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Fire Fighting Robot

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Abstract: *The profession of a firefighter has always continued to be dangerous, even as the world takes baby steps toward a more automated and self-driving tomorrow. Because the flames can spread fast if not put out immediately, firefighters are almost always caught in a life-threatening situation. Our robot firefighting system provides a rather ingenious solution to that dilemma and saves these unsung heroes. An Arduino Uno development board serves as a central controller for this self-sufficient firefighting robot. It senses the presence of neighboring bright flames; thus, it can respond quickly and accurately. As soon as fire is detected, a water spray mechanism actuated by a servo motor is activated. The servo motor successfully aims the nozzle at the fire by rotating to create an optimal spray pattern. In order to provide a constant water supply in case of fires, a water pump also raises water from the main water tank to the nozzle. The operation of this technology minimizes human involvement by acting in dangerous conditions and preserves lives*

Keywords: Firefighting Robot, Autonomous Fire Extinguishing, Fire Detection, Servo Motor

I. INTRODUCTION

Fire poses a constant danger to human life and property, especially in urban organizations where the rapid spreading of fire can lead to disastrous consequences [1]. Firefighters remain at risk of dying at the very least during the suppression of fires drastically improved safety procedures [2]. One of the potential alternatives outlined to reduce this risk is automation and the development of intelligent robotic systems [3]. Robotic firefighting systems are built in such a manner that they can operate within environments that are adverse toward human beings, and thus protect lives [4]. One significant technical breakthrough is the Arduino-based Fire Fighting Robot which is utilized as an inexpensive fire-detection platform [1]. The other advantage is an adaptable suppression technique suitable for several levels of firefighting operations [4]. The fire-sensor real-time handling will initiate the robot's water spraying mechanism based on exceptional flame-sensing sensitivity and precision of the exact fire location [3]. The nozzle spray can be turned around by a servo motor, hence ensuring optimal coverage of the affected area [5]. Besides, it enhances firefighting by providing an uninterrupted flow of water from the main tank to the nozzle [4]. The deployment of these types of autonomous systems mitigates key safety issues by reducing human involvement [2]. Moreover, it demonstrates how technology can save lives and serve as a milestone in including robotics in emergency response situations [5]. In this study article, the design, development, and working of an Arduino-based firefighting robot are investigated to lend insight into the understanding of the potential of these technologies in saving lives during modern firefighting operations [3].

II. COMPONENTS REQUIRED

1. Arduino board (UNO)
2. Car chassis
3. L298 motor driver module
4. Flame sensor module
5. N90 Servo motor
6. L293d motor driver module
7. Mini DC submersible pump

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8. 12v battery
9. On-off- switch
10. DC female connector jack
11. Connecting wires

III. MODEL

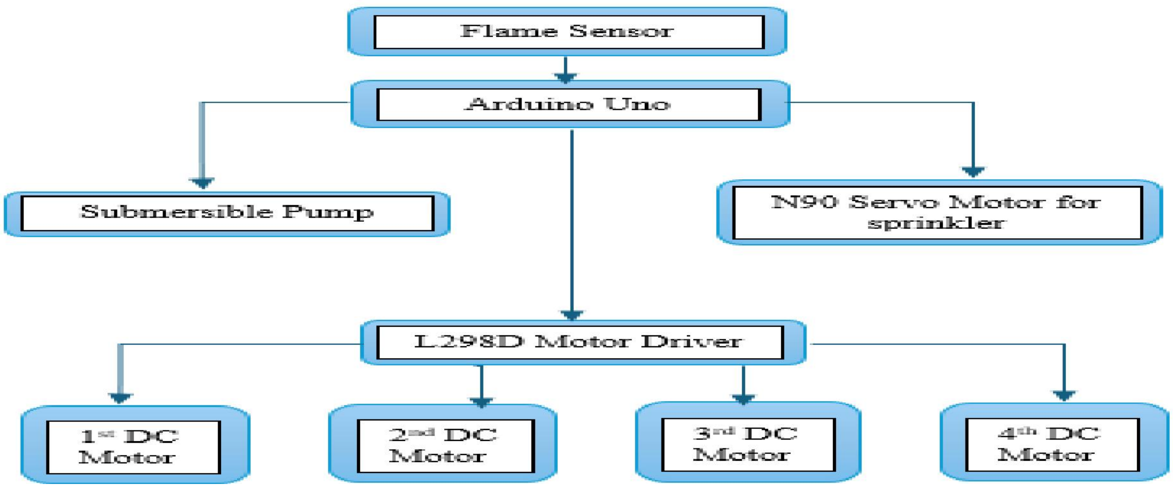

Fig. 1 BLOCK DIAGRAM

IV. WORKING

The heart of the working of the robots is formed by Arduino Uno, the microcontroller chip that acts as the robot's brain. The robot can see the fire through a flame sensor. The sensor is responsive to light in the range of wavelengths 760 to 1100 nm band and can detect fires sometimes as far as 100 cm away.

Following the detection of fire, the robot moves toward it. The robot is controlled in motion by motors which are driven through L298 motor driver modules. High-power driver modules L298 may be used for driving both DC and stepper motors. Whenever the robot comes near a fire, the water pump is activated and splashes water on the flames. All control of this is handled by the motor driver L293D to drive the pump. The motor driver IC L293D has the potential to drive two DC motors at the same time in both directions.

A servo motor controlled the spray of water by moving the nozzle sideways. They also demonstrate how robotics logically intervenes in safety and disaster management. The water sprays are the main firefighting robots where effective safety systems of control might improve fire response while reducing risks through automation, fast communication, and adapted customization. It is a nice demonstration of the role played by robotics to enhance the productivity of machinery while keeping safety under risk conditions.

V. CIRCUIT DIAGRAM

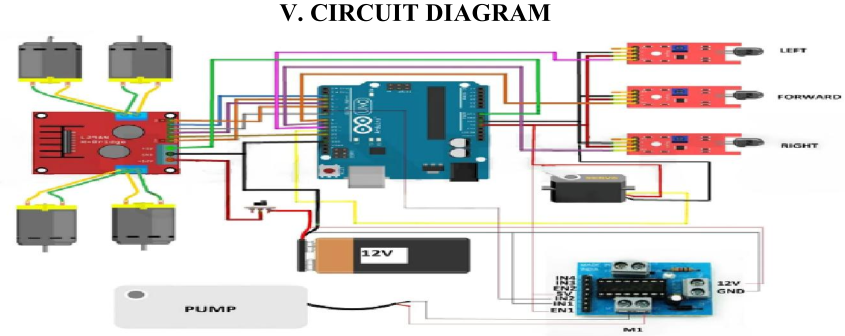

Fig. 2 CIRCUIT DIAGRAM

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VI. CODE

```
#include <Servo.h>  //include servo.h library
Servo myservo;
int pos = 0;
int motor_speed = 70;
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 7       // left motor
#define RM1 4       // right motor
#define RM2 12       // 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);
  analogWrite(3, motor_speed);
  analogWrite(5, motor_speed);
  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() {
```

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```
  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, HIGH);
   digitalWrite(LM2, LOW);
   digitalWrite(RM1, HIGH);
   digitalWrite(RM2, LOW);
   fire = true;
   }
   else if (digitalRead(Left) ==0) {
   digitalWrite(LM1, HIGH);
   digitalWrite(LM2, LOW);
   digitalWrite(RM1, HIGH);
   digitalWrite(RM2, HIGH);
   }
   else if (digitalRead(Right) ==0) {
   digitalWrite(LM1, HIGH);
   digitalWrite(LM2, HIGH);
   digitalWrite(RM1, HIGH);
   digitalWrite(RM2, LOW);
}
delay(300);//change this value to increase the distance
    while (fire == true) {
     put_off_fire();
    }
}
```

VII. RESULT

Fig. 3.1 RESULT

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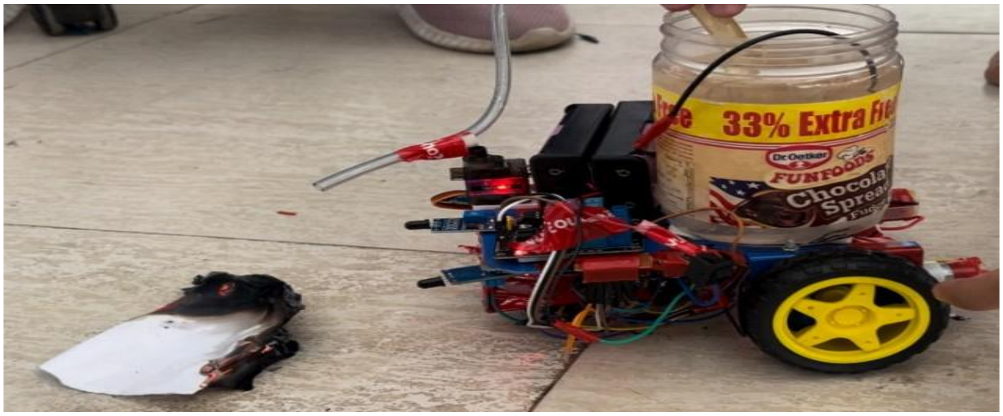

Fig. 3.2 RESULT

Under carefully observed test conditions, the firefighting robot was able to observe, track, find, and locate fire before acting to put it out. Flames were found at a distance of about 0.8 meters with 100% accuracy. Due to different terrains, the mobility system made the robot travel steadily circumventing obstacles. This active fire suppression system, equipped with either a foam or water extinguishing system that takes about five seconds to respond, really did well in dousing flames. In comparison with traditional firefighting methods, test results reveal that the system can significantly reduce the spread of fire and improve safety conditions. These findings confirm that the robot can perform well in hazardous real-world situations, thereby reducing human hazards while enhancing firefighting effectiveness.

VIII. CONCLUSION

This Fire Fighting Robot we made is a significant advancement in fire safety and disaster management. It combines flame detection, immediate response, and directional water discharge to combat fires effectively. This could minimize human intervention in hazardous situations, potentially saving lives and reducing property damage.

IX. ACKNOWLEDGMENT

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