Ahsanullah University of Science & Technology
Department of Computer Science & Engineering

HYDREGION (A Firefighter Robot)

Project Report

Microprocessors and Microcontrollers Lab (CSE 3118)

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Objective

Our project showcases the development of a Fire Fighting Robot. The objective of our project, is to assist in extinguishing fires and minimize the risk to human firefighters. These robots are designed to navigate through hazardous environments, including confined spaces, debris-filled areas, or unstable structures and carry out firefighting tasks autonomously or under remote control enhancing efficient navigation, effective fire suppression, remote operation and monitoring, adaptability to various fire scenarios. By achieving these objectives, firefighting robots can assist human firefighters in extinguishing fires more efficiently, protecting lives and property.

The use of Arduino microcontrollers provides a flexible and programmable platform for controlling the robot's movements, sensors, and firefighting mechanisms. By utilizing Arduino in a firefighting robot, it can integrate sensors, control actuators and enable effective communication. Arduino's flexibility and modularity allow customization and adaptation, making it a valuable component in developing efficient and capable firefighting robots.

Social Values:

The use of firefighting robots can bring several social values and benefits like,

Human Safety: Firefighting robots can operate in hazardous and life-threatening environments, reducing the risk to human firefighters. By replacing or assisting human intervention in dangerous situations, these robots help protect the lives and well-being of firefighters.

Enhanced Efficiency and Effectiveness: Firefighting robots can improve the efficiency and effectiveness of firefighting operations. They can quickly detect fires, navigate through challenging terrains, and suppress the flames more accurately. This leads to faster response times and increased chances of successful fire containment and extinguishment.

Alerting and Warning: Using an alarm in a firefighting robot can create public awareness and recognition. It helps individuals to follow safety protocols, evacuate if necessary, and cooperate with firefighting personnel. This recognition can encourage people identify the presence of a firefighting operation in progress and raises awareness about ongoing fire safety efforts.

Reduced Property Damage: By swiftly detecting and responding to fires, firefighting robots can help minimize property damage. Their ability to access inaccessible or dangerous areas and apply targeted firefighting methods can help control fires more effectively, limiting the extent of destruction and saving valuable assets.

24/7 Availability: Firefighting robots can operate continuously, providing round-the-clock fire monitoring and response capabilities. They do not tire or require rest, ensuring constant vigilance and immediate action when fires occur. This capability is particularly valuable in scenarios where human resources may be limited or response time is critical.

Remote Assistance in Critical Situations: Firefighting robots can provide remote assistance in critical situations where human access is limited or dangerous. In scenarios such as chemical fires, explosions, or structural collapses, the robot can be deployed to gather crucial information, assess risks, and relay data to human operators.

Access to Confined Spaces: Firefighting robots are designed to access confined spaces such as narrow corridors, staircases, or areas with structural instability. Their compact size and maneuverability enable them to reach areas that may be challenging for human firefighters to access. This allows for comprehensive fire suppression efforts and reduces the likelihood of fire spreading.

Humanitarian Aid in Disaster Zones: Firefighting robots can be deployed in disaster zones, providing humanitarian aid beyond firefighting. These robots can assist in search and rescue operations, locating survivors, delivering supplies, or assessing structural integrity. Their versatility and adaptability make them valuable assets in post-disaster recovery efforts.

Cost-Effective Solutions: While the initial investment in firefighting robots may be significant, the long-term benefits can outweigh the costs. Firefighting robots can reduce property damage and mitigate the financial losses associated with fire incidents. They can also optimize resource allocation by minimizing the need for additional manpower and equipment in certain scenarios.

Overall, firefighting robots contribute to social values such as human safety, efficiency, property protection, rapid response, firefighter training, public trust, and technological advancement. By leveraging technology to enhance firefighting capabilities, these robots play a significant role in safeguarding lives, reducing damage, and improving the overall effectiveness of firefighting operations.

Required Components:

- Arduino Uno r3
- Jumper wire
- Pipe line for water
- Double side foam tape
- Water container
- Bo motor
- 18650 battery
- Mini servo
- Wheel
- Flame sensor
- L293d motor driver
- Battery holder
- Mini bread board
- Board sheet "22x15"
- Glue gun
- Mini water pump
- Switch
- Transistor
- Resistor

Working Procedure:

A fire-fighting robot using Arduino typically involves several components and sensors to detect and extinguish fires. Here's a general outline of the working procedure:

Fire Detection:

- Flame Sensor: The robot is equipped with flame sensors to detect an increase in temperature, indicating the presence of a fire.

Movement Control:

- Motors: The robot is equipped with BO motors and servo motors to enable movement in various directions.
- Motor Controller: An Arduino-compatible motor driver module is used to control the motors and provide appropriate voltage and current to drive them.

Alarm Activation:

- Buzzer: When the fire sensors detect fire or smoke, they will send a signal to the Arduino to activate an alarm. The robot will be connected to a loudspeaker or buzzer to sound the alarm.

Fire Extinguishing:

- Water/Solution Dispenser: The robot can be equipped with a water tank or fire extinguishing solution reservoir.
- Pumping Mechanism: A water pump or similar mechanism is used to spray water or fire-suppressing solution on the fire.
- Nozzles: Multiple nozzles can be installed to cover a larger area while extinguishing the fire.

Control and Communication:

- Arduino Board: An Arduino microcontroller board acts as the brain of the robot, receiving sensor inputs and controlling the actuators.
- Wireless Module: A wireless communication module, such as Wi-Fi or Bluetooth, can be used for remote control or to send status updates and alerts.

Firefighting Logic:

- Programming: The Arduino board is programmed using the Arduino IDE or other compatible software. The program includes logic to interpret sensor data, make decisions, and control the robot's movements and firefighting actions.
- Decision-Making: Based on the sensor inputs, the robot determines the fire's location, calculates the optimal path, and decides when to dispense water or fire-suppressing solution.
- Autonomous Operation: The robot can be designed to operate autonomously, continuously scanning for fires, moving towards them, and extinguishing them until a predefined condition is met.

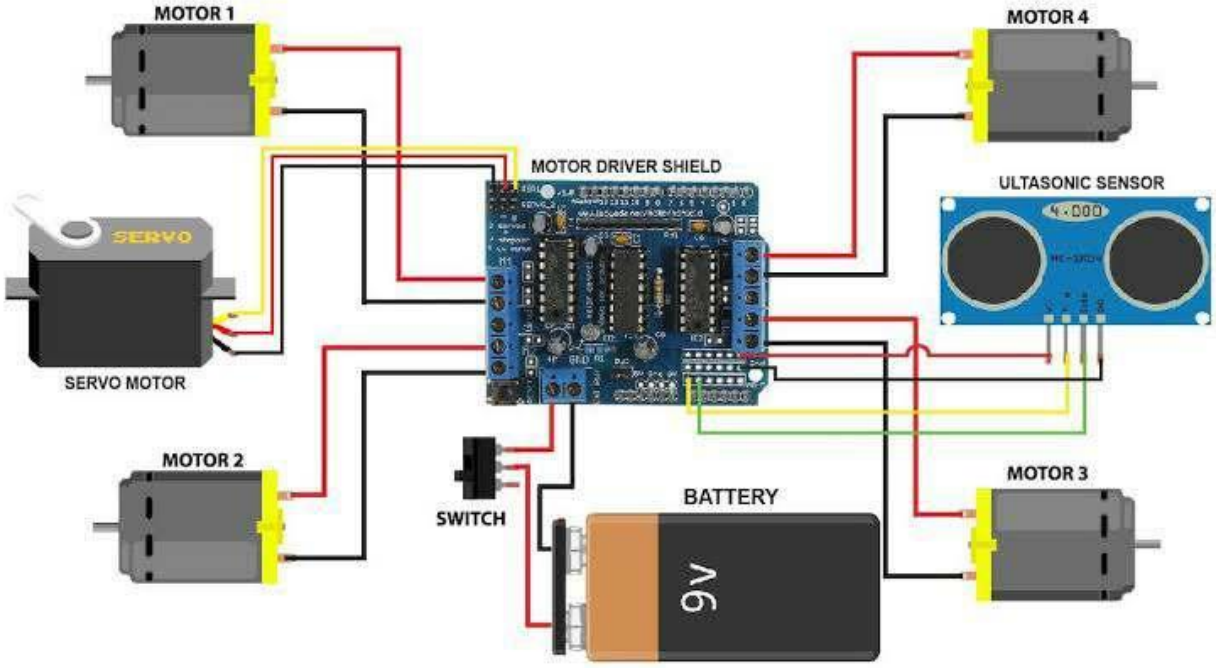


Figure: Circuit Diagram

The project entails constructing a robotic vehicle utilizing an Arduino UNO microcontroller as its central processing unit. It incorporates a range of components, including Li-Ion battery, RGB LED, flame sensor, USB-A to B cable, wires, wifi module, motor driver, servo motor, gear motors, wheels, and foam board.

The vehicle is operated using an android app. The flame sensor detects the presence of fire around the environment. The Arduino UNO processes this data and commands the gear motors to navigate around obstacles, ensuring a safe trajectory and a relay module is used to control the water flow

The wifi control functionality enables wireless communication between users and the vehicle via wifi. Commands from a mobile device are transmitted to the Arduino UNO, which interprets and executes them. User commands can dictate the vehicle's movements, including forward, backward, left, and right.

Estimated Budget:

Equipment	Quantity	Price
ARDUINO UNO R3	1	1,100
Jumper wire	1 set	100
Pipe line for water	1	50
Double side Foam Tape	1	100
Water Container	1	20
BO motor	4	75*4 = 300
18650 battery	2	115*2 = 230
Mini servo	1	150
Wheel	4	70*4 = 280
Flame sensor	3	50*3 = 150
L293D Motor Driver	2	300*2 = 600
Battery Holder	1	55
Mini Bread Board	1	45
Board Sheet "22x15"	1	50
Glue Gun	1	200
Mini Water Pump	1	145
Switch	1	6
Transistor	1	5
Resistor (1k)	1	2
Wi-Fi Module	1	1200
Buzzer	1	25
		Total : 4813

Pictures of the project:

Including a visual depiction of our robot to bring our documentation to a new level of usefulness. These images provide a tangible knowledge of the robot's design by displaying its multiple pieces, the precision with which it is assembled, and its valuable uses.

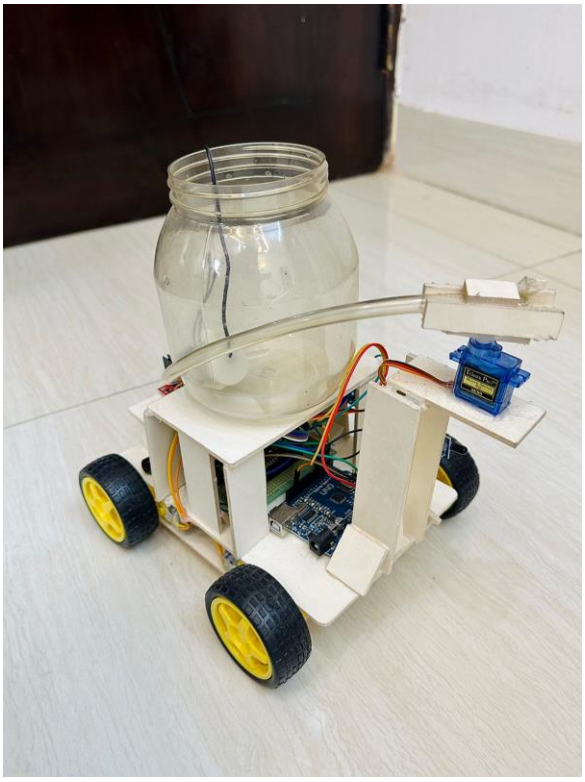
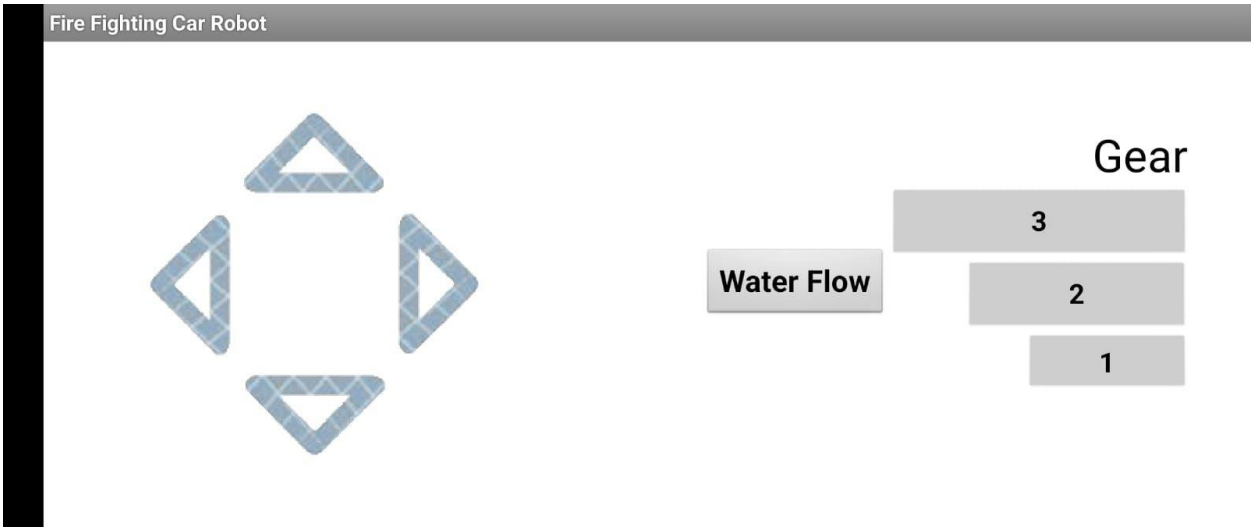


Figure: Hydregion (A Fire Fighting Robot)

Picture of the application used to control the robot:



Conclusion:

In conclusion, the development of a fire-fighting robot using Arduino has shown great potential in enhancing fire safety and emergency response. The robot successfully incorporates fire detection, alarm activation, localization and navigation, fire extinguishing mechanisms, and a user interface to facilitate its operation.

By utilizing fire sensors, the robot is capable of swiftly detecting the presence of fire or smoke, ensuring prompt response and intervention. The integration of an alarm system effectively alerts individuals in the vicinity, enabling timely evacuation and reducing potential risks. As technology advances, further improvements can be made to enhance the robot's capabilities and integrate it seamlessly with existing fire safety systems.