CSE461

Project Report

Lab Section: 08

Group: 08

[Fire Extinguishing Robot(Car)]

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1. **Project Title:** Automated Fire Extinguishing Robot(Car)

2. Purpose

Objective:

The main goal of this project is to build a robot that can find and put out fires on its own. It is meant to make fire emergencies safer by not needing humans to go near dangerous fires. The robot will use sensors to detect heat or flames and spray water or use another method to extinguish the fire. This project shows how robots can be helpful in real-life safety situations. The idea is to create a simple but working example of how technology can fight fires automatically.

Scope:

This robot is made to be used in small places like homes, classrooms, or offices where a fire might start. It can help put out small fires quickly and safely before they get bigger. The robot is designed to move around basic areas and detect fires, making it a great project for learning about robots and safety. It can also be used to teach others how robotics and sensors work together to solve problems. In the future, it could be improved to work in bigger spaces or for more complicated situations.

Significance:

This project is important because it shows how robots can make fire emergencies safer and easier to handle. Instead of risking people's lives, the robot can find and put out fires quickly. It can also save money by stopping small fires from becoming big ones. This project inspires others to think about how robot

s can make everyday life safer. For beginners, it's a simple way to show how robots can solve real problems and make a difference.

3. Components

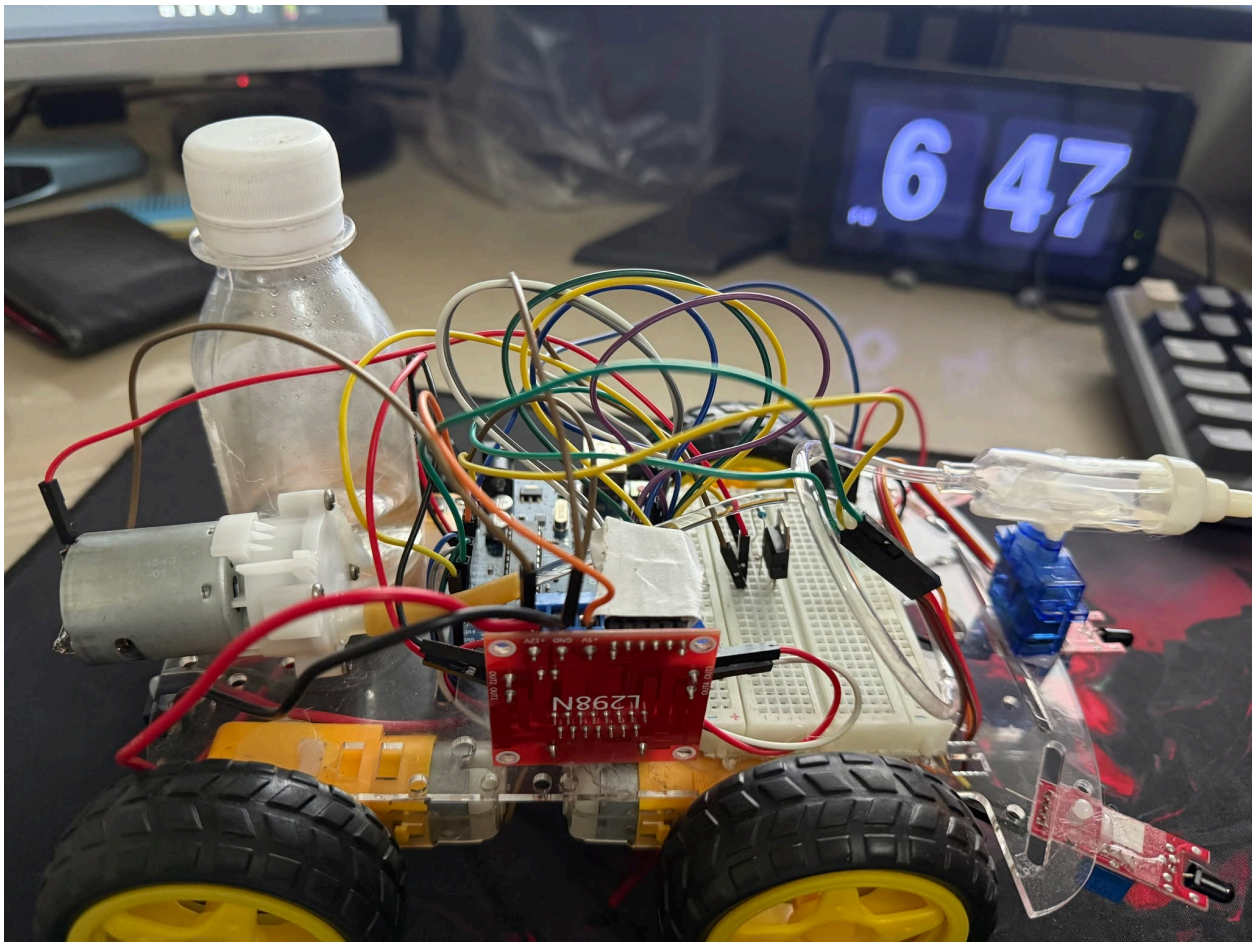
- Microcontroller: Arduino Uno
- Sensors:
    - 3 x Flame/Temperature Sensor

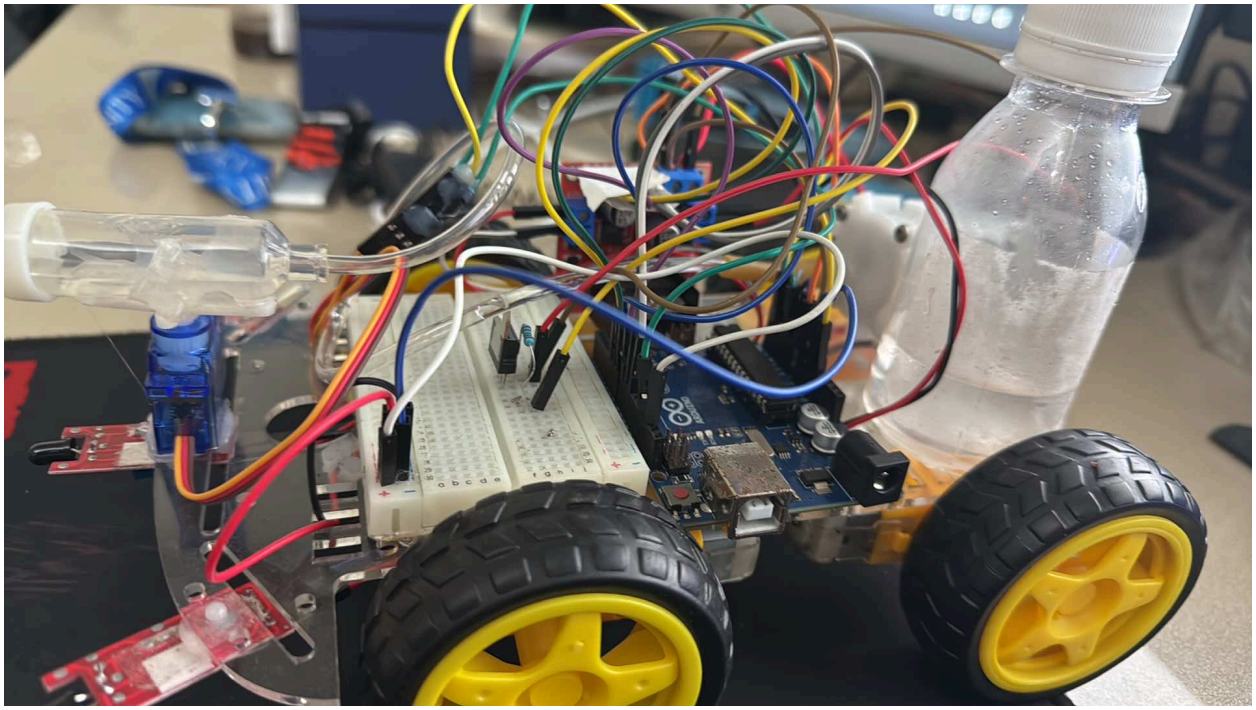
- Actuators:
    - Wheels
    - Servo Motor

    - DC Motor
    - Water Pump

- Body/Chassis: Transparent Car Chassis
- Additional Components: Motor Driver, Switch, Transistor, Capacitor, Register, Breadboard, Jumper Wires, Water Bottle, Batteries x 2.

4. Diagram/Circuit Setup:





5. Cost Breakdown

No	Components	Quantity	Unit Cost (BDT)	Total Cost (BDT)
1	Arduino Uno	1	750	750
2	Flame Sensor	3	90	270
3	Servo motor	1	150	150
4	DC Motor	4	90	360
5	L-298N Motor Driver	1	450	450
6	65mm Robot Wheel for BO Motors	4	65	260
7	Water Pipe	1	40	40

8	Wire, Resistors, Switch, Capacitor, Transistor	----------	150	150
9	RS-360 mini Water Pump	1	450	450
10	Rechargeable battery	2	100	200
11	Switch	1	65	65
Total Cost (BDT)				3145

6. Functionality Breakdown

- **Functionality 1: Flame Detection and Direction Tracking**
  - **Overview:**

    The robot can detect flames in its surroundings using flame sensors. Once a flame is detected, it calculates the direction of the fire and adjusts its movement accordingly to head towards it.
  - **Working Procedure:**

    1. Workflow: The sensors continuously scan the environment for heat or flame signals.
    2. Sensor Integration: Flame sensors are positioned to cover multiple angles and detect the location of the fire.
    3. Actuator Logic: The DC motors drive the wheels to steer the robot in the direction of the detected flame.
    4. Control Logic: The microcontroller processes data from the sensors and adjusts the robot's movement to align with the flame's position.
    5. Power Management: The entire system is powered by batteries, ensuring consistent operation of sensors, motors, and other components.

- **Functionality 2: Flame Suppression While Advancing**
  - **Overview:**

    As the robot moves toward the flame, it sprays water continuously to extinguish the fire while ensuring it doesn't get damaged by the heat.
  - **Working Procedure:**

    1. Workflow: The robot activates the water pump and moves forward simultaneously once the flame is detected.
    2. Sensor Integration: Sensors monitor the proximity and intensity of the flame to adjust the spraying and movement.

3. Actuator Logic: The water pump is controlled by the microcontroller to start spraying water in the direction of the flame.
4. Control Logic: The microcontroller coordinates the robot's movement and water-spraying actions to ensure steady progress toward extinguishing the fire.
5. Power Management: Batteries power the water pump and motors, ensuring seamless operation.

- **Functionality 3: Multi-Flame Detection and Suppression**
  - **Overview:**

    The robot is capable of extinguishing multiple flames by detecting and moving to new fire sources after the first flame is put out.
  - **Working Procedure:**

    1. Workflow: Once a flame is extinguished, the robot scans the environment again for additional flames and repeats the suppression process.

    2. Sensor Integration: Flame sensors continuously monitor the area, even while the robot is extinguishing a flame, ensuring no fire is missed.

    3. Actuator Logic: The robot adjusts its movement and water-spraying mechanism dynamically to handle multiple flames.

    4. Control Logic: The microcontroller ensures the robot shifts focus to a new flame only after confirming the previous one is fully extinguished.

    5. Power Management: Efficient battery usage supports continuous scanning, movement, and flame suppression.

7. Business Proposal

- **Target Audience:**
  The primary target audience for this robot includes small business owners, educational institutions, and households where fire safety is a concern. It is also ideal for hobbyists,

students, and educators interested in robotics and safety projects. Fire safety personnel could use this as a demonstration tool for training purposes. Additionally, it appeals to tech enthusiasts looking for affordable and functional automation solutions for fire suppression.

- **Market Analysis and Competitors :**
  In the current market, fire safety robots are available but are often costly and designed for large-scale industrial use. Competitors include advanced robotics companies offering high-end fire suppression systems. However, our robot differentiates itself by being cost-effective, compact, and easy to deploy in smaller settings. It serves a niche market of households and small businesses that lack access to expensive fire safety solutions. Furthermore, the integration of simple technology ensures affordability and scalability, providing an edge in educational and entry-level robotics markets.

- **Revenue Model:**
  Revenue can be generated through the sale of the robot as a finished product, as well as through DIY kits targeted at students and hobbyists. Additional income streams include offering workshops or online tutorials for assembling and programming the robot. Partnerships with schools, training centers, and fire safety organizations could provide opportunities for bulk sales. Customization options and future upgrades, such as remote control or advanced fire suppression mechanisms, could also be monetized for premium customers.

8. Potential Challenges

- **Technical Challenges:**
  One of the main technical challenges is ensuring the sensors can detect flames accurately in different conditions, such as bright light or shadows. The motors and water pump might not work as precisely as needed, which could affect the robot's movement and ability to spray water efficiently. Another concern is power management, as inconsistent battery performance could cause the robot to stop working properly during operation.

- **Design Challenges:**
  The robot's small chassis might make it difficult to fit all the components, such as the sensors, water bottle, and pump. Additionally, the weight of the water bottle and other parts needs to be balanced carefully to ensure the robot moves smoothly without tipping over. The overall durability of the design could also be a challenge, especially since water could damage some parts over time.

- **Integration Challenges:**
  Connecting all the components, such as sensors, motors, and the water pump, might lead to wiring complexity. Loose connections or tangled wires could cause the system to malfunction. Compatibility issues between the microcontroller and other parts could also arise, requiring extra debugging or adjustments. Synchronizing all the components to work together in real-time is another potential hurdle.

- **Budget Constraints**:
  The total cost of the project is already close to the allocated budget, which means there's little room for high-quality upgrades or replacement parts. If any components like sensors or motors fail, it might increase the costs and delay the project. Sticking to the budget while ensuring the robot functions well is a key concern.

- **Risk Mitigation:**

  To overcome these challenges, we will conduct thorough testing to ensure that all components, including sensors, motors, and the water pump, work reliably in various conditions. We will use lightweight and compact parts to save space and improve the robot's balance. Our team will organize the wiring neatly to prevent connection issues and keep spare parts on hand to handle replacements quickly. We will also choose high-capacity batteries to ensure a stable power supply and test the robot multiple times before final use. These steps will help us reduce risks and make the project successful.