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ARDUINO BASED FIRE FIGHTING ROBOT

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ABSTRACT

A fire fighter's work entails detecting and extinguishing fires. In this rapidly evolving technological age, the world is gradually moving toward automated systems. Firefighters, on the other hand, are often in danger of losing their lives. The majority of the deaths were caused by toxic gases found in the firefighting environment. As a result, in order to resolve these issues, our system was developed a fire-fighting robot.

This firefighting robot uses ARDUINO, Fire sensors, etc. When the Robot detects a fire, it gives a message to the ARDUINO. Then ARDUINO sends the signal to the motor driver and thus water is sprayed in the direction of the fire. It assists firefighters in extinguishing the fire. And it will perform its operation where firefighters can't reach. This will save the risk of fire fighters' life and avoid any further damage.

I. INTRODUCTION

One of the most important parameter in fire disaster is life, i.e. lives lost in saving someone else life. It is sometimes impossible for fire-fighters personnel to access the site of a fire because of explosive materials, smoke, and high temperatures. A fast response to detect the fire can avoid many disastrous things. From the given statics (Fig.1), it is observed that fire can take place at domestic as well as at industrial level. A normal spark can generate a massive fire breakout. Not only lives of industrial people but also the lives of domestics people is at risk because of poor fire management system. But it can be avoided using proper fire controlling methods. For such environments, fire-fighting robot is proposed. In today's generation a lot of robots are proposed and designed to remove the human factor from dangerous and deadly work. The use of robots is becoming very common that safely completes the labour intensive or deadly work for human beings. A Fire Extinguishing Robot is based on IOT Technology. In Fire Extinguishing robot, we intend to build a system that could extinguish a small flame by sensing and moving to the location itself. It will automatically detect the fire with the help of flame sensors. Once it detects the fire breakout location, it navigates itself accordingly to reach the fire source and extinguishes the fire by using built-in fire extinguishing system. For fire detection it is using three flame sensors. First one for the left direction, second one for the forward direction and third one for the right direction. Fire extinguishing system will get activated when fire detection system detects fire. It then reaches the breakout point and water pump will start ejecting the water when it detects fire. The key features of this system is to provide surveillance of fire so that major fire accidents can be prevented and loss of human lives gets minimized.

II. METHODOLOGY

The theme of this paper is to automatically sense the environmental fire and extinguish it without human intervention. The methodology is divided into three parts. The first part is on the design structure, followed by hardware description and the finally on the programming design. All these three parts were assembled together and experiments were then performed to build a system that can extinguish the fire that was carried out.

Design Structure

In this section, the prototype of robotic system is presented, in which it consists of IR flame sensors, servo motors, submersible water pump, motor driver, mini breadboard, BO motors, rubber wheels, processor, and communication module for exchanging data between the fire-fighting robot and Arduino software. The robot carries four main functions: First, it initializes itself i.e. its sensors gets initializes as the power is supplied.

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Second, robot sense the surrounding environment (for instance for the level of temperature) and identify the fireplace. Third, robot sends the navigating information and starts to navigate itself towards the fireplace. Fourth, finally the robot starts to extinguish the fire with the help of servo motors and submersible water pump.

III. CIRCUIT DIAGRAM

In this section, we present the models and materials used in our research work. The following table provides an overview of the key components and specifications of the hardware and software utilized in our study

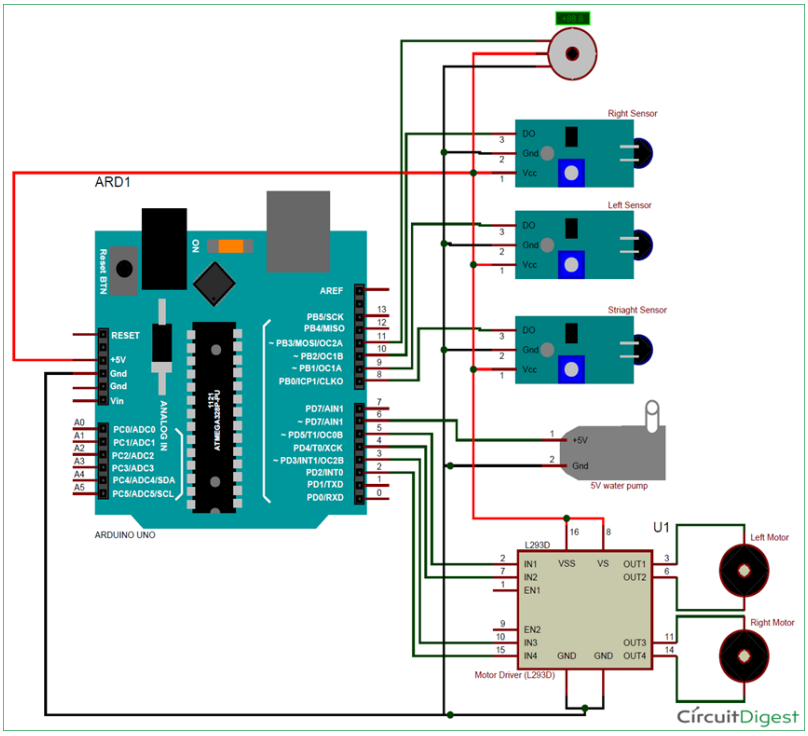

Figure 1: Circuit Diagram

Arduino-based fire-fighting robot with three IR flame sensors that detects fire and autonomously moves, equipped with a robot chassis with a motor driver to control movement, and extinguishes fire using a DC water pump motor:

Components:

1. Arduino board (e.g., Arduino Uno)
2. IR flame sensors (3x)
3. Motor driver module (e.g., L298N)
4. DC water pump motor
5. Robot chassis with motors (typically DC motors)
6. Power supply (e.g., battery pack)
7. Jumper wires

Circuit Connections:

1. Connect the power supply to the Arduino board and the motor driver module.
2. Connect the Arduino board to the motor driver module as follows:

- Connect the Arduino's 5V pin to the VCC pin of the motor driver module.
- Connect the Arduino's GND pin to the GND pin of the motor driver module.
- Connect two digital pins of the Arduino to the motor driver module's input pins (e.g., IN1 and IN2) for controlling motor movement.

3. Connect the robot chassis motors to the motor driver module:

- Connect one motor to OUT1 and OUT2 pins of the motor driver module.

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- Connect the other motor to OUT3 and OUT4 pins of the motor driver module.

4. Connect the IR flame sensors to the Arduino board:

- Connect the VCC pin of each flame sensor to the Arduino's 5V pin.
- Connect the GND pin of each flame sensor to the Arduino's GND pin.
- Connect the output pin of each flame sensor to a separate digital pin on the Arduino (e.g., A0, A1, A2).

5. Connect the DC water pump motor to the Arduino board:

- Connect the positive terminal of the water pump motor to an external power supply.
- Connect the negative terminal of the water pump motor to the collector pin of a transistor (e.g., NPN transistor).
- Connect the emitter pin of the transistor to the GND pin of the external power supply.
- Connect the base pin of the transistor to a digital pin on the Arduino (e.g., D3).
- Add a diode (e.g., 1N4001) across the terminals of the water pump motor to protect against voltage spikes.

Programming:

1. Upload the necessary code to the Arduino board to control the flame sensors, motor driver, and water pump motor.
2. In the code, read the sensor outputs to detect the presence of fire.
3. Based on the sensor readings, control the motor driver to move the robot autonomously.
4. When fire is detected, activate the water pump motor using the Arduino's digital pin connected to the transistor's base.

IV. WORKING/IMPLEMENTAION

WORKFLOW:

The main brain of this project is the Arduino, but in-order to sense fire we use the Fire sensor module. THE sensors have an IR Receiver (Photodiode**)** 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 be 5V(HIGH).

So, we place three such sensors in three directions of the robot to sense on which direction the fire is burning

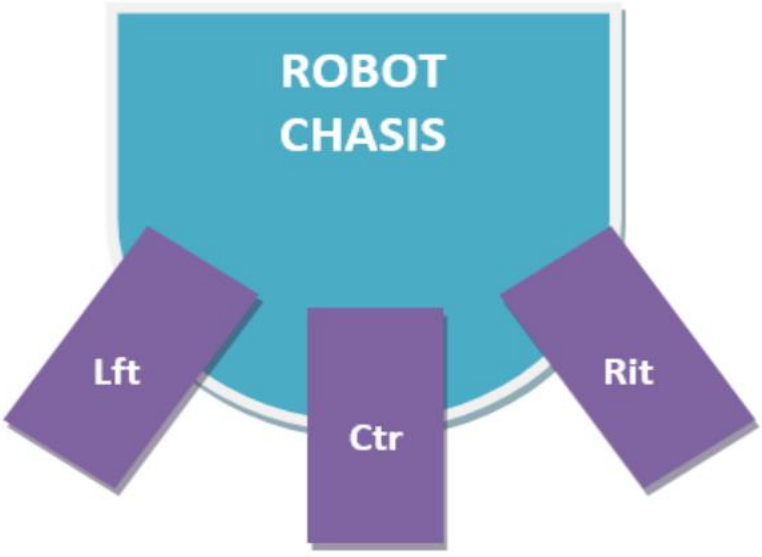

Fig 2: Directivity Representation Of Ir Sensor On Chasis

We Detect The Direction of the fire we can use the motors to move near 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**.**

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FLOW CHART:

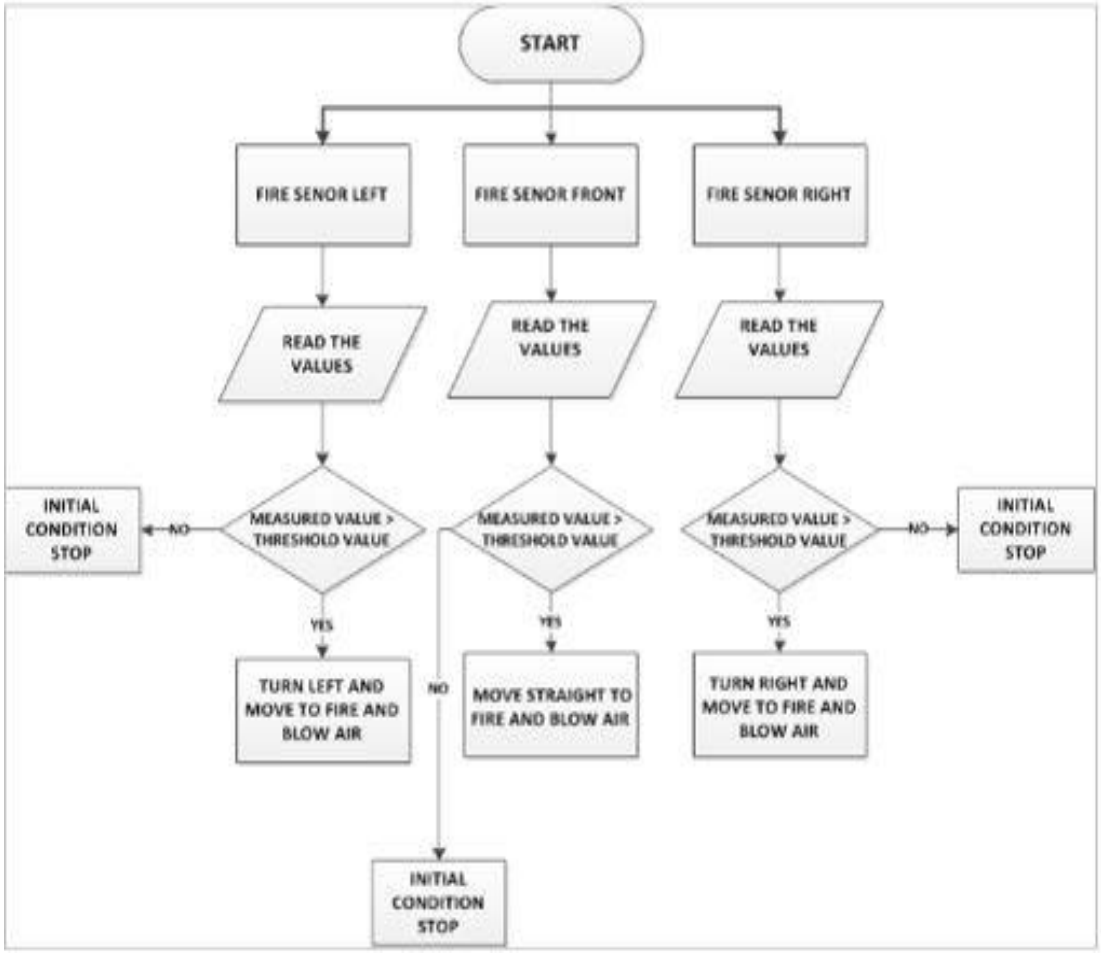

Fig 3. Flowchart

V. RESULTS AND DISCUSSION

The fire sensor will output a HIGH when there is fire and will output a LOW when there is fire. So we have to keep checking these sensor if any fire has occurred. If no fire is there we ask the motors to remain stop by making all the pins high.

If there is any fire we can ask the robot to move in that direction by rotating the respective motor. Once it reaches the fire the left and right sensor will not detect the fire as it would be standing straight ahead of the fire. Now we use the variable named “fire” that would execute the function to put off the fire.

Figure 4: Working Model

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Once the variable fire becomes true, the fire fighting robot arduino code will execute the put_off_fire function until the fire is put off. This is done using the code below.Inside the put_off_fire() we just have to stop the robot by making all the pins high. Then turn on the pump to push water outside the container, while this is done we can also use the servo motor to rotate the container so that the water is split all over uniformly.

VI. CONCLUSION

In conclusion, This model of Fire Extinguishing Robot aids to share out the burden of fire fighters in firefighting task. Our project aims to build a real time firefighting robot which moves in a constant speed, identify the fire and then extinguish it with the help of pumping mechanism. The detection and extinguishing was done with the help basic hardware components attached with the robot. Firstly, IR Flame sensors are used for the detection of fire. Secondly, BO Motors and Rubber wheels are used to navigate the robot to reach the fireplace. Finally, the robot extinguishes the fire with the help of submersible water pump and servo motors.

VII. FUTURE SCOPE

- ✓ Expanding and fortifying the robot's chassis to enable it to carry even more water and possible a CO2 cannister.
- ✓ Upgrading the batter pack to increase its operating time.
- ✓ Upgrading the water pump and to combat fires from farther away.
- ✓ Adding more capable and sensitive sensors to detect fire and survivors from farther and through obstacles.
- ✓ Adding GSM e-sims module to enable full control while still relaying to operators from much further away
- ✓ Including multiple GPS modules to relay highly accurate positioning data.
- ✓ Integrating more advanced Image Processing System (IPS) and System on Chip (SoC) to increase its processing power to enable faster decision making.

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