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Fire Extinguisher Robot

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ABSTRACT:With the advent of technology, humans are replaced with robots in lifethreatening situations. We aim to design a robot capable of detecting and extinguish fires. By designing and implementing an autonomous robot capable of detecting and extinguishing flames, disasters can be avoided with minimal risk to human life. In this research, we illustrate an autonomous robot capable of detecting flames indoors or industrial places and manoeuvring towards the flame to extinguish it with the help of water which is inside the tank. In this paper, dynamic modelling of a tracked mobile robot for firefighting is addressed. The impact of recoil force produced by the working fire monitor on the robot motion and stability is studied, with consideration of the effect of the fire monitor's jet velocity and orientation (pitch and tilt angles). The critical conditions for slipping and tipping-over of the robot in fire extinguisher are analysed. The effectiveness of the presented dynamic model and analysis is verified by simulations. The results are helpful in the design and control of tracked mobile fire-fighting robots

KEYWORDS:Detect, Extinguish, Tracked, Analysis, Orientation.

I. INTRODUCTION

Fire extinguishing is an extremely difficult and dangerous task but still often is carried out by human operators, thus is putting human life, extremely valuable as it is, in a very precarious and Fire extinguishing is an extremely difficult and dangerous task but still often is carried out by human operators, thus is putting human life, extremely valuable as it is, in a very precarious and vulnerable situation. Various numbers of researches have already been conducted to minimize the fire accidents and to reduce the demolition in fire accidents.

The fire security of the home, office, and building are important aspects of human life. Fire disasters may occur anytime, anyplace, anyhow and result in high losses of life and property. Every year we are losing important life and property which not only results to personal loss but in fact a social and mental loss. It was found that the mean FRI (Fire Risk Index) are 2.8 on a scale of 5.0 for the fire hazard condition, which indicates an extremely alarming condition. Due to that, Robots are designed to find a fire, before it rages out of control. It is often referred that fire fighters cannot access the source of fire due to the damage happened to the building and very high temperature, or even due to the presence of explosive materials, and as we expect human life to be more valuable than a machine it is better to say that odds are very much towards it. With such limitations and high life risk in the handling of the fire, a technical breakthrough can help fighting the fire is necessary areas of our life.

In developing nations like India, fire dangers are a prevalent occurrence that result in yearly losses of life and property. Fire emergencies happen in situations where either a person cannot arrive in time or where approaching and extinguishing the fire would be dangerous and perhaps fatal. The Design and development of a Fire Extinguisher Robot will provide an impactful solution for society and help save lives. The solution uses ESP32 CAM Module to analyse fire and decide the right course of managing the fire hazard. After analysing it uses WIFI module as a communicating device which helps to move the robot in the direction of where fire take place. The fire extinguisher robot is activated by the user through a mobile application, which uses a pump and a servo motor to synchronise the direction of water output as it sprays water onto the fire.

II. RELATED WORK

In today's modern high-tech world there are variety of ideas of such robots that are in the market which can be used in hazardous situation, and be really helpful to Humankind with their advance technologies. These robots can also



enhance and updated from particular time to time. Some works of such functioning robots are described in the following sections.

Jet Fighter is a type of Autonomous Fire Fighting Mobile Platform that is introduced by Tokyo Fire Department. It can be operated and controlled by remote user and has the ability to extinguish flame after locating the source of fire. It is equipped with a monitoring system and operates through a wireless communication system. It is equipped with an obstacles avoidance system embedded into its autonomous navigation system [1].

Furthermore, there is another type of portable Autonomous Fire Fighting Mobile Platform that is specifically designed to be thrown into the fire site to collect data and information, search for victims and evacuate them from the fire site. It can be controlled by the operator and the victims are able to communicate with the operator by using the built-in microphone and speaker system during emergency cases. Also, this system contains the camera to capture the scene of fire site, sensors for temperature measurement, CO₂ and O₂ concentration measurement. Since it is specially designed to be thrown into the fire site, it can withstand with high temperature, over 15000 C, waterproofed and has impact resistance feature [2].

BEAR (Battlefield Extraction-Assist Robot) by Vecnarobotics is a type of rescuing robot built in form of a humanoid that can lift and carry victims for casualty extraction, unsafe building evacuation, and also searching and rescuing work. However, its cost is prohibitive [3].

The work in this paper is divided in two stages. 1) Fire Detection 2) Fire Extinguishing. Fire Detection is done through the ESP32 CAM Module. It is a camera module which is connected to Web Application through WI-FI. To extinguishes the fire, We put a tank on backside of Robot with help of relay and motors the fire is going to extinguish.

III. METHODOLOGY

In this project, we are creating a robot using an ESP CAM 32 MODULE, Motor Driver, Relay, Water Pump, Fire Sensor and this robot are connected through a web application. When the fire is detected through fire sensor, a signal is pass to the ESP CAM Module. IN ESP CAM Module, it checks the condition whether fire take place or not. When condition is true, a signal send to the Relay and it start the water pump. By this way, we able to extinguish the fire successfully.

The web-site consist of A Screen Window with the help of it, user able to see surrounding situation. And there are four buttons namely LEFT, RIGHT, FORWARD, BACKWARD, STOP to move the ROBOT.

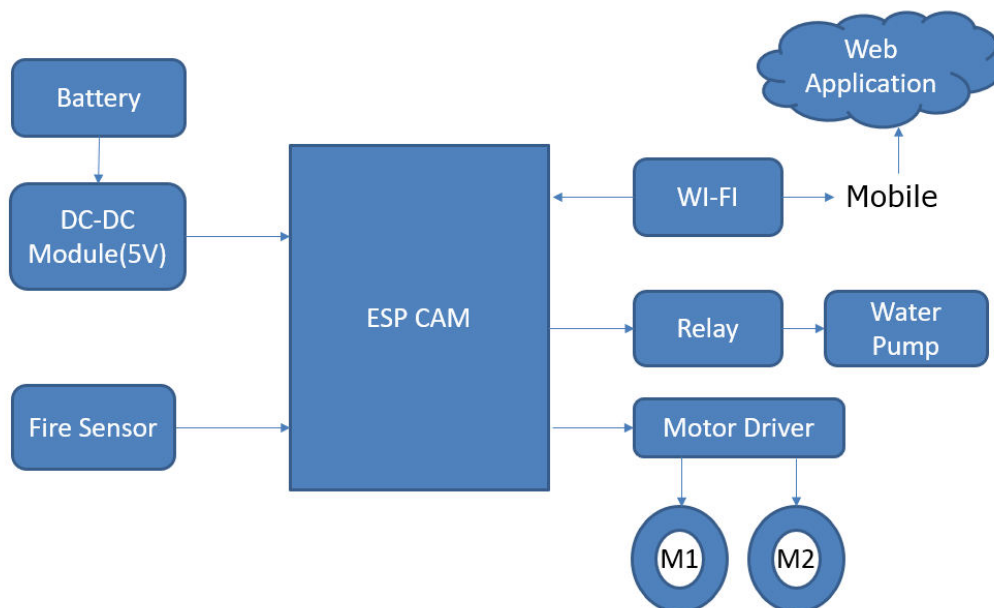


Fig. Block Diagram



Hardware Requirements

1) ESP32 Cam Module

With the extra capability of employing a camera, the ESP32 CAM Wi-Fi Bluetooth Development Board with OV2640 Camera Module is based on the ESP32 chip. A compact, very competitive camera module that can function on its own as a bare minimum system is available in the ESP32-CAM. Widely applicable in numerous IoT applications is the ESP32 CAM. It is appropriate for IoT applications such as wireless positioning system signals, industrial wireless control, wireless monitoring, QR wireless identification, and smart home gadgets

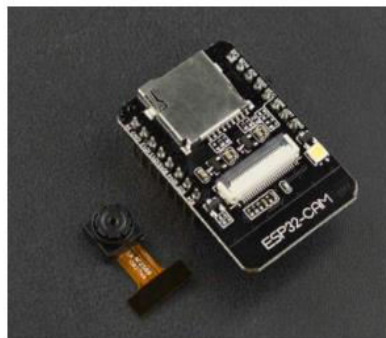


Fig. ESP Cam Module

2) Fire Sensor

The Flame sensor that employs infrared technology is utilised to find a fire. To find the flame, a photo transistor is set in front of a flame sensor.

The Flame Sensor's three connection pins are as follows:

1. Ground - The flame sensor's common ground pin.
2. VCC - The flame sensor's power source is a positive 5V voltage.
3. Flame Detection Pin on the digital output.

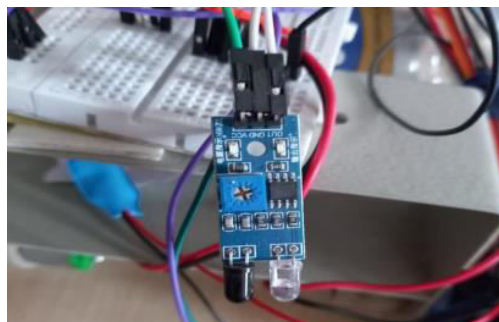


Fig. Fire Sensor

3) Motor Driver L298N

You can simultaneously control the speed and direction of two motors with the Motor Driver, a motor control module. This Motor Driver was designed and constructed using the L298N IC. Its output, which is high voltage and high current, is used to power the project's motors, which move the robot in all four directions.

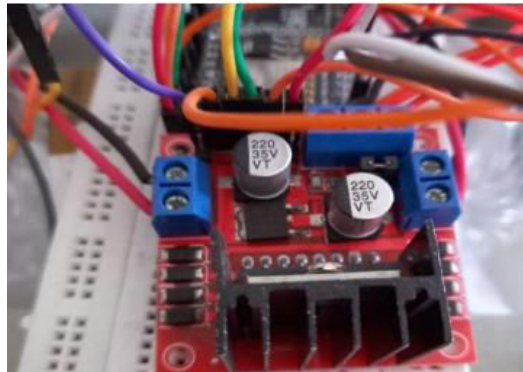


Fig. Motor Driver Module

4) Battery

Lead-acid batteries that use lead peroxide and sponge lead to convert chemical energy into electrical energy. These are mostly used in substations and power systems because they have increased cell voltage and minimal cost.



Fig. Lead Acid Battery

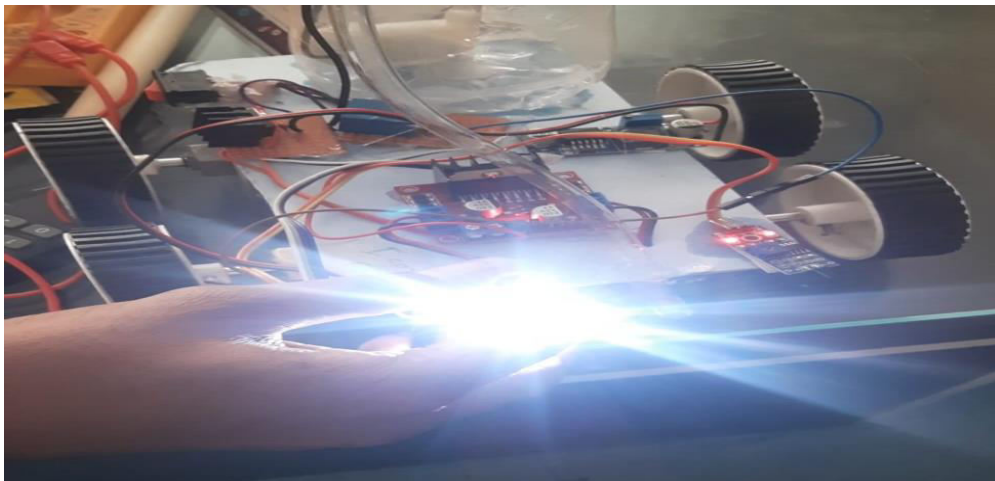
5) Relay

A relay connects the water pump to the ESP32 Cam. A relay is a device that enables a device that only needs a small amount of current, like an MCU Node, to operate a device that needs a big amount of current, like a water pump. Relays operate similarly to electrical switches. The low current side of the relay has three terminals: VCC, GND, and IN. The node MCU controls the relay through the IN pin. On the high current side of the relay, there are three more terminals labelled NO, C, and NC, which stand for ordinarily open, common, and normally closed.

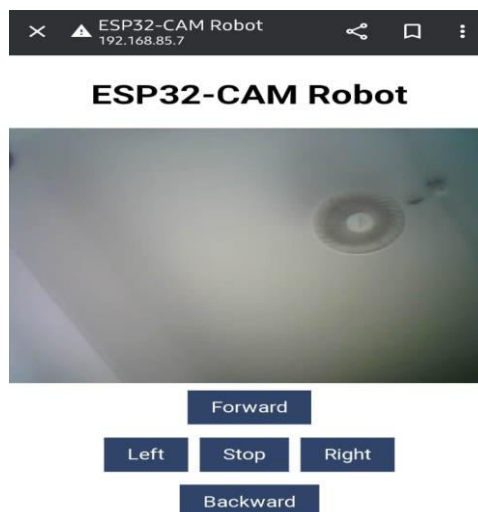


Fig. Relay

IV. EXPERIMENTAL RESULTS



(a) Robot Model



(b) Web-site for controlling robot



V. CONCLUSION

This Project presents a Fire Extinguishing Robot using wi-fi communication and it is designed and implemented with ESP32 CAM Module in the Robotics and mobile application. Experimental work has been carried out carefully. The result shows that higher efficiency is indeed achieved using the robotics. The proposed method is verified to be highly beneficial for security purpose and industrial purposes.

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