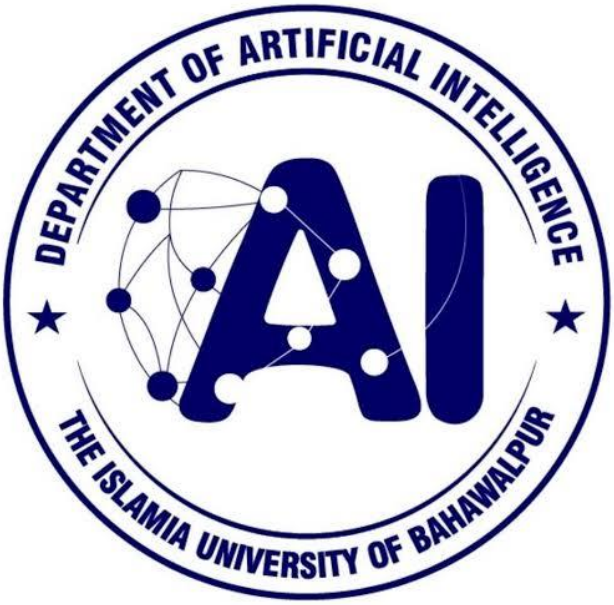
Project Report

Project Supervisor:

- **Sir Mobeen Shahroz.**

Team members:

- **Faisal Shahzad.**
- **Shoaib Awais.**
- **Muhammad Hassan Imtiaz.**
- **Abdul Hadi.**



AI INNOVATORS

Department of Artificial Intelligence
Faculty of Computing - The Islamia University of Bahawalpur

Project Proposal: Fire Fighting Robot

Introduction:

Robotics is an interesting and fun field with lot of potential for exploration and new discoveries. Robotics is an interdisciplinary field that merges engineering, computer science, and technology to create intelligent machines capable of performing tasks autonomously. This dynamic domain focuses on designing, building, and programming robots that can interact with their environment and execute complex functions. We explore with the **Fire Fighting Robot.**

Problem Statement:

This project aims to address the problem by developing a firefighting robot capable of detecting and suppressing fires autonomously. The robot will be equipped with sensors to detect the presence of fire, a navigation system to maneuver around obstacles, and a suppression mechanism to extinguish the fire effectively. The goal is to create a reliable and efficient robot that can operate in environments where human intervention is limited or unsafe.

Statement:

Firefighting robots are an essential innovation designed to address the limitations and dangers associated with traditional firefighting methods. By autonomously detecting and extinguishing fires, these robots can operate in hazardous environments, reducing risks to human life and ensuring faster response times. The development of such a robot involves integrating sensors, navigation systems, and suppression mechanisms into a compact and reliable device capable of operating in various settings. The objective is to create a robot that can function effectively in real-world fire scenarios, providing a critical tool in emergency response.

Key Points of Concern for a Firefighting Robot Project:

1. Reliability in Extreme Conditions
2. Accuracy in Fire Detection
3. Obstacle Navigation
4. Durability and Maintenance
5. Battery Life and Power Failure

All of these things are technical but straightforward, the industry pushing to create more and more human-like machines, there’s a certain fog surrounding the discipline.

Objective:

The objective of this project is to design and build an autonomous robot capable of detecting and extinguishing fires in a controlled environment. The robot will be equipped with various sensors and actuators to navigate the area, locate the source of the fire, and extinguish it efficiently.

- Develop an autonomous robot capable of detecting and extinguishing fires.
- Implement sensors for flame detection, temperature monitoring, and obstacle avoidance.
- Design a robust chassis that can navigate through obstacles and uneven surfaces.
- Integrate a water or chemical extinguisher system for fire suppression.
- Test the robot in various simulated fire scenarios.

Features:

1. Autonomous Navigation:

The robot is equipped with advanced algorithms and sensors (such as LIDAR, infrared, and ultrasonic) to autonomously navigate through obstacles, confined spaces, and hazardous environments.

2. Fire Detection Sensors:

The robot utilizes multiple sensors, including flame sensors, temperature sensors, and smoke detectors, to accurately identify the location and intensity of a fire.

3. Obstacle Avoidance:

- With real-time obstacle detection, the robot can avoid furniture, debris, and other impediments while moving toward the fire source.

4. Environmental Mapping:

The robot can create a map of its environment using sensors, which helps it plan the most efficient route to reach the fire.

5. Real-Time Monitoring and Alerts:

- The robot is capable of sending live data, including video feeds and sensor readings, to a remote control center, enabling real-time monitoring and decision-making.

Specifications/Hardware:

1. Arduino Uno:

The Arduino Uno serves as the brain of the robot, controlling all the sensors, actuators, and communication modules. It receives input from the flame, temperature, and smoke sensors to detect the presence of fire and then processes this information to decide on the robot's actions.

2. Flame Sensors:

Infrared Flame Sensor / UV Flame Sensor: Detects the presence of fire by sensing the infrared or ultraviolet radiation emitted by flames.

3. Servo Motors:

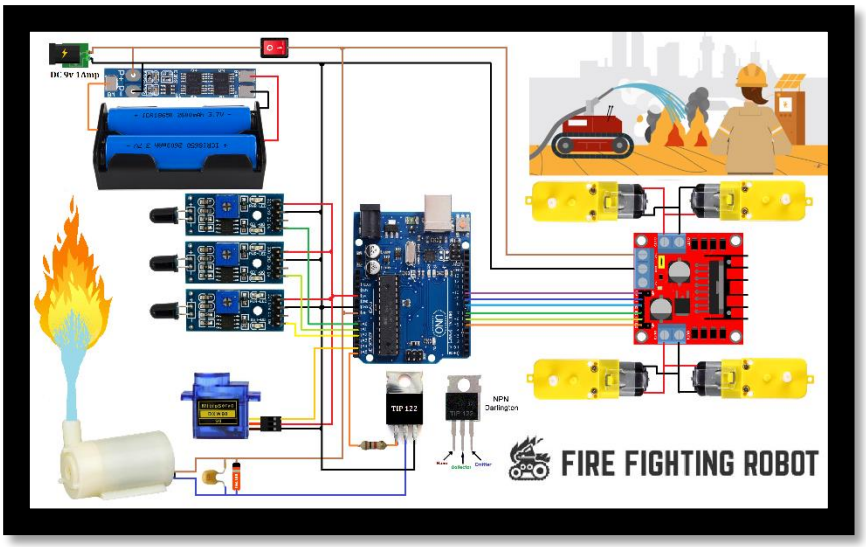
Responsible for driving the wheels or tracks, enabling the robot to move and navigate.

4. Battery:

Provides power to all the components of the robot. The capacity depends on the power requirements and expected operating time.

5. Smoke Sensors:

MQ-2 / MQ-7 Gas Sensors: Detects smoke and harmful gases, indicating the presence of fire even in the absence of visible flames.



Methodology

1. Research and Planning

- Analyze existing firefighting robots and identify key features.
- Study the types of sensors and actuators required for fire detection and suppression.
- Develop a project timeline and allocate tasks.

2. Design and Prototyping

- **Chassis Design:** Design a mobile base capable of navigating the environment.
- **Sensor Integration:** Integrate flame, smoke, and temperature sensors for fire detection.
- **Extinguishing Mechanism:** Design a system to deploy water or chemical agents for fire suppression.
- **Control System:** Develop a microcontroller-based control system for autonomous operation.

3. Implementation

- Assemble the robot based on the design specifications.
- Program the control system to handle navigation, fire detection, and suppression.
- Calibrate sensors for accurate fire detection and navigation.

4. Testing and Validation

- Create a controlled environment to simulate fire scenarios.
- Test the robot's ability to detect and extinguish fires.
- Analyze the robot's performance and make necessary adjustments.

5. Deployment and Demonstration

- Present the robot in a demonstration environment.
- Discuss potential improvements and future applications.

Logic:

The firefighting robot using an Arduino Uno operates by continuously monitoring its environment through flame, temperature, and smoke sensors. When the sensor readings exceed predefined thresholds, the robot confirms the presence of fire by cross-checking data from multiple sensors. Upon detection, the Arduino triggers the motors to navigate the robot towards the fire, avoiding obstacles using ultrasonic sensors. Once at the fire source, the Arduino activates the fire suppression system, such as a water

pump, to extinguish the fire. This logic ensures an efficient and autonomous response to fire incidents.

Future upgradation:

Future upgrades for the firefighting robot could include AI for smarter fire detection, LIDAR for better navigation, wireless communication for remote monitoring, modular extinguishing systems for different fire types, and extended battery life for longer operation.