REPORT

FIRE-FIGHTING ROBOT

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INTRODUCTION

The Firefighting Robot is designed to detect and extinguish small fires automatically or under manual control. It uses multiple sensors to detect smoke, flames, and obstacles, while controlling water spraying through a pump and servo nozzle. This robot aims to enhance safety in hazardous environments where human intervention is risky.

HARDWARE COMPONENTS

Controller Arduino : UNO

Display : LCD I2C (16x2)

Communication : Bluetooth Module

Actuators :

4 × DC Motors (robot movement)

Relay + Water Pump (fire extinguishing system)

Servo Motor (nozzle sweeping left/right)

2 × Buzzers (mode change tone + fire/obstacle siren)

Sensors :

Smoke Sensor (gas/smoke detection)

Flame Sensor (fire/flame detection)

Ultrasonic Sensor (TRIG/ECHO) for obstacle avoidance

Power Supply : Rechargeable Lithium battery

SOFTWARE & LOGIC

The robot is programmed in **C++ using Arduino IDE.**
It has **two operation modes:**

1. **Manual Mode:**
    - Controlled via Bluetooth commands:
        - F → Forward
        - B → Backward
        - L → Left
        - R → Right
        - S → Stop
2. **Automatic Mode:**

- Moves forward by default.
- Uses the ultrasonic sensor to avoid obstacles (reverse + turn).
- Continuously monitors flame and smoke sensors.
- If fire/smoke is detected → starts pump, activates siren, and sweeps nozzle.

Main Functions in the Code

- **Fire Detection:** Reads smoke and flame sensors, compares against thresholds.
- **Siren Control:** Alternates tones for fire/obstacle alerts.
- **Servo Sweep:** Moves nozzle between 70°–110° for water spraying.
- **Obstacle Avoidance:** Stops, reverses, and turns to avoid collisions.
- **LCD Display:** Shows system messages (Mode, Fire, Smoke, Obstacle).

WORKFLOW

1. Robot powers on → calibrates flame sensor baseline.
2. User selects **Manual** or **Auto** mode via button.
3. In case of **fire/smoke detection**:
    - Relay activates water pump.
    - Servo nozzle sweeps left and right.
    - Siren buzzer alerts.
    - LCD displays status.
4. In case of **obstacle detection**:
    - Robot stops and performs avoidance maneuver.
    - LCD updates with distance.

RESULTS

Successfully detects smoke and fire.

Activates pump and sweeps nozzle for extinguishing.

Avoids obstacles in autonomous mode.

Operates in both **Manual** (Bluetooth) and **Auto** modes.

Provides clear alerts via buzzer and LCD.

CONCLUSION & FUTURE ENHANCEMENTS

Conclusion:

The robot successfully achieves its firefighting task and supports dual operation modes.

Future Improvements:

- Add a thermal camera for precise fire detection.
- Integrate GSM/Wi-Fi for remote alerts.
- Increase water storage capacity.
- Optimize battery performance.

REFERENCES

Arduino Documentation

Sensor & Module Datasheets

Open-source robotics projects