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Fire Fighting Robot- The Fire Extinguisher

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Abstract: *This study presents the design and implementation of a fire fighting robot using an Arduino UNO microcontroller as the central control unit. The robot is equipped with a flame sensor for detecting fires, a motor driver for precise motor control, and a water pump for extinguishing flames. Additionally, an ultrasonic sensor is integrated for obstacle detection and navigation, enhancing the robot's mobility in complex environments. A Bluetooth module allows for remote control and monitoring of the robot's operation, while a buzzer provides audible feedback during emergency situations. The performance of the fire fighting robot is evaluated under various conditions, demonstrating its effectiveness in autonomously detecting and extinguishing fires. Overall, the developed robot offers a promising solution for automated fire fighting tasks, with potential applications in both indoor and outdoor environments.*

Keywords: Arduino UNO, Flame sensor, motor river, water pump, Ultrasonic sensor, Bluetooth, Buzzer

I. INTRODUCTION

A fire accident will result in an extensive damage to both living and non-living things. The major challenge faced after fire accidents is coming back to a normal life. The firefighters also get injuries while saving people from fire and extinguishing a fire. So, many robots are designed to rescue from the fire without involving the workforce. The robots can go to places where humans cannot be able to go. Thus, the best solution for extinguishing a fire is using a fire fighting robot. Many robots are given the task of remotely extinguishing flames or tracking the fire scenario. There are numerous robot models. Some examples include flying robots, wheeled robots, legged robots, humanoid robots, and underwater robots. The proposed study has designed the wheeled robot to extinguish the fire.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. Fire can take many lives to and can injure many people for their life time. But it can be avoided using proper fire controlling methods.

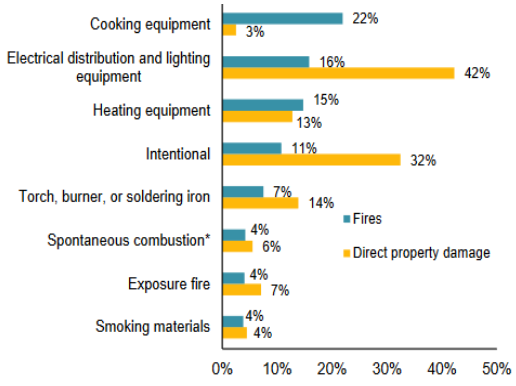

Fig-1: Causes of fire accident

II. PROBLEM FORMULATION

Fire disaster is one of the dangerous problems that can lead to heavy loss both financially and by taking lives. Sometime it becomes difficult for fighters to access the site of afire because of explosive materials, smoke, and high

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temperatures. Such situations risk the lives of fire fighters too. In such environments, fire-fighting robots can be useful. This 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. Sometime delay in the arrival of fire fighters leads to numerous consequences. The Fire Extinguishing robot continuously monitors the environment and extinguishes it without delay.

II. LITERATURE SURVEY

Author : S. Dina, M. Mahalekshmi, V. Kokila, R. Jeya Preetha, S. Sankarakumar.

The design and implementation of the firefighting robot were thoroughly discussed in J. Reinhart V. Khandwala (2003). The robot's hardware assembly and construction, the processing method based on sensor responses, and all of the crucial design elements to study include the navigation algorithm that allows the robot to locate an efficient path through the house model. Miller Lynette Daniel Rodriguez (2003) talked about the construction of each robot component which are supposed to discover and extinguish a minor fire in a model home represented by a light-emitting diode. This paper will go over each robot component, starting with the start signal and progressing to the platform of robot, line following and finding room, and finally detection of fire. [1]

Author : Chaitrali D. Phartale, Anumant Shinde, Pooja B. Vibhute, Prof. A.U. Deshmukh.

"Automatic Fire Fighting Robot", Abhilash Dhumatkar, Sumit Bhiogade, Shashank Rajpal, Datta Renge, Prof.V. Kale. In this Automatic Fire extinguisher Robot that can detect and extinguish a fire on its own is assembling of various components. A Thermostat Sensor, sometimes called an optical sensor, Detects visually sense the fire, usually in a narrow range, in order feature in forest operations, at industrial check points in undeveloped villages, to momentarily distract an fire, to helpful fire covered area at much less time and useful from dangerous hazardous the environment using fire extinguisher robot. A dazzler, sometimes called an optical distracter, transmits a visually intense light, usually in a narrow beam, in order to 1) attract the attention of a person and to make them alert to heck points in noncombat land operations, to momentarily distract an assailant, to alert drivers in vehicles approaching a check point, and to alert civilian traffic to approaching forces. [2]

Author : Mr. Kumara Swamy, P.Swathi, V.Shashi Kumar, M.Charan, A.Vinay.

The common conventional firefighting methods involve fire brigades, portable fire extinguisher (hand held) and sprinklers. These conventional methods consume lot of time to reach the place of the mishap likethe fire brigade must be deployed from the fire station andshould get through the traffic and reach the fire struck area, the portable extinguisher is also no gift because it isgenerally place at one off the corners of the building which may be difficult to reach and it needs constant maintenance. On the other hand the sprinkler and smoke detector set up is very non reliable method because the sprinkler pipes has any defect may not provide enough pressure and it is suited to cover large areas. [3]

Author: Khaled Sailan, Prof. Dr.-Ing. Klaus-Dieter Kuhnert, Simon Hardt

They proposed an obstacle avoidance robot named as Amphibious Autonomous Vehicle. In this robot, a fuzzy controller is used to avoid static obstacle in real time.It aims to guide the robot or vehicle along its path avoiding all the obstacle that comes along the path. [4]

III. 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.

A. 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. Fig 2 shows the basic prototype of our firefighting robot. The robot carries four main functions: First, it initializes itself i.e its sensors gets initializes as

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the power is supplied. 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.

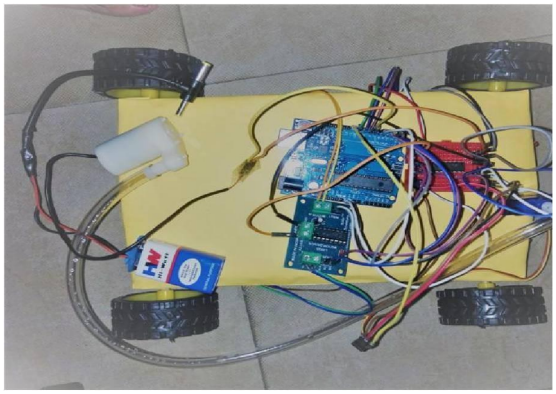

Fig-2: Fire Fighting Robot

B. Hardware Implementation

The hardware part is one of the crucial parts in the development of firefighting robot. It includes Arduino UNO, IR flame sensors, servo motors, submersible water pump, motor driver, mini breadboard, BO motors, and rubber wheels. Fig 3 shows the block diagram of firefighting robot which consists of three IR flame sensors as the input of the system. Arduino UNO is used as a micro- controller that connects other components. L293D Motor driver is used to drive motors and is capable of running two DC motors (Left DC motor and Right DC motor) at the same time.

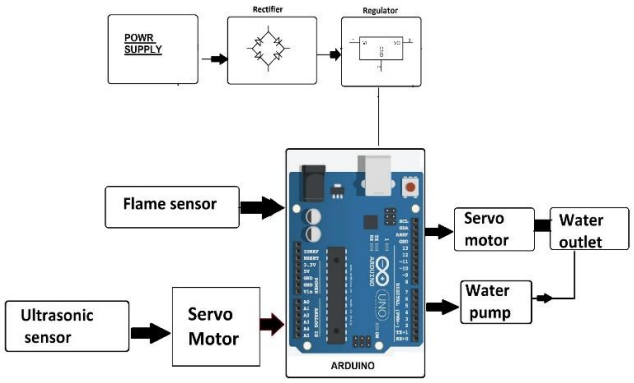

Fig-3: Block Diagram of Fire Fighting Robot

C. Hardware Used

ATmega328P IC(Arduino UNO):

Fig-4: Arduino UNO

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Fig-4 shows the fire fighting robot is equipped with an Arduino UNO board powered by an ATmega328P IC, serving as the brain of the operation. It utilizes various sensors such as infrared and temperature sensors to detect the presence and intensity of fire. Additionally, it employs motors and wheels for mobility, allowing it to navigate through different terrains and reach the affected areas swiftly. The robot is also equipped with a water reservoir and a pump system, enabling it to extinguish fires effectively. Its hardware components are integrated with a robust software system programmed to analyze sensor data, make real-time decisions, and execute firefighting maneuvers autonomously, ensuring quick and efficient response to fire emergencies.

IR Flame Sensor

The fire fighting robot is equipped with an IR (infrared) flame sensor, a crucial component for detecting the presence of fire. The IR flame sensor works by detecting the infrared radiation emitted by flames, allowing the robot to identify the location and intensity of the fire. This information is essential for the robot to autonomously navigate towards the source of the fire and deploy its fire fighting mechanisms effectively. By integrating the IR flame sensor into its sensor suite, the robot can swiftly and accurately respond to fire emergencies, minimizing damage and ensuring the safety of the surrounding environment.

Fig-5: IR Flame Sensor

L293D Motor Driver

The fire fighting robot incorporates an L293D motor driver to control its motors, facilitating precise movement and maneuverability. The L293D motor driver is a dual H-bridge IC that allows bidirectional control of two DC motors or a single stepper motor. By utilizing the L293D, the robot can control the speed and direction of its motors, enabling it to navigate through various terrains and obstacles with ease. This motor driver plays a critical role in the robot's mobility, allowing it to efficiently respond to fire emergencies by swiftly reaching the affected areas and executing firefighting maneuvers. Additionally, the L293D's built-in protection features ensure the safety and reliability of the robot's motor control system, enhancing its overall performance and functionality in firefighting scenarios.

Fig- 6: L293D Motor Driver

Servo Motors

Fig. shows the Servo Motors. Servo Motors are electronic devices that are mainly used for providing specific velocity and acceleration.

Fig-7: Servo Motor

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Submersible Water Pump

Fig. shows the submersible water pump. Submersible Water Pump is ideal for making automatic watering system using Arduino. The water pump is an important part of the robot as it will pump water to extinguish the fire.

Fig-8: Submersible Water Pump

BO Motors

Fig. shows the BO motor.BO Motor is a dual shaft motor having 300 rpm .It converts electrical energy into mechanical energy .It is the replacement to our metal gear DC motors .Our robot uses four dual shaft motors.

Fig-9: BO Motor

D. Programming:

For programming ,the Arduino software provides an integrated development environment (Arduino IDE) and core libraries. The Arduino IDE program is a software program written in Java language and based on the Processing .The Arduino IDE is basically a framework built on top of C and C++ and compiled using avr-gcc and AVR Libc. The open source Arduino IDE makes it easy to write code and upload it to the Arduino Uno for execution. It is available for all major desktop platform i.e., Windows, Mac OS X, and Linux .Fig.10 shows the Arduino IDE program.

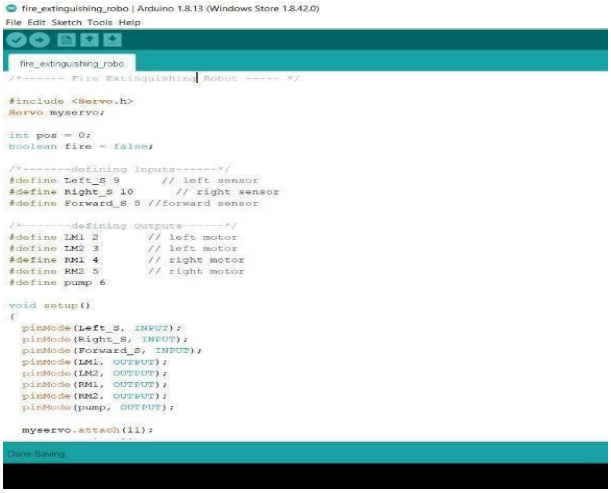

Fig-10. Arduino IDE program

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IV. RESULT DISCUSSION

Fire Fighting Robot has developed to reduce human life lost and to develop such a device that automatically sense fire and extinguish it without human intervention. In this the fireplace is detected using IR flame sensors and are connected to Arduino UNO , which control the movement of Motor drive that helps the robot to reach the fireplace and extinguishes it with the pumping mechanisms In the industry if any fire accident occurs, there is a need of person to monitor continuously and rectify it. In this process if any time delay takes place irreparable loss occurs in industry. The firefighting robot continuously monitors the surrounding and helps in extinguishing the fire.

V. 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.

VI. ACKNOWLEDGEMENT

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