A REPORT ON

FIRE EXTINGUISHING ROBOT

BY

A. Manognya-2017AAPS0389H
Abhigna Reddy-2017A4PS0785H
Pranav Kora-2017A4PS0524H

Under the supervision of

DR. ASHRAD JAVED

BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI HYDERABAD CAMPUS
(APRIL 2020)

COURSE-ROBOTICS: BITS F441

INRODUCTION

According to National Crime Records Bureau (NCRB), it is estimated that more than 1.2 lakh deaths have been caused because of fire accidents in India from 2010-2014. Even though there are a lot of precautions taken for Fire accidents, these natural/man-made disasters do occur now and then. In the event of a fire breakout, to rescue people and to put out the fire we are forced to use human resources which are not safe. With the advancement of technology especially in Robotics it is very much possible to replace humans with robots for fighting the fire. This would improve the efficiency of firefighters and would also prevent them from risking human lives.

OBJECTIVE

The aim for our project is for our fire extinguishing robot to detect the flames of a fire and in doing so move towards the fire and pump out water around it to extinguish it. We could use these robots in small rooms or spaces. Could be deployed in server rooms and Power Plant control rooms. With enough time, hope to increase the load the robot can carry and also add a Video and Camera transmission. And also add remote control.

WORKING PRINCIPLE

The main brain of this project is the Arduino, but in-order to sense fire we use the Fire sensor module. These sensors have an IR Receiver which is used to detect the fire. When fire burns it emits a small amount of Infra-red light, this light will be received by the IR receiver on the sensor module. Then we use an Op-Amp to check for change in voltage across the IR Receiver, so that if a fire is detected the output pin (DO) will give 0V (LOW) and if the is no fire the output pin will give 5V (HIGH).

We placed three such sensors in three directions of the robot at the front so that the robot can sense the direction in which the fire is burning. Once the direction of fire is detected the robot moves towards the fire by driving our motors through the L293D module. When near a fire we have to put it out using water. Using a small container, we can carry water, a 5V pump is also placed in the container and the whole container is placed on top of a servo motor so that we can control the direction in which the water has to be sprayed.

A. Design of Fire Extinguishing Robot:

An Arduino based simple algorithm is employed for detection of fireside and measurement of distance from fire source while the robot is on its way to extinguish fire. A water spreader is employed for effective extinguishing. It's seen that the velocity of water is greatly reduced with the utilization of water spreaders. Two sensors: LM35 and Arduino Flame Sensors are used to detect the fire and distances on its way towards fire

B. Mobility of the Robot:

This is a mobile robot. We use two wheels made from Nylon and a caster ball for the robots' mobility. Two motors are mounted with the nylon wheel by two separate shafts. The wheels are of four-inch diameter and with a thickness of 0.7 inch. The motors' movement is controlled by a motor driver which responds to the signal from the Arduino. An algorithm is

established which is programmed to regulate both motors separately. The use of caster balls is formed for simplicity and its low cost. The robots' movement is especially controlled by rear wheels. Caster ball is employed for front support providing a versatile mobility.

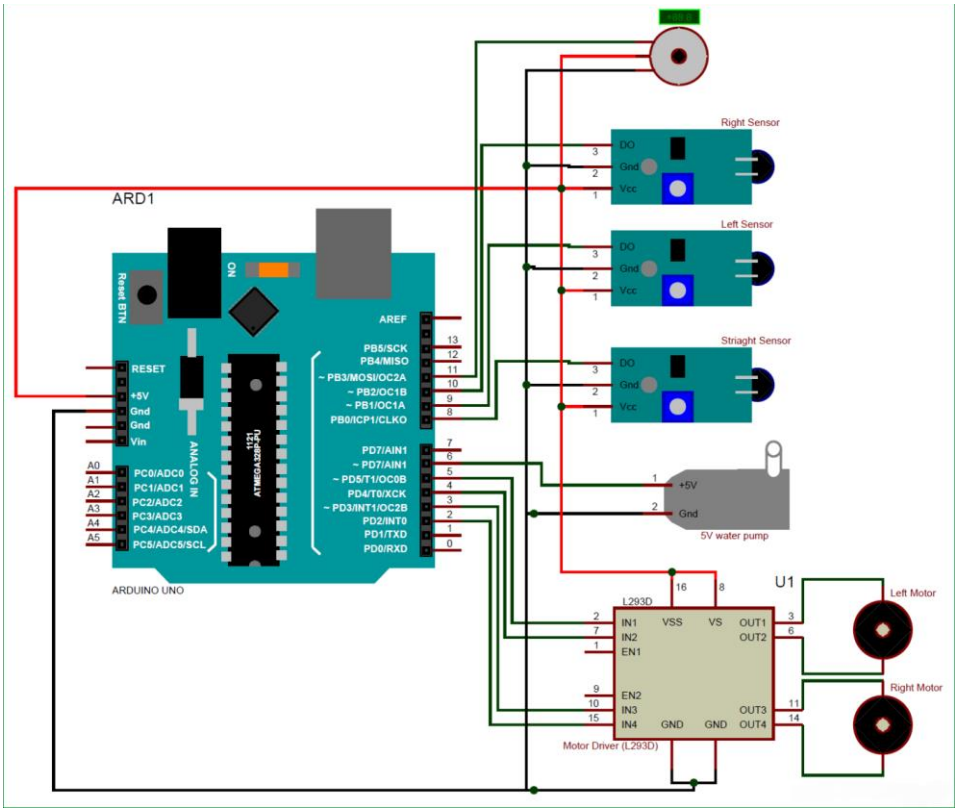
C. Water Spreading Mechanism:

The water container is made of a material which has water resistant property. We use screw and glue to set up the pump. An aluminium pipe is fixed along with the pump. A water spreader is used at the front of the pipe to spread the water. The spreader is used to decrease the velocity of the water from the pump. It also helps to spread the water effectively for the purpose of extinguishment.

CONTROL AND SENSOR UNIT

A. Control Unit:

The logic control unit of the robot is solely an Arduino Uno. The Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. The input/output pins are connected in different ways with the motor, pump and sensors through jumper wires and breadboard. In this way, it establishes control over each component of the robot and the robot does the job as per the programme induced in the Arduino Uno. The power supply control unit is solely a LiPo battery. To power the motor, pump and the whole circuit, a Lithium polymer battery is used. It is a 2200 mAH and 12V battery. It is a rechargeable battery of lithium-ion technology in a pouch format. These types of batteries are lighter but also less rigid. To power the Arduino, the voltage of the battery is stepped down to 8V by 7808IC. Because Arduino operates best at this voltage. Motors and pump selected for the robot can be best powered at 12V. So, choosing a 12V LiPo the battery was efficient.



B. Sensor Unit:

Multisensor Fire Detection System (MSFDS) is employed for the detection and extinguishment purpose. This technique includes the use of quite one sensor at a time and also makes the collaboration of the sensors. There are two sensors connected to the Arduino Uno: Arduino Flame Sensor and LM35. The LM35 sensor gives a proportional value of the temperature as an output. When the robot moves within the direction of the flame, LM35 identifies significant temperature rise near the source of the flame and changes the output. The robot is programmed to stop when this output changes significantly. LM35 sensor is connected with the control unit through an extended jumper wire inside a pipe. So, the sensor maintains a substantial distance from the body. When it detects temperature rising, the motor stops and within a fraction of second, it gets back to a secure and accommodated distance to throw water.

CODE FOR ARDUINO

```
#include <Servo.h>
Servo myservo;
int pos = 0;
boolean fire = false;
/*-------defining Inputs------*/
#define Left_S 9      // left sensor
#define Right_S 10      // right sensor
#define Forward_S 8 //forward sensor

/*-------defining Outputs------*/
#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_S, INPUT);
  pinMode(Right_S, INPUT);
  pinMode(Forward_S, 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_S) ==1 && digitalRead(Right_S)==1 && digitalRead(Forward_S) ==1) //If Fire not
detected all sensors are zero
    {
    //Do not move the robot
    digitalWrite(LM1, HIGH);
    digitalWrite(LM2, HIGH);
    digitalWrite(RM1, HIGH);
    digitalWrite(RM2, HIGH);
    }
    else if (digitalRead(Forward_S) ==0) //If Fire is straight ahead
    {
    //Move the robot forward
    digitalWrite(LM1, HIGH);
    digitalWrite(LM2, LOW);
    digitalWrite(RM1, HIGH);
    digitalWrite(RM2, LOW);
    fire = true;
    }
    else if (digitalRead(Left_S) ==0) //If Fire is to the left
    {
    //Move the robot left
    digitalWrite(LM1, HIGH);
    digitalWrite(LM2, LOW);
    digitalWrite(RM1, HIGH);
    digitalWrite(RM2, HIGH);
    }
    else if (digitalRead(Right_S) ==0) //If Fire is to the right
    {
    //Move the robot right
    digitalWrite(LM1, HIGH);
    digitalWrite(LM2, HIGH);
    digitalWrite(RM1, HIGH);
    digitalWrite(RM2, LOW);
```

```
   }

delay(300); //Slow down the speed of robot

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

ADVANTAGES

1. Can accurately detect the direction of fire with increased flexibility.
2. Reduces human effort.
3. Reliable and economical.
4. Not sensitive to any weather conditions.

DISADVANTAGES

1. No monitoring system or remote control for the vehicle.
2. It cannot be used to put out large scale fires.
3. Can carry a load of up to a max of 3.5Kg.

REFERENCES

1. E. Krasnov and D. Bagaev, "Conceptual analysis of firefighting robots' control systems," 2012 IV International Conference "Problems of Cybernetics and Informatics" (PCI), Baku, 2012, pp. 1-3.
2. A. Bradshaw, "The UK Security and Fire Fighting Advanced Robot project," IEE Colloquium on Advanced Robotic Initiatives in the UK, London, UK, 1991, pp. 1/1-1/4.
3. T. L. Chien, H. Guo, K. L. Su and S. V. Shiau, "Develop a Multiple Interface Based Fire Fighting Robot," 2007 IEEE International Conference on Mechatronics, Changchun, Jilin, 2007, pp. 1-6.
4. https://transmitter.ieee.org/makerproject/view/583df
5. https://circuitdigest.com/microcontroller-projects/arduino-fire-fighting-robot-code