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Autonomous Fire Extinguishing Robot

[1]BHAGYASHREE PRADHAN, [2]BIPUL SWAIN, [3]KIRAN KUMAR DAS, [4]SUSHREE UPASANA

[1,2,3] Students, Department of Electronics and Communication Engineering, Gandhi Institute For Technology, Bhubaneswar, Odisha, India
[4]Assistant Professor, Department of Electronics and Communication Engineering, Gandhi Institute For Technology, Bhubaneswar, Odisha, India

Abstract: - ***Fires are catastrophic events that can result in the loss of human life, property damage, and long-term disabilities for the affected victims. Firefighters are primarily responsible for managing fire situations; however, they often face significant challenges, especially in hazardous environments like nuclear power plants, oil refineries, and gas storage facilities. With advancements in robotics, human intervention has become less critical, and robots are increasingly being used for safety purposes. In our daily lives, fire accidents have become more frequent and, in some cases, lead to dangerous situations where it becomes difficult for firefighters to protect human life. In such instances, firefighting robots are employed to safeguard human lives, property, and the environment from fire hazards. These robots operate in two modes—Automatic mode and Manual mode. In Automatic mode, the robot operates autonomously based on pre-set user commands, while in Manual mode, the robot can be controlled by the user. This paper discusses the development of firefighting robots that can extinguish fires without the need for human firefighters.***

Keywords: *-Robotics, Fire Suppression, Cloud Technology, Risk*

I. INTRODUCTION

The project focuses on the development of a **firefighting robot**. Robots are capable of executing tasks more efficiently, accurately, and economically than humans. Without the assistance of modern machinery, firefighters often risk their lives when confronting fire emergencies. The firefighting robot is programmed to detect and extinguish fires in affected zones. Utilizing wireless communication, the robot can be remotely operated, minimizing human exposure to danger. During a fire outbreak or explosion, deploying human resources can be highly unsafe. Therefore, robots are designed to replace human involvement in hazardous environments and perform tasks in areas that are otherwise inaccessible. Today, robots are increasingly being used in various fields. The aim of this project is to design and develop a prototype system that can autonomously identify fires and manually extinguish them, thus safeguarding firefighters from life-threatening situations.

II. PROBLEM STATEMENT

The primary objective of this project is to create a robotic vehicle that can extinguish fires during major fire incidents. Severe fire accidents are common in industries like nuclear power plants, petroleum refineries, gas storage facilities, chemical factories, and other large-scale

industrial sites, often resulting in massive property loss and human casualties. Sometimes, firefighting personnel are unable to access the fire site due to extreme heat or the presence of explosive materials. In such dangerous environments, firefighting robots can be effectively deployed to combat fires. These robots operate where human intervention is either impossible or extremely risky. Moreover, firefighting robots can shield firefighters from severe hazards in petrochemical plants, hazardous chemical areas, and toxic or explosive fire scenarios. Thus, they play a critical role in minimizing human injuries and saving lives.

III. HARDWARE COMPONENTS

1. Flame Sensor:

A sensor highly sensitive to visible light, primarily used to detect fire.

2. MQ2 Gas Sensor:

A metal-oxide semiconductor device that senses the leakage of gases like methane, LPG, and others.

3. Relay Module:

An electrically operated switch that can handle high load circuits with a low-power input signal.

4. Mini Water Pump:

A small submersible pump used for transferring water, crucial for extinguishing fires.

5. Jumper Wires:

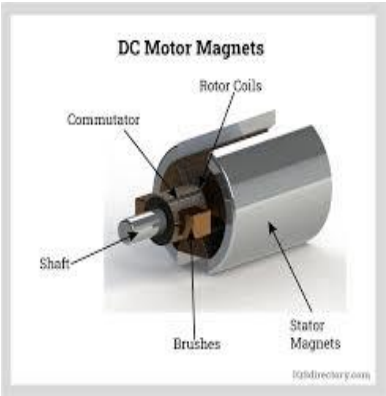
Wires used to establish connections between various components in a circuit.

6. NodeMCU:

A microcontroller board based on the ESP8266-12E Wi-Fi System-on-Chip, programmed using the Lua language, and open-source.

7. Battery:
Provides power supply to the entire circuit and hardware modules.

8. DC Motor:
A motor designed to manage mechanical loads within the system.

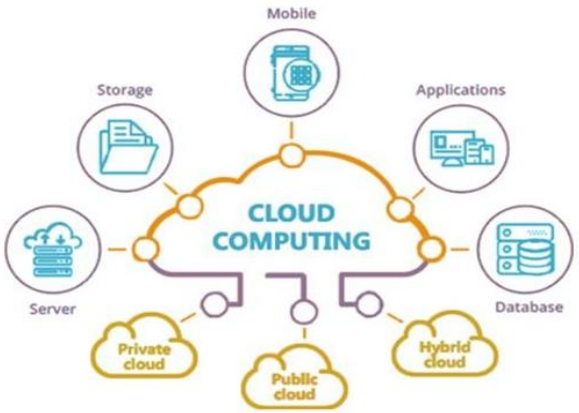


IV. SOFTWARE COMPONENTS CLOUD COMPUTING

Cloud computing is a virtualization-based technology that allows the creation, configuration, and customization of applications online. It integrates various elements such as hard drives.

software programs, databases, and development platforms.

The term "cloud" refers to a network, typically the internet. In cloud computing, remote servers are utilized to store, manage, and access data instead of relying on a local hard drive. Data can include files, images, documents, audio, video, and much more. Through cloud computing, a wide range of services—such as software, servers, databases,

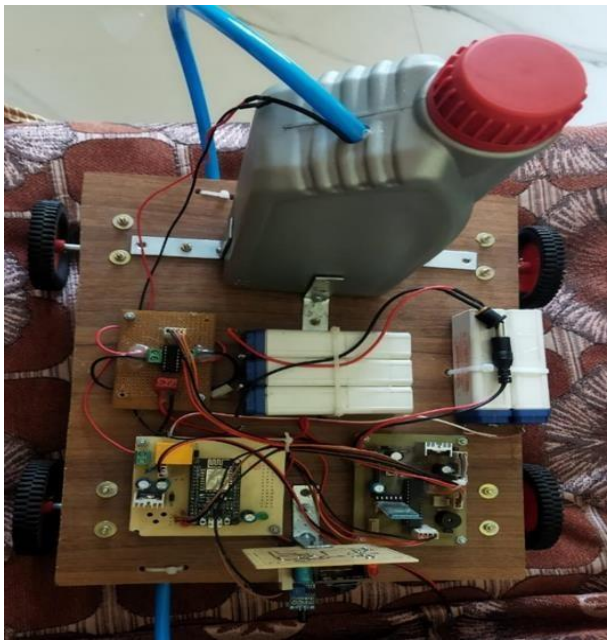


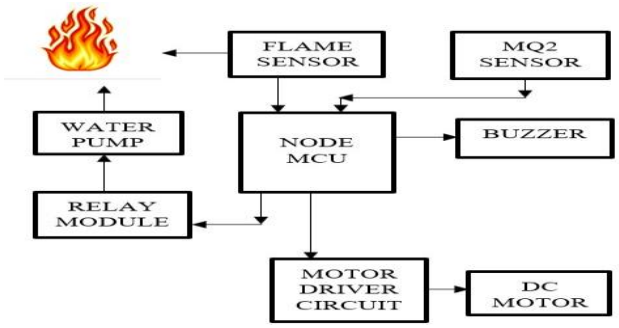
networking, and storage—are provided over the internet.
The name "cloud computing" arises because users can access their data and applications from virtualized servers rather than being restricted to physical devices. By leveraging cloud services, individuals can store and retrieve information remotely, allowing access from virtuallyanywhere.
This method eliminates the need for powerful local machines, as the heavy lifting is done by massive remote server farms. Once connected to the internet, users can work with their data and applications on any device seamlessly.

UBIDOTS:

Ubidots is an Internet of Things (IoT) platform that facilitates the real-time collection, storage, and analysis of data from connected devices. It offers a cloud-based system where users can build customized dashboards, set alerts, and receive notifications for easy monitoring and interaction with IoT data. The platform supports easy integration with devices and sensors by providing a wide range of development tools such as pre-built

libraries, SDKs, and APIs compatible with popular hardware. Additionally, Ubidots supports several communication protocols including MQTT, HTTP, and TCP. Ubidots finds applications across various industries like smart cities, agriculture, healthcare, energy, and manufacturing, helping improve operational efficiency, reduce costs, and optimize productivity.





WORKING

A robot is an autonomous machine capable of performing specific tasks without human intervention.

In this project, we design a **Fire Fighting Robot** that not only encompasses basic robotic functions but is also equipped with the ability to detect and extinguish fires.

ARDUINO IDE:

The Arduino Integrated Development Environment (IDE) is a software application used for writing and uploading programs to Arduino boards. It features a code editor for programming, a message area, a text console, a toolbar with buttons for common functions, and a series of menus. The IDE communicates with Arduino hardware to upload the developed programs and interact with the devices, making it a vital tool for developing embedded and robotic systems.

Figure (b) illustrates the Ubidots cloud dashboard, used for manual operation of the robot

V. CONCLUSION

In this project, we successfully implemented an automatic Fire Fighting Robot utilizing sensors and wireless communication technologies. Fires can cause immense destruction, leading to significant loss of human life and property. Often, it becomes extremely difficult or even impossible for

firefighters to access the site of the fire due to hazardous conditions such as the presence of explosive materials, smoke, and extreme heat.

This project demonstrates that robots can be deployed in environments where human lives would be at risk. The robot is capable of operating in areas that are inaccessible to humans and can act swiftly in emergencies. In such critical scenarios, Fire Fighting Robots prove to be highly valuable for fire suppression.

The robot efficiently detects and navigates toward the fire, taking immediate action to extinguish it using a water pump system. Overall, this design outlines the development and implementation of a firefighting robot that can autonomously locate and put out fires, significantly enhancing safety measures in hazardous environments.

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