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AUTONOMOUS FIRE PROTECTION ROBOT

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***Abstract*—A fire is a catastrophe that can cause property damage,loss of life and undefined disability for the victim.Fire fighters are often exposed to advanced pitfalls. Humans are replaced by robots in danger of death case of figure as a result of the advancement of technology.Our objective is to create a robot able to detect and extinguish fires.Catastrophes can be prevented with minimal risk to human life by designing and applying a fire brigade capable of detecting and putting out flames. Thus, this project is improved in order to control fire with a robotic vehicle.This paper demonstrates simulation and perpetration of an independent fire protection robot which can describe the fire using different detectors,image acquisition and transmission of real-time updates to the remote user via the IOT for the purpose of extinguishing the fire.Additionally, the suggested robot avoids obstacles while moving forward in automatic mode to search for fire and pour water if fire detected. The robot can also be manually controlled by the remote user via a web page that can also displays live streaming from the ESP32 camera mounted on the robot.**

Keywords*—*Arduino UNO, ESP 32, Flame Detector, Water Pump

I. INTRODUCTION

Fire is both useful and dangerous. Fire is due to a chemical reaction. If oxygen in the atmosphere join forces with carbon and hydrogen in a fuel, a chemical reaction occurs. Therefore the energy as heat and light is liberated through this procedure. It's known as fire.For illustration, we use it for cooking our food, heating our houses in the winter and producing electricity. However, if the fire becomes uncontrollable, it can be very hazardous. Annually, lakhs of homes and businesses as a result of fire. Extensive forested regions are correspondingly devastated and more number of animals or are killed or wounded. We spend a huge amount of money annually to combat fires. And we're putting more time into trying to find new ways to to keep from it happening by taking action in advance and stopping fires.

The term robot is deduced from Karel Capek's show in early the 19's, comprehended as "robots" which means forced labor. A robot is a machine that is designed to perform tasks autonomously or with minimal human intervention. It is a type of artificial intelligence that has the ability to sense its environment, process data, and take action based on the data it has collected. Robots can be programmed to perform a variety of tasks, from simple repetitive actions to complex problem-solving activities. They are able to carry out repetitive tasks faster, cheaper and with more precision than humans.

Autonomous fire protection robots are designed to assist human firefighters in extinguishing fires, especially in situations where it may be too dangerous or difficult for humans to enter. These robots are typically equipped with a range of sensors and tools that enable them to detect fires, navigate through smoke-filled environments, and extinguish flames using water or other firefighting agents. The main objective of autonomous fire protection robots is to assist in fire fighting operations and provide a safer environment for fire fighters. These robots are designed to operate autonomously or semi-autonomously, without the need for human intervention in certain situations, such as in high-risk areas or where access is limited. Some specific objectives of autonomous fire protection robots include Early detection of fires, Safe and effective fire suppression, Navigation and obstacle avoidance, Remote operation. It uses an IR sensor, flame sensor and Arduino microcontroller board to control its movements and operations, along with a camera module that provides real-time video feed of the environment. By using these components together, the robot can detect fires at an early stage and provide a safe and effective method for extinguishing the fire.

II. A REVIEW OF LITERATURE WORK

The project is titled "Autonomous Fire Protection Robot". A robot is an automated device that resembles a human and does a variety of sophisticated activities. Let us take an examine in more detail about current fire protection devices. The attributes of the preceding robots that were comparable toward this robotic projects and were incorporated into the review of the literature are listed below:

The present thesis[1] is related to the robot that encompasses with a built-in real-time device. The source code is developed in such a way that it is unique among all other prototypes available in the market. When the user opts an automatic mode, the robo twill under go a set of field patterns untill the fire comes down. For directional purpose the robot uses the INFRARED Sensor. The output from the sensor is converted by A/D converters then the signal is then introduced into the microcontroller's input pin. The microcontroller would initiate actuators that will only be activated by the motors when only in the case of fire is observed. A liquid holding capable drum is placed on the on the head of the robot. Water is dispersed through flames to rule out fire. In their paper, they also showed us how the robot is monitored by voice.

"Pokey" - The robot designated for fire fighting. [2] is another documentary that denotes a kind of robot that protects from fire, who made his way out of contests, and became more "grave" than any existing system. The document comprises an elaborate explanation of the equipment utilized and fundamental operational algorithms. As the robot operates within a building or any type of residential complex environment, therefore it is outfitted with the requisite detectors. These robots offer valuable

characteristics including the utilization of two modes of fire detectors that function in diverse ways and the use of advanced fire protecting equipment. The downside to this system is its on-board computer, which has a low efficiency and can only handle basic tasks without the ability to handle more complex or extended operations.

One notable study on fire protection robots is the development of the "Firefighting Robot" by researchers at the Tokyo Institute of Technology in Japan[3]. The robot is designed to operate in high-temperature environments and can navigate through smoke-filled buildings to detect and extinguish fires. It is equipped with a variety of sensors, including a flame sensor, infrared sensor, and ultrasonic sensor, which enable it to detect and locate fires quickly and accurately.The robot is also equipped with a water cannon that can be used to extinguish fires. It has a range of 6 meters and can shoot water at a rate of 20 liters per minute. In addition, the robot can also be fitted with a foam nozzle to provide a more effective means of extinguishing fires.The Firefighting Robot is controlled remotely by a human operator using a joystick and a control panel. The robot's movements and actions are displayed on a monitor, allowing the operator to navigate it through the building and direct it to the location of the fire. hile more testing is needed in real-life fire situations, this robot has the potential to provide a safe and efficient alternative to human firefighters in hazardous situations.

The dual-mode fire-extinguishing robot[4] is designed in a way that depending on type of situation, the robot itself acts as an automatic and user-controllable device. the robot is to detect potential flames and obstructions in case of automatic mode. This robot is moving and searches for traces of flames. The algorithm is similar like all other robots. In case of manual mode, the Bluetooth module is used in case of manual mode. With the implementation of Bluetooth the user can controle the robot about a specified range of location.

The Prometheus project[5], led by the German Aerospace Center, is a notable project in this field. It involves the development of a robot that can autonomously navigate through burning buildings and detect fires using thermal cameras and other sensors. The robot can also extinguish fires using a fire extinguishing arm, which is controlled by an intelligent control system that takes into account the robot's location and the location of the fire. The main advantage of the Prometheus project is the robot's ability to navigate through burning buildings and detect fires using thermal cameras and other sensors. The robot is also equipped with a fire extinguishing arm, which can be used to extinguish fires. However, one of the main drawbacks of the Prometheus project is that the robot's movement is limited by the environment it is operating in, and it may not be able to navigate through complex environments.

A robust heavy duty tank robot[6] composed of military graded materials. The materials used here in order to be resistant to fire. The user is the ultimate controller to run this device. Coming to the working of this system, the sensors used in this robot are connected to the microcontroller and processes the gestural inputs and transmits the signals to the servomotor placed on either side of the robot.

III. Implementation of Proposed System & Methodology

This section will provide an explanation of the steps involved in implementing and the operating principle of the proposed Autonomous fire protection robot. Moreover, the section will feature presenting the outcomes obtained during the robot's practical tests.

3.1 Robot implementation

Designing a robot system for deliverance operations in real fire situations involves fulfilling several requirements, since it involves executing actual deliverance procedures such as approaching victims and directing them to the nearest exit. The design of the rescue robot platform is crucial. However, in order to control the robot system securely from a distance, we require a powerful remote controller that can also help firemen design the necessary follow-up procedures for additional rescue operations.The ESP32 and Arduino Uno micro controllers serve as the foundation for the planned autonomous fire protection robot. The hardware connection and design procedure are made easier by the L293D built-in motor driver shield in this type of structure.As part of this endeavor, the robot has been equipped flame detector module has been mounted on the midpoint of the robot, left forepart and also on its right forepart. For the purpose of detecting impediments, an ultrasonic sensor is used and it is mounted on a servo motor.

Additionally, a small water pump that is operated by an Arduino has been mounted on a servo motor and connected to one of the Arduino's digital pins. The driving procedure was aided by Wi-Fi camera module that was mounted on the robot's forepart. The robot is fully wireless driven by Wi-Fi technology utilising a web application.

3.2 Block diagram

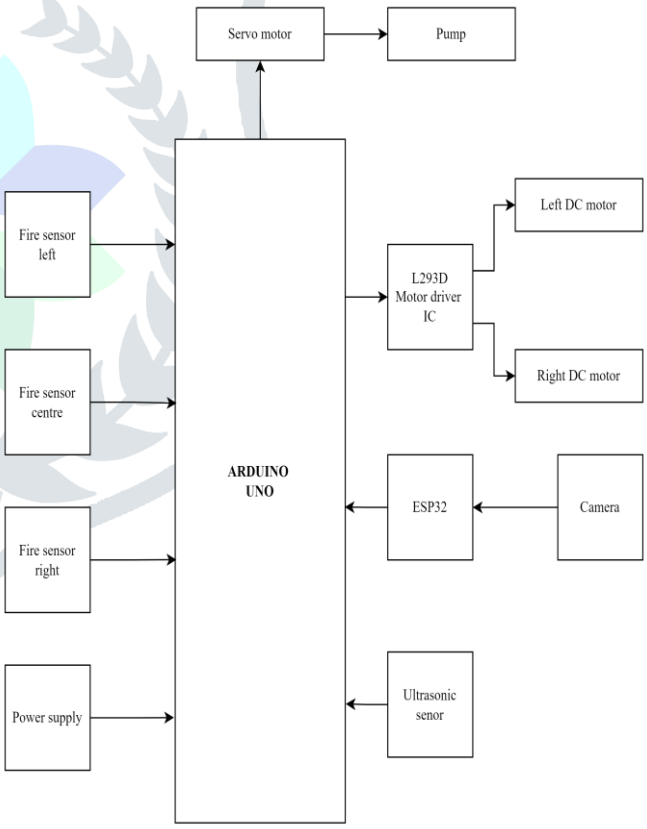

Fig 1 Block diagram

From Fig 1, there are at least five interfacing circuits, L293D driver module, Arduino uno with Microcontroller, flame sensors, ultrasonic sensors, servo motor and 5v pump. Here Arduino uno acts a heart of our project, in the above block diagram we can see that there are three flame sensors and ultrasonic sensor which acts as input interface to the microcontroller and servomotor, pump, driver module acts a output interface to the microcontroller.

Here the input and output interface can be indicated with the arrow lines with the respective the microcontroller performs

with the respective commands and delay which is programmed on Arduino software.

3.3 Flowchart

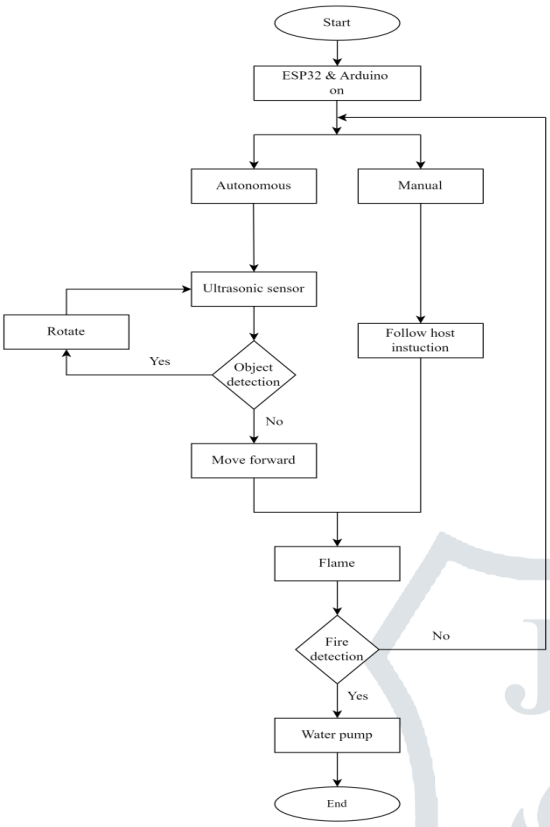

Fig 2 Flowchart of Proposed Technology

3.4 Working

An autonomous firefighting robot that can recognize flames and smoke and effectively put them out has been implemented in this project. This robot has perfect control over its forward, left, and right movements. The robot's motion is driven by the Arduino code in combination with the motors. If any flame is detected, the sensors are activated. Upon receiving a signal indicating a dangerous environment, the motor will begin to rotate and move the robot to that location, where it will begin to pump water using a servo motor. This procedure will be carried out repeatedly until the fire has completely gone out. The simulation was run after the project had been successfully built, and the desired result was obtained. There were appropriate results snapshots attached. As a result, an autonomous firefighting robot has been created to successfully complete the project's goals.

3.5 Results and Discussion

An autonomous firefighting robot that can recognize flames and smoke and effectively put them out has been implemented in this project. This robot has perfect control over its forward, left, and right movements. The robot's motion is driven by the Arduino code in combination with the motors. If any flame is detected, the sensors are activated. Upon receiving a signal indicating a dangerous environment, the motor will begin to rotate and move the robot to that location, where it will begin to pump water using a servo motor. This procedure will be carried out repeatedly until the fire has completely gone out. The simulation was run after the project had been successfully built, and the desired result was obtained. There were appropriate results snapshots attached. As a result, an autonomous firefighting robot has been created to successfully complete the project's goals.

IV. CONCLUSION

This project implements an autonomous fire defence system that goes towards the fire and pumps out water to put it out, in accordance with the sketch and design. As a result, the main goal is to use WiFi technology and thereby enable citizens to put out fires in their houses, which is affordable, simple to use, and effective. Therefore , it will undoubtedly reduce the number of people killed in fires in shopping complexes, apartments, and other educational institutions. As a result of the robot's use and practical testing, good performance and efficiency have been reached.

V. FUTURE ENHANCEMENTS

In the future,it will be possible to use a Raspberry Pi equipped with a camera module for surveillance and also for tracking of movements. Additionally, research on artificial intelligence for mapping and implementation for localization could begin. Additionally, research on artificial intelligence for mapping and Implementations for localization could begin. Additionally, a second arm might be created to eliminate any potential obstacles or limitations in future research. The robot's dimensions will shrink by adopting light body materials and the advancement of semi conductor technology. This robot could serve a variety of functions in the sea if the body is built to be waterproof..

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