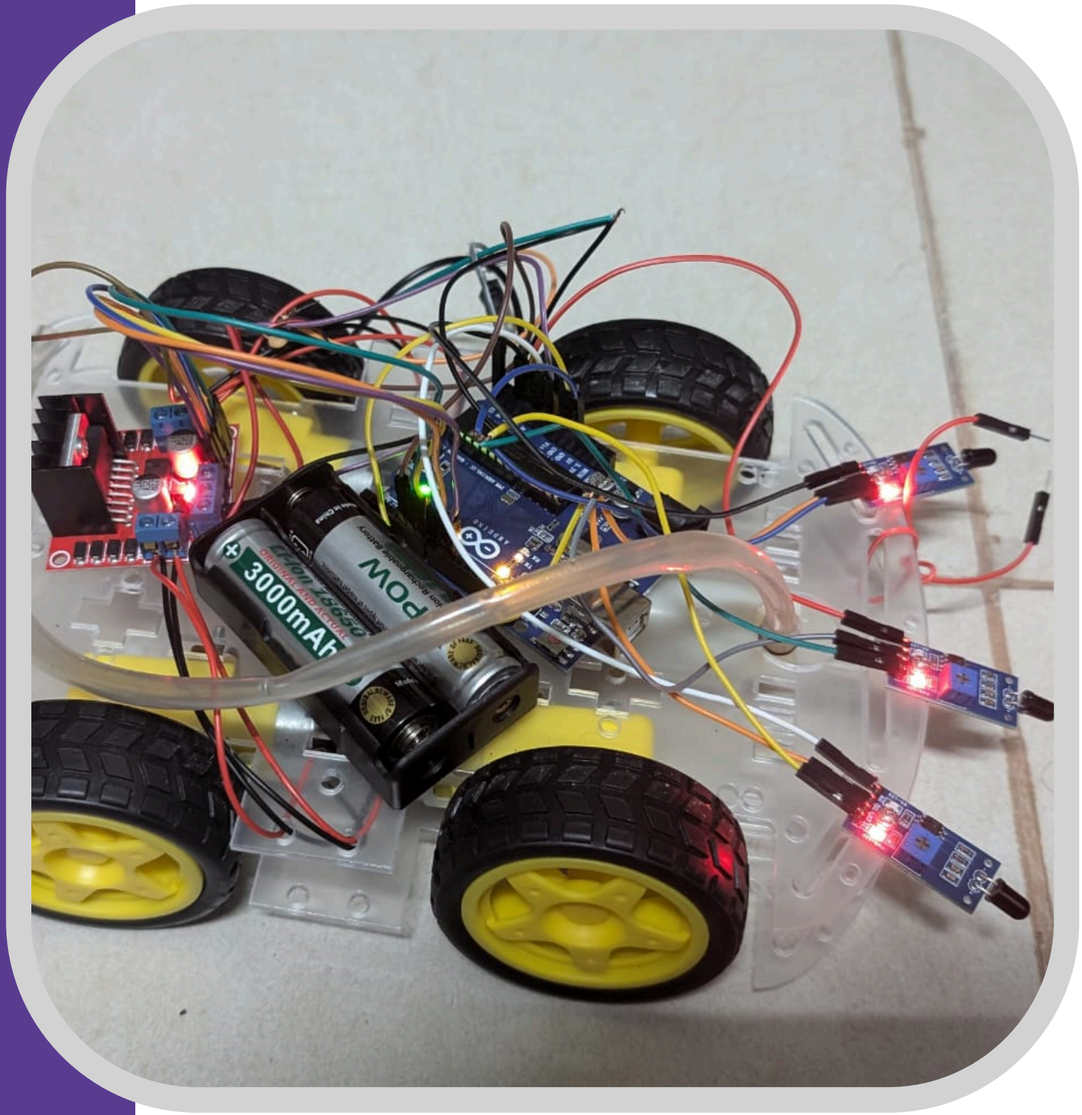
PURPOSE OF THE PROJECT

The purpose of this project is to design and develop an autonomous fire-fighting robot capable of detecting and extinguishing fires at the source. This robot, powered by Arduino, is equipped with fire sensors to identify flames and a water-spraying mechanism to suppress them. The primary aim is to provide a mobile, cost-effective solution for rapid fire detection and suppression, enhancing fire safety in smaller, confined spaces where traditional firefighting methods might be delayed or inaccessible.

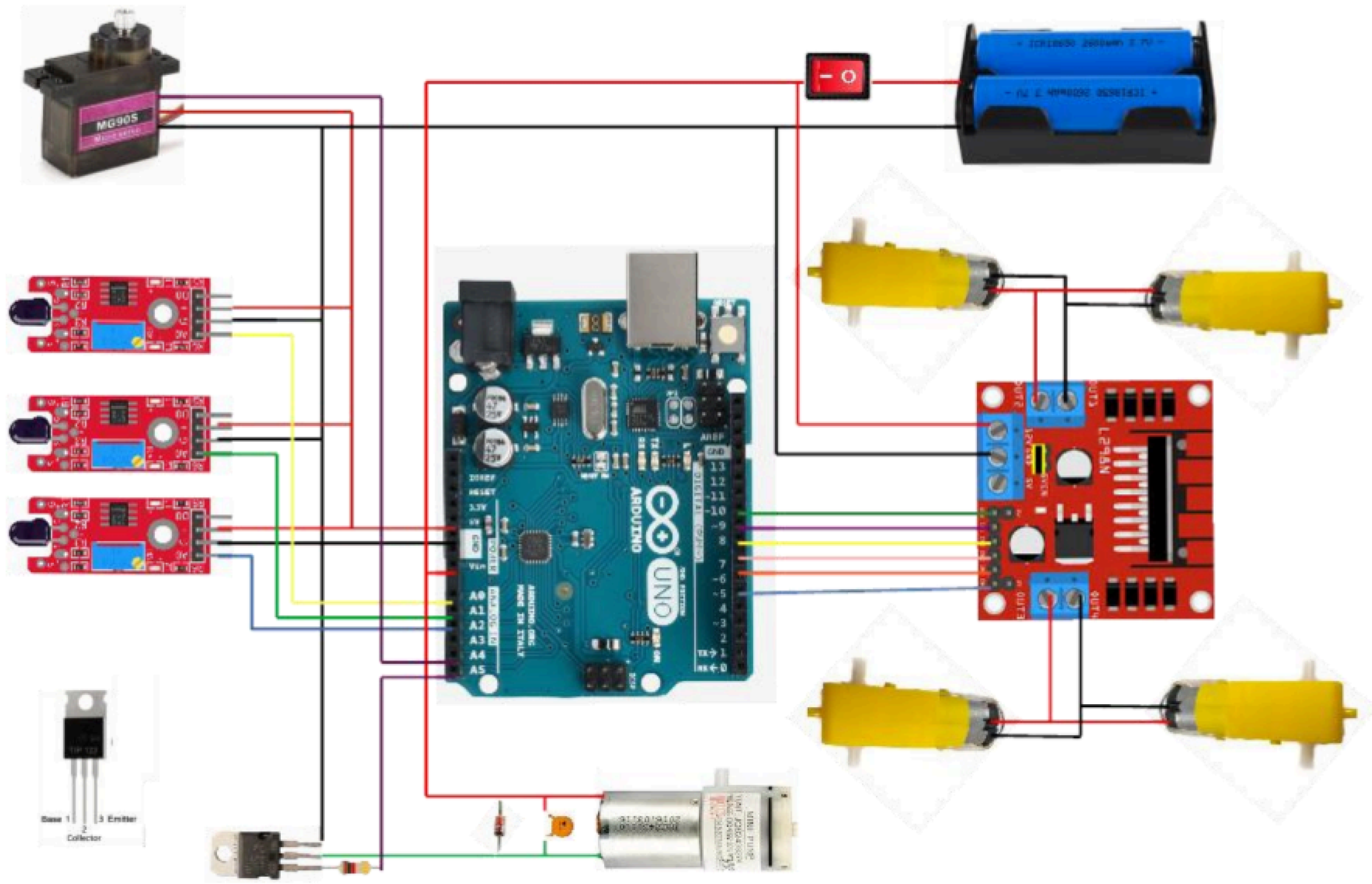
PROBLEM STATEMENT

Fires, even in small spaces, can quickly escalate, posing serious threats to both human lives and property. Manual fire suppression in such situations can be risky, especially in confined or hazardous areas. Our robot addresses this problem by autonomously detecting the presence of fire, navigating towards the source, and activating an extinguisher system to combat the flames, all without requiring direct human intervention.

The importance of such robots in fire safety cannot be overstated. Autonomous firefighting robots offer a quick, efficient, and safer alternative for early-stage fire suppression. They minimize the risks to human firefighters, improve response times, and can potentially prevent small fires from turning into large, devastating incidents.



CURCUIT DIAGRAM



OBJECTIVE

Fire Detection

- Equip the robot with sensors capable of quickly identifying the presence of fire or high temperatures within its vicinity.

Autonomous Navigation

- Enable the robot to autonomously move toward the detected fire source, avoiding obstacles along the way.

Fire Extinguishing

- Integrate a mechanism to safely and effectively extinguish the fire upon reaching its source, such as a water pump or extinguisher system.

Safety and Reliability

- Ensure the robot operates safely and reliably in various indoor environments, reducing risks to people and property in fire-prone areas.

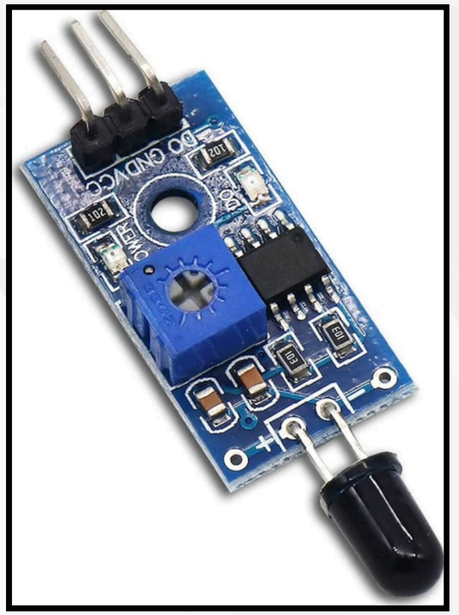
Cost-Effectiveness

- Design the robot to be a budget-friendly fire-fighting solution that can be easily maintained and deployed in small-scale spaces like homes, laboratories, and warehouses.

COMPOUNDS USED :

FLAME SENSORS

The flame sensors detect the presence of fire by identifying specific wavelengths of light emitted by flames. These sensors generate signals when flames are nearby, which the Arduino processes to trigger movement and activate the extinguisher.

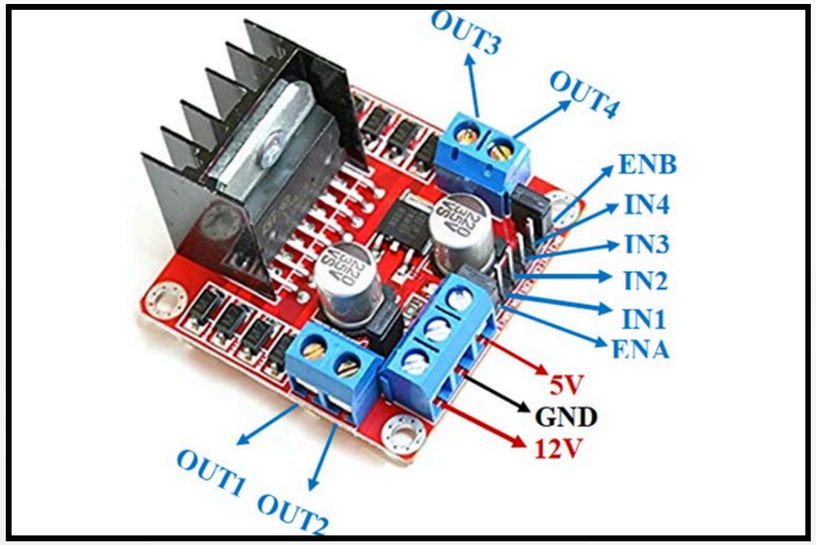


ARDUINO UNO

The Arduino UNO microcontroller acts as the brain of the robot, processing data from the flame sensors and controlling the motors and extinguisher mechanism based on this input.

BO MOTORS (BATTERY OPERATED MOTORS)

These DC motors provide the driving force for the robot, allowing it to move toward the fire source. They are controlled by the Arduino through the motor driver.

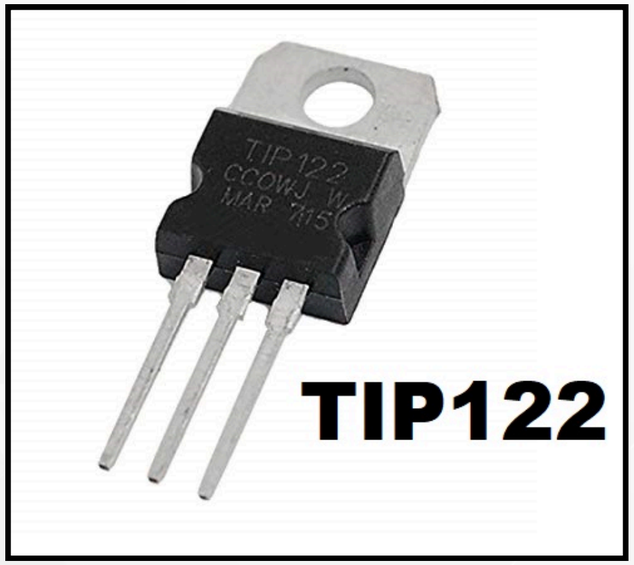


L298 MOTOR DRIVER

The L298 motor driver module serves as an interface between the Arduino and the BO motors, allowing the Arduino to control motor speed and direction with sufficient power.

3.7 V BATTERIES (18650)

These rechargeable lithium-ion batteries provide power to the entire circuit, including the Arduino, sensors, and motors.



TIP-122 TRANSISTOR

The TIP-122 is a power transistor used to amplify the current, allowing sufficient power to activate the extinguisher system (like a water pump).

EXPLANATION OF CODE

In this code, an Arduino-controlled fire-fighting robot is programmed to detect and extinguish fires using flame sensors, motors, a pump, and a servo motor. The robot’s components are interfaced through defined pins, including flame sensors for detecting fire on three sides (front, left, and right), and motors for movement.

1. Pin Setup and Initialization: The robot initializes communication at 9600 bps, sets up sensor pins for input, and configures motor and pump pins for output. Servo positions are adjusted at the beginning to calibrate the starting orientation of the extinguishing system.
2. Motor Control and Movement: The forword, backword, turnRight, and turnLeft functions control the robot's movement using the L298 motor driver module. These directional functions are triggered based on sensor input, allowing the robot to move toward the fire’s location autonomously.
3. Fire Detection and Extinguishing Logic: In the main loop, the flame sensors’ analog readings (s1, s2, and s3) indicate the proximity of fire. The robot’s response depends on the sensor readings:
    - If a fire is detected in any direction, the robot stops, activates the pump to extinguish the fire, and uses the servo to direct the spray at the detected flame.
    - When no fire is detected, the robot performs a routine movement to continue searching.
4. Servo and Pump Activation: The servoPulse function handles the servo’s position adjustments, allowing the robot to sweep its extinguisher for optimal fire coverage. The pump is activated to spray water, targeting the area of detected fire based on sensor feedback.
5. Serial Monitoring: Sensor values are printed via serial output, allowing for real-time monitoring of fire detection levels and robot responses.

This design ensures that the robot can autonomously detect, navigate to, and extinguish small fires in controlled environments.

CONCLUSION

The "Fire Fighting Robot using Arduino Auto Fire Chaser and Extinguisher" project successfully demonstrates a practical solution for autonomous fire detection and suppression. Using flame sensors to detect fire and an Arduino to control movement and a water pump, the robot can locate and extinguish small fires without human intervention. This design highlights the potential of low-cost, adaptable robotics for enhancing fire safety, especially in areas where human response may be delayed or where early fire control is critical.

Overall, this project shows that accessible components and programmable control can be combined to create an effective, self-sufficient fire-fighting system. While simple in design, the robot serves as a foundation for further development and customization, offering a versatile platform for exploring more advanced fire-fighting applications. The success of this prototype emphasizes the role of robotics in addressing safety challenges in innovative and affordable ways.

FUTURE WORK

This project has demonstrated the potential of an autonomous fire-fighting robot, yet several enhancements could increase its efficiency and adaptability. For instance, integrating additional sensors such as ultrasonic or infrared for obstacle detection would enable the robot to navigate complex environments and avoid obstructions while approaching a fire. Similarly, incorporating localization methods like GPS could allow the robot to operate in larger or outdoor areas, improving its ability to reach fire sources accurately.

To broaden its fire-fighting capabilities, future work could focus on diversifying the types of sensors used for fire detection, such as adding smoke or heat sensors to detect various fire conditions. Upgrading the extinguishing mechanism to support different suppression agents, like CO2 for electrical fires, would make the robot more versatile for handling various fire types. These modifications would transform the robot into a more capable and adaptive solution, expanding its potential use cases in different settings and enhancing its value as an autonomous fire management tool.