CSE 461 Project Report
Firefighting Robot
Group 3

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Introduction:

The duty of robotics is to produce effective solutions for real-world problems which constantly strive for innovation. One of these challenges is the protection and security of various environments that arise from potential fire hazards.The ability to properly detect fire and efficiently take measures to suppress it is the main goal of our robot.This report provides a comprehensive overview of the design, implementation and operational capabilities of our robot. Combining the principles of fire detection and suppression, the robot provides various applications in firefighting, industrial safety etc.

Application area:

The most desirable application for our robot is in urban conditions and emergency situations where it is essential to combat fires swiftly. Urban conditions can provide drastic challenges such as densely packed structures, rubbles and other structures impeding access and hindering rescue efforts. Our robot can successfully detect fires and spray water halting further expansion of the fire.

Components:

- Arduino Uno microcontroller board
- Motor driver controller (for controlling the DC motors)
- Batteries
- Jumper Wires
- Water Container
- Relay (likely used for controlling high voltage or high current devices like the water pump)
- 1 Servo motor (for precise angular control)
- Water pump (for pumping water, likely used in firefighting mechanism)
- 3 Infrared (IR) sensors
- 2 DC motors
- Passive components
- Breadboard

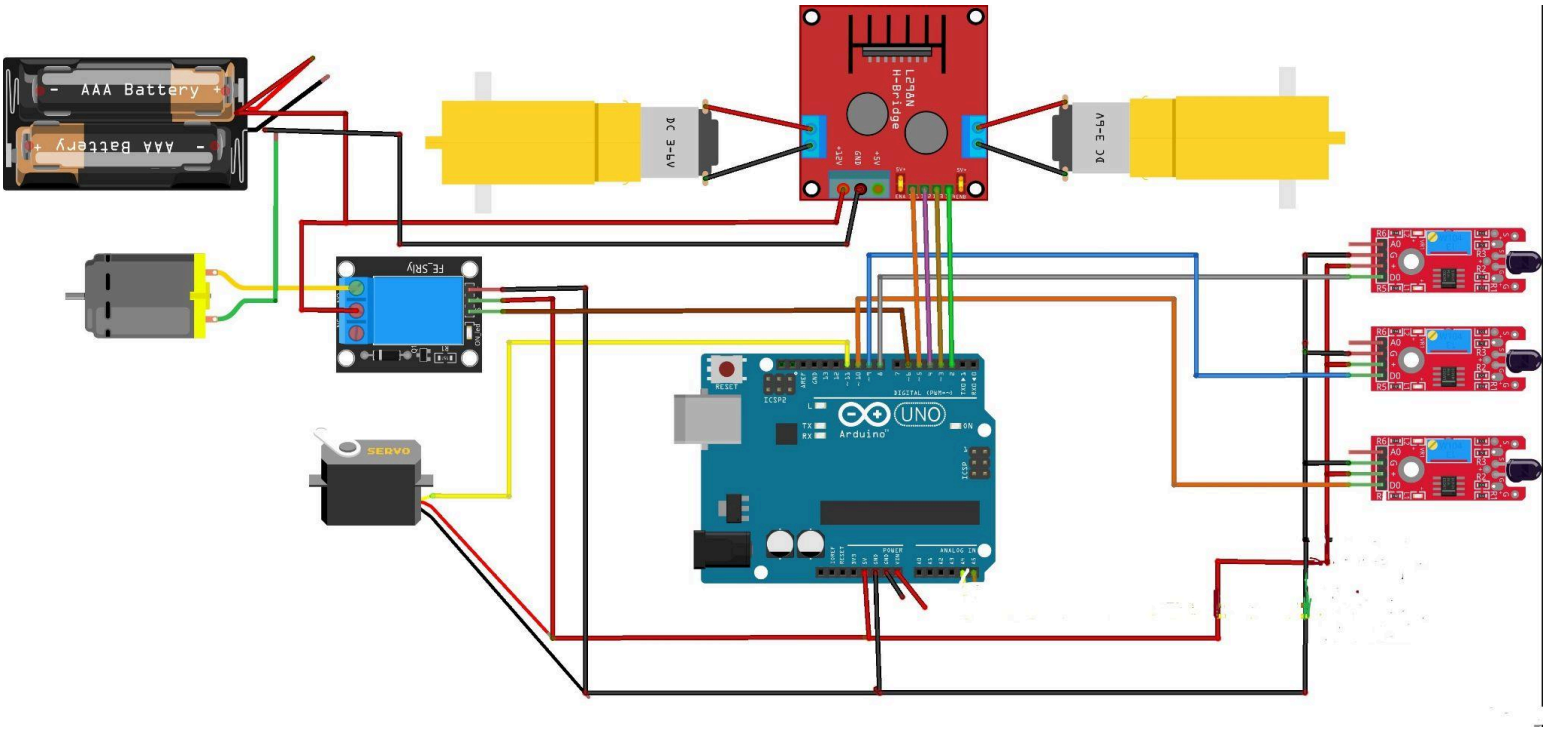

Diagram:

Code:

```
#include <Servo.h>  //include servo.h library
Servo myservo;
int pos = 0;
boolean fire = false;
#define Left 9      // left sensor
#define Right 10    // right sensor
#define Forward 8   //front sensor
#define LM1 2       // left motor
#define LM2 3       // left motor
#define RM1 4       // right motor
#define RM2 5       // right motor
#define pump 6
void setup()
{
```

```
  pinMode(Left, INPUT);
  pinMode(Right, INPUT);
  pinMode(Forward, INPUT);
  pinMode(LM1, OUTPUT);
  pinMode(LM2, OUTPUT);
  pinMode(RM1, OUTPUT);
  pinMode(RM2, OUTPUT);
  pinMode(pump, OUTPUT);

  myservo.attach(11);
  myservo.write(90);
}

void put_off_fire()
{
    delay (500);

    digitalWrite(LM1, HIGH);
    digitalWrite(LM2, HIGH);
    digitalWrite(RM1, HIGH);
    digitalWrite(RM2, HIGH);

   digitalWrite(pump, HIGH);
   delay(500);

    for (pos = 50; pos <= 130; pos += 1) {
    myservo.write(pos);
    delay(10);
  }
  for (pos = 130; pos >= 50; pos -= 1) {
    myservo.write(pos);
    delay(10);
  }

  digitalWrite(pump,LOW);
  myservo.write(90);

  fire=false;
}

void loop()
{
   myservo.write(90); //Sweep_Servo();
```

```
    if (digitalRead(Left) ==1 && digitalRead(Right)==1 && digitalRead(Forward) ==1)
    {

    digitalWrite(LM1, HIGH);
    digitalWrite(LM2, HIGH);
    digitalWrite(RM1, HIGH);
    digitalWrite(RM2, HIGH);
    }

    else if (digitalRead(Forward) ==0)
    {
    digitalWrite(LM1, LOW);
    digitalWrite(LM2, HIGH);
    digitalWrite(RM1, HIGH);
    digitalWrite(RM2, LOW);
    fire = true;
    }

    else if (digitalRead(Left) ==0)
    {
    digitalWrite(LM1, HIGH);
    digitalWrite(LM2, HIGH);
    digitalWrite(RM1, HIGH);
    digitalWrite(RM2, HIGH);
    }

    else if (digitalRead(Right) ==0)
    {
    digitalWrite(LM1, HIGH);
    digitalWrite(LM2, HIGH);
    digitalWrite(RM1, HIGH);
    digitalWrite(RM2, HIGH);
    }

delay(300); //distance change here


     while (fire == true)
     {
      put_off_fire();
     }
}
```

Future scope:
Enhanced Suppression Mechanisms: The next step of our project is to include features that use variable nozzles and pressure controls to control the intensity of the spraying water depending upon the size of fire. Additionally, other forms of fire suppression methods can be installed, like CO_2 and inert gasses for extinguishing fires in confined spaces

Integration of Advanced Sensors: Incorporating other advanced sensors like thermal imaging cameras, gas sensors for detecting hazardous flames and LIDAR for improved detection. These can drastically improve the ability of the robot to detect fires and more efficiently navigate through hazardous environments.

Challenges:
The most challenging part of this project was to properly synchronize the hardware and software part of our robot. Numerous tests and scenarios were carried out to check the reliability of our sensors and the proper implementation of our code. Most importantly, the lack of reliability of our IR sensor posed the biggest challenge and we had to constantly replace it with newer ones. It is very difficult to properly integrate ultrasonic sensors with our robot.

Video Link:
https://www.youtube.com/shorts/giCbLVWW8UE

Conclusion: In conclusion, the development of a fire fighting robot with water spraying capabilities presents a monumental advancement in robotics for emergency and urban safety scenarios. Through the usage of advanced sensors, actuators and control algorithms in aligning with complex hardware-software synchronization, it addresses the solution of fire outbreak in critical situations that are difficult to manually put out and thus comes the effectiveness of our robot..