■ Firefighting Robot

■ Overview

The Firefighting Robot is an autonomous hardware project designed to detect and extinguish small fires. It uses flame sensors for fire detection, an Arduino-based control system for decision-making, and a water pump with a servo mechanism for suppression.

■ Workflow

1. Power Supply & Regulation - Power from 18650 Li-ion batteries regulated through LM2596HVS.
2. Fire Detection - Flame Sensors monitor the environment and send signals to Arduino.
3. Decision-Making - Arduino processes data and controls motors via L293D.
4. Navigation & Positioning - Robot moves toward fire, stops at safe distance.
5. Fire Suppression - Relay activates water pump, servo positions nozzle.
6. Safety & Reset - Robot retreats and resumes patrol.

■ Materials & Components

Arduino Uno/Nano, LM2596HVS Regulator, L293D Motor Driver, Flame Sensors (2-4), Servo Motor, 5V Relay Module, Water Pump, DC Motors with Wheels, 18650 Li-ion Battery, Chassis Frame, Jumper Wires, Water Tank.

■ Tools Required

Soldering iron and solder, Screwdrivers and pliers, Breadboard or PCB, USB cable for Arduino.

■ Software

Arduino IDE for programming, C/C++ (Arduino language), Optional: Proteus or Tinkercad for simulation.

■■ Working Principle

1. Flame sensors detect IR light emitted by fire.
2. Arduino identifies fire direction by comparing outputs.
3. Robot moves toward fire.
4. Relay activates pump, servo aims spray.
5. Water extinguishes fire, system resets.

■ Block Diagram

[Flame Sensors] --> [Arduino Controller] --> [Motor Driver (L293D)] --> [DC Motors]
|
--> [Relay Module] --> [Water Pump + Servo]
|
[LM2596HVS Voltage Regulator] --> [Battery]

■ Use Cases

Educational robotics projects, Fire safety demonstrations, Small-scale fire suppression in labs or workshops, Proof-of-concept for industrial firefighting robots.

■ Features

Autonomous fire detection and suppression, Directional flame sensing, Portable and battery-powered, Expandable for IoT integration.

■ Future Improvements

Add camera module or thermal imaging, Integrate IoT alerts, Upgrade to metal chassis, Use PID control for smoother navigation.

■■■ Setup & Usage

1. Assemble chassis and connect components.
2. Upload Arduino code via IDE.
3. Fill water tank and power on.
4. Test with a small candle flame.
5. Observe extinguishing process.

■■ Safety Precautions

Test with small flames only, Keep fire extinguisher nearby, Avoid flammable materials, Use proper insulation.