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PROJECT DOCUMENTATION

Monufia National University

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subject:
Wireless & Mobile Sensing

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Fire Fighting Robot documentation

overview

A **fighting robot** is a compact, remote-controlled or autonomous machine designed for competitive battles in an arena. Powered by an **Arduino board**, it combines motors for mobility, sensors for detection, and actuators for attacking

Define the problem

The technology behind fighting robots can be adapted to address the critical problem of detecting and combating forest fires, which cause extensive environmental damage and threaten wildlife and human communities.

Forest fires often spread rapidly in remote, hard-to-access areas, making it difficult for firefighters to detect and control them in time. Traditional firefighting methods are labor-intensive, risky, and may lack precision.

Solution

A fighting robot, equipped with Arduino-controlled systems, can be modified to tackle this issue:

1. **Mobility**: The robot's compact design allows it to navigate rugged forest terrain, reaching areas inaccessible to humans.
2. **Sensors for Detection**: Using heat and smoke sensors, it can detect fires early, sending real-time data to authorities for rapid response.
3. **Combat Mechanism**: Instead of offensive weapons, the robot can be equipped with water sprayers or fire-retardant dispersers to combat small fires directly.
4. **Autonomy**: With autonomous functionality, it can patrol forests continuously, monitoring and mitigating fire risks without endangering human lives.

By leveraging fighting robot technology, we can develop cost-effective, efficient solutions for forest fire detection and control, reducing damage and enhancing safety for both humans and ecosystems.

1-Function of the Circuit

The Fire Fighting Robot using Arduino consists of several key components that perform specific functions to enable the robot to detect, navigate, and combat fire. Below is a breakdown of the main components and their functions:

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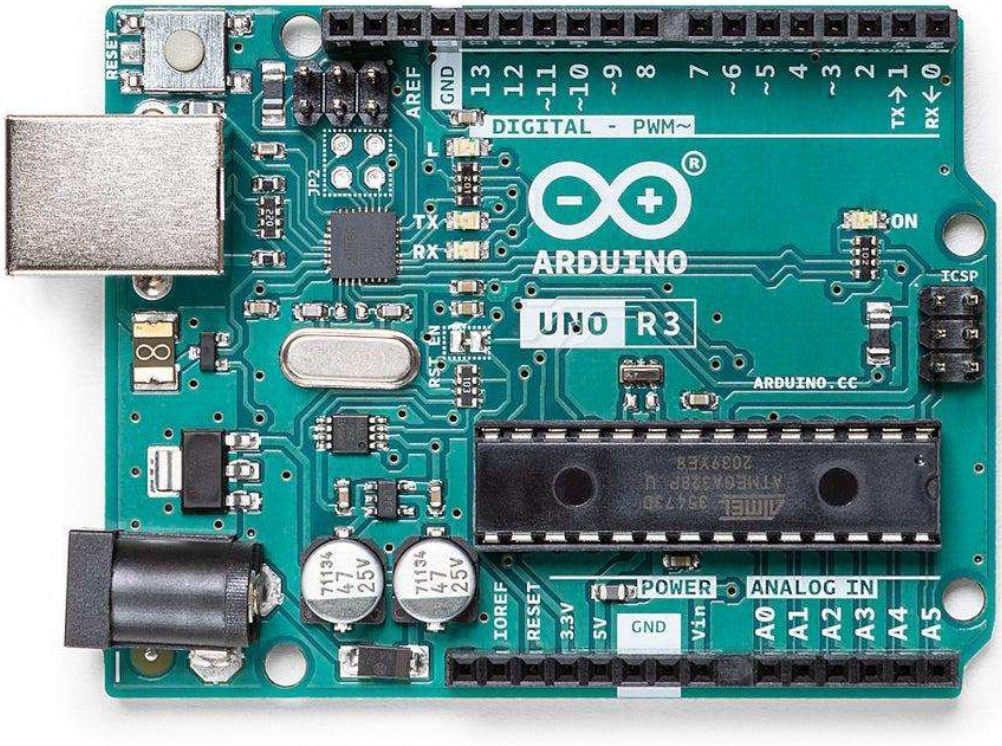
1) Arduino Uno Rev3



- **Function**: Acts as the brain of the robot, controlling all other components and executing the programmed instructions.
- **Details**:
  - Processes sensor inputs (e.g., heat and flame detection).
  - Controls motors, the water pump, and other actuators.
  - Interfaces with external modules like the Bluetooth module for communication.

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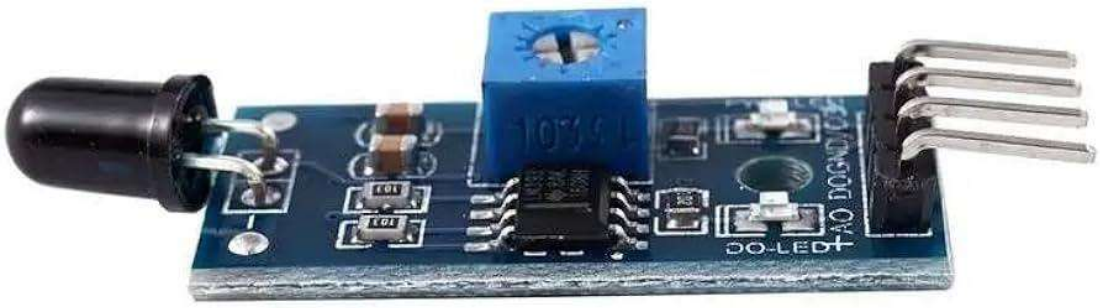
2) Flame Sensor Module



- **Function**: Detects the presence of flames within its range.
- **Details**:
  - Converts light intensity from flames into electrical signals.
  - Sends data to the Arduino for decision-making.
  - Allows the robot to locate and focus on fire sources.

3) L298 Motor Driver Module

- **Function**: Drives the robot's motors for movement.
- **Details**:
  - Controls the direction and speed of the DC motors.
  - Supports the dual-shaft motors used for navigation.
  - Receives commands from the Arduino to enable autonomous movement.

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4) DC Geared Motors (Dual Shaft, 450RPM)

- **Function**: Provides mobility for the robot.
- **Details**:
  - Ensures stable and precise movement, even on rugged terrains.
  - Dual shafts allow flexibility in motor placement for effective movement.

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5) Micro Water Pump

- **Function**: Dispenses water or fire-retardant material to extinguish flames.
- **Details**:
  - Activated by the Arduino upon detecting a fire.
  - Sprays liquid in the direction of the detected fire, enabling effective fire suppression.

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6) Bluetooth Module V4.0 CC2541

- **Function**: Enables wireless communication between the robot and a smartphone or computer.
- **Details**:
  - Allows the user to monitor and control the robot remotely.
  - Facilitates manual overrides in case of emergencies.

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7) Ultrasonic Sensor

- **Function**: Monitors the water level in the robot's tank.
- **Details**:

- Measures the distance between the sensor and the surface of the water.
- Sends real-time data to the Arduino to detect whether the tank is empty or full.
- Prevents the water pump from running if the tank is empty, avoiding motor damage.

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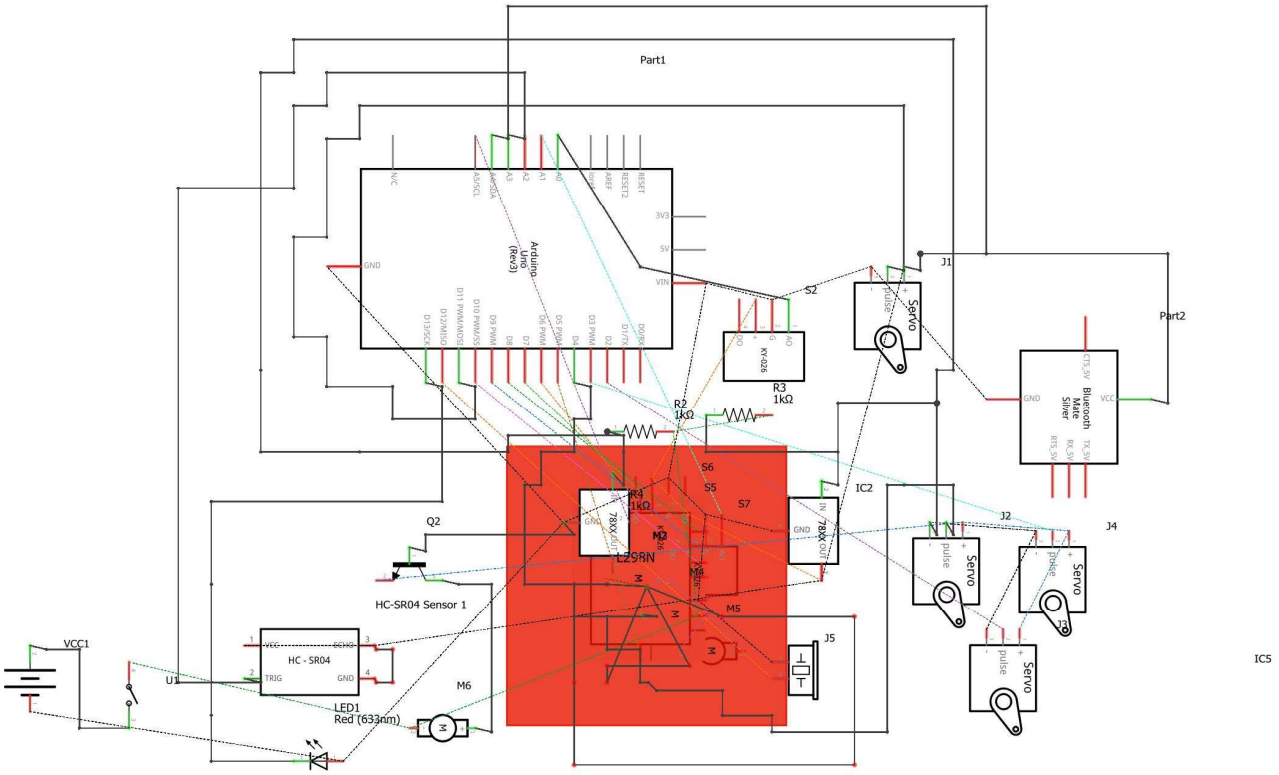
8)Rechargeable Li-ion Batteries

- **Function**: Supplies power to all components.
- **Details**:
  - Provides a reliable power source for prolonged operation.
  - Supports the high current demands of motors and the water pump.

2-Schematic Diagram



3-Bill of Materials

Product Description	Approximate Price (USD)	Quantity	Specifications	Notes
Arduino Uno Rev3	8.60	1 unit	Arduino	Ideal for beginners in programming and electronics
18650 Battery Case Holder 3 Cells	0.38	1 unit	3 Cells Holder	Suitable for mounting 18650 cells in power projects
Ceramic Capacitor 33pF 50V	0.03	3 units	33pF 50V Capacitor	Used for signal filtering and reducing interference
Power Transistor TO-220	0.18	1 unit	Tip122 5A 100V NPN	Suitable for controlling large motors and electrical devices
DC Geared Motor Dual	3.60	4 units	Shaft 3-12VDC 450RPM with Wheel	Used in robotics and mechanical projects
PU Clear Hose Tube Pipe	0.32	1 meter	1 Meter (6.5x4.5mm)	Used for liquid transport in small-scale projects
Rechargeable Li-ion Battery	4.80	3 units	18650 Samsung 22F 2200mAh	Strong batteries compatible with many projects
Magnetic Buzzer	0.16	1 unit	6V 12mm 2 Pin	Used to produce sound in electronic projects
L298 Motor Driver Module	1.60	1 unit	12V input 4 DC motors, or 2 DC motors with directional and speed control.	Used to drive motors in robotics
Micro Water Pump	3.70	1 unit	370C 6V 1LPM 200kpa	Suitable for small water pumping projects
Trimmer Potentiometer	0.07	1 unit	PT10M-V10 10mm 100KΩ 3 Pins	Used to adjust resistance in electronic circuits
Trimmer Potentiometer	0.14	1 unit	3386H-1-104TLF 100kOhm 0.5W 3 Pins	Used to adjust voltage or current in precision circuits
Carbon Resistor	0.05	10 units	1KΩ 0.5W Through Hole	Used to limit current in electronic circuits
Flame Sensor Module 4 Pins Blue Version	2.10	3 units	3.3V - 5V DC	Used to detect flames in security projects
Toggle Switch	0.40	1 unit	2 Pins 15A E-TEN1021 ON/OFF	Used for controlling circuits in electronic projects
Bluetooth Module V4.0 CC2541 (Android&IOS BT-05)	6.00	1 unit	2.0V to 3.6V	Used for wireless communication via Bluetooth
Jumper Wire 20 cm (Male to Female Pin)	1.00	70 units	Male to Female Pin	Used to connect components in electronic projects
Jumper Wire 20 cm (Male to Male Pin)	0.90	50 units	Male to Male Pin	Used to link components in electronic circuits
ultrasonic sensor hc-sr04	1.18	1 unit	5V DC	used for measuring distances by emitting high-frequency sound waves and measuring the time it takes for them to bounce back.
regulator 7805	0.12	3units	9V to 12V	used linear voltage regulator that outputs a steady 5V from a higher input voltage

4-Data sheets

•Arduino Uno Rev3
Datasheet:https://docs.arduino.cc/resources/datasheets/A000066-datasheet.pdf

•Battery Case Holder (3 Cells)
Datasheet:https://www.digikey.com/en/htmldatasheets/production/1298968/0/0/1/18650-lithium-ion-battery-holders

•Ceramic Capacitor 33pF 50V
Datasheet:https://www.farnell.com/datasheets/2577800.pdf

•Power Transistor TO-220
Datasheet:https://www.farnell.com/datasheets/309521.pdf

•DC Geared Motor Dual
Datasheet:https://media.crouzet.com/datasheets/english/dc-motors-d-c-geared-motors-with-brushes-2-nm-double-ovoid-3-9-watts-3-9-w-Part%20number-82869014.pdf

•Rechargeable Li-ion Battery
Datasheet:https://www.ineltro.ch/media/downloads/SAAItem/45/45958/36e3e7f3-2049-4adb-a2a7-79c654d92915.pdf

•Magnetic Buzzer
Datasheet:https://www.farnell.com/datasheets/2171929.pdf

•L298 Motor Driver Module
Datasheet:https://www.sparkfun.com/datasheets/Robotics/L298_H_Bridge.pdf

•Micro Water Pump
Datasheet:https://5.imimg.com/data5/IQ/GJ/PF/SELLER-1833510/dc-mini-submersible-water-pump.pdf

•Trimmer Potentiometer
Datasheet:https://www.farnell.com/datasheets/1506494.pdf

•Carbon Resistor
Datasheet:https://assets.rs-online.com/v1699613067/Datasheets/7ec977c91977fd4e95a020bd86d6d6c5.pdf

•Flame Sensor Module 4 Pins Blue Version
Datasheet:https://rogerbit.com/wprb/wp-content/uploads/2018/01/Flame-sensor-arduino.pdf

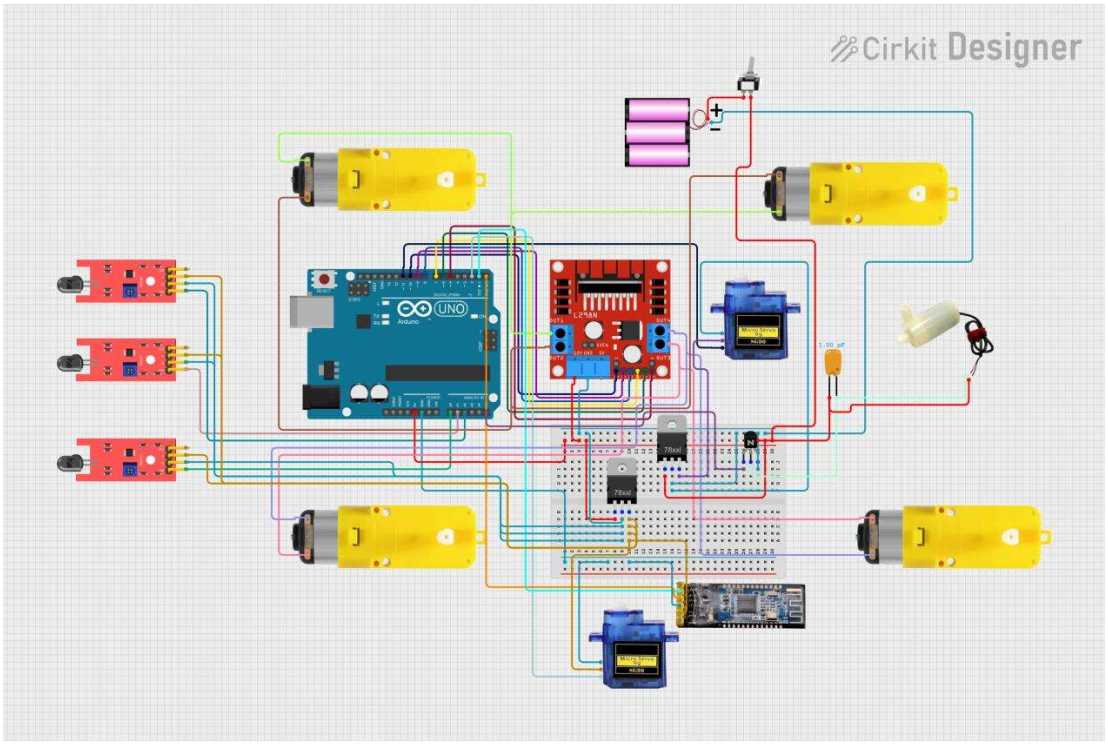
•Toggle Switch
Datasheet:https://www.farnell.com/datasheets/32931.pdf

•Bluetooth Module V4.0 CC2541 (Android & iOS BT-05)
Datasheet:https://people.ece.cornell.edu/land/courses/ece4760/PIC32/uart/HM10/DSD%20TECH%20HM-10%20datasheet.pdf

•Ultrasonic Sensor HC-SR04
Datasheet:https://cdn.sparkfun.com/datasheets/Sensors/Proximity/HCSR04.pdf

•Regulator 7805
Datasheet:https://www.sparkfun.com/datasheets/Components/LM7805.pdf

5-Board



Board (PCB Printed Circuit Board)