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Dual Mode Fire Extinguishing Robot

D Jagan[1], K Priyanka[2], B Ujwala[3], K Prashamson[4], K Sai Rithish[5]
Associate Professor, Dept. of Electronics & Communication Engineering[1]
UG Student, Dept. of Electronics & Communication Engineering[2,3,4,5]
Christu Jyothi Institute of Technology & Science, Jangaon, Telangana, India
jagan410d@gmail.com, kalakotipriyanka1@gmail.com, ujwalabascula@gmail.com,
kommuprashamson435@gmail.com, kongararithish@gmail.com

Abstract: *The robot is designed with a dual-mode functionality, enabling it to navigate autonomously through unknown environments to detect and suppress fires, as well as be manually controlled for targeted intervention in complex scenarios. The system integrates various sensors, including flame sensors for fire detection and obstacle avoidance sensors for navigation. The extinguishing mechanism employs a water spraying system activated upon fire detection or manual command.*
A dual-mode fire extinguisher robot is an innovative device designed to tackle fire emergencies efficiently. It typically operates in two modes: manual and autonomous. In manual mode, the robot can be controlled remotely by a human operator to navigate complex environments. In autonomous mode, it uses sensors, cameras, and algorithms to detect fires and extinguish them without human intervention..

Keywords: IoT, Arduino uno, Fire sensor, LCD, Motor Driver, Water Pump, Humidifier, Buzzer, Relay

I. INTRODUCTION

A fire extinguishing robot is a cutting-edge machine designed to detect and suppress fires in various environments, such as industrial settings, warehouses, and public spaces. Equipped with advanced sensors, cameras, and extinguishing agents, these robots can navigate through spaces, identify fires, and deploy extinguishing agents to put out flames. They offer rapid response, accessibility, and safety in firefighting situations, reducing the risk to human life and minimizing damage to property. With their ability to operate in hazardous environments and reach areas difficult for humans to access, fire extinguishing robots are becoming an essential tool in fire safety and prevention, providing a proactive and effective approach to firefighting.

II. INTERNET OF THINGS (IOT)

"Today computers and, therefore, the Internet are almost wholly dependent on human beings for information. Nearly all of the roughly 50 petabytes (a petabyte is 1,024 terabytes) of data available on the Internet were first captured and created by human being by typing, pressing a record button, taking a digital picture, or scanning a bar code. Conventional diagrams of the Internet … leave out the most numerous and important routers of all - people. The problem is, people have limited time, attention and accuracy all of which means they are not very good at capturing data about things in the real world. And that's a big deal. We're physical, and so is our environment … You can't eat bits, burn them to stay warm or put them in your gas tank. Ideas and information are important, but things matter much more.

Yet today's information technology is so dependent on data originated by people that our computers know more about ideas than things. If we had computers that knew everything there was to know about things using data they gathered without any help from us we would be able to track and count everything, and greatly reduce waste, loss and cost. We would know when things needed replacing, repairing or recalling, and whether they were fresh or past their best. The Internet of Things has the potential to change the world, just as the Internet did. Maybe even more so".

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III. DUAL MODE FIRE EXTINGUISHING ROBOT

An IoT-based field protection and control system represents a cutting-edge approach to modern agricultural management and infrastructure security. By integrating Internet of Things (IoT) technology, this system enables real-time monitoring, data collection, and automation to enhance the efficiency and safety of fields. The primary objectives include protecting crops from pests and environmental hazards, optimizing resource usage, and ensuring the safety and security of agricultural fields and infrastructure.

This advanced system leverages sensors, actuators, and communication networks to provide farmers and field managers with actionable insights, enabling proactive decision- making and efficient control of field operations. Through the seamless integration of IoT technologies, the system aims to improve yield, reduce losses, and promote sustainable farming practices.

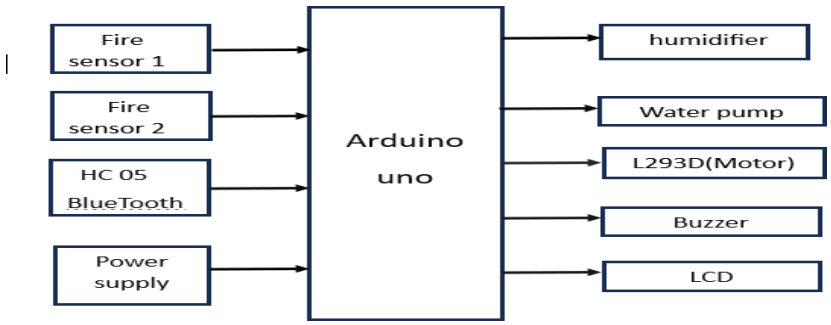
IV. EXISTING SYSTEM

1. Water-based systems: Sprinkler systems, water spray systems, and foam-water systems.
2. Gas-based systems: Clean agent systems, carbon dioxide systems, and inert gas systems.
3. Chemical-based systems: Dry chemical systems, wet chemical systems, and foam systems.
4. Specialized systems: Water mist systems, fine water spray systems, and clean agent systems for specific applications.

V. PROPOSED SYSTEM

The proposed system outlines a dual-mode fire extinguishing robot leveraging an Arduino Uno as its central controller. The robot is equipped with dual fire detection capabilities via two distinct fire sensors, enhancing its reliability and coverage. For communication and potential remote operation, an HC-05 Bluetooth module is integrated. The system incorporates a power supply to ensure autonomous operation. Upon detecting a fire, the robot is designed to respond in multiple ways: it can activate a humidifier and a water pump to suppress the flames, with the water pump's operation potentially managed by an L293D motor driver for directional control or varying intensity. Simultaneously, a buzzer will sound to provide an immediate audible alert of the fire. Furthermore, a connected LCD will display crucial information regarding the fire detection status and the robot's response actions. This dual-mode approach, combining both humidification and water-based extinguishing methods with remote communication and status display, aims to create a versatile and effective autonomous fire extinguishing robot.

VI. BLOCK DIAGRAM



VII. SOFTWARE EMPLOYED

The Arduino Integrated Development Environment (IDE) is a software platform designed for programming Arduino microcontroller boards. It provides a user-friendly interface that simplifies the process of writing, compiling, and uploading code to Arduino devices. The IDE is open-source and supports a wide range of Arduino boards, from the popular Arduino Uno to more advanced models like the Arduino Mega and Arduino Nano. Key features of the Arduino IDE include a text editor with syntax highlighting and auto-completion, making it accessible even to beginners in programming and electronics. Additionally, the IDE includes a library manager that allows users to easily install and

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manage libraries of pre-written code, enabling faster development of projects by leveraging existing functionalities such as sensors, communication protocols, and display drivers.

In addition to its basic functionality, the Arduino IDE supports debugging tools and serial monitor features that aid in troubleshooting and real-time communication between the Arduino board and a connected computer. This capability is crucial for monitoring sensor outputs, debugging code logic, and verifying system behaviour during development. Moreover, the Arduino IDE is platform-independent, compatible with Windows, macOS, and Linux operating systems, ensuring broad accessibility across different user environments. Overall, the Arduino IDE serves as a foundational tool for hobbyists, educators, and professionals alike, empowering them to create interactive and innovative projects using Arduino microcontrollers with ease and efficiency.

VIII. RESULT AND DISCUSSION

Explanation of the Flowchart:

1. Start: The system begins its operation.
2. Power On?: Checks if the power supply is active. If not, it stays at the start.
3. Initialize System (LCD, Bluetooth): Once powered, the Arduino initializes the LCD for display and the Bluetooth module for communication.
4. Read Fire Sensor 1: The Arduino reads the data from the first fire sensor.
5. Read Fire Sensor 2: The Arduino reads the data from the second fire sensor.
6. Fire Detected? (Sensor 1 OR Sensor 2): The Arduino checks if the reading from either of the fire sensors indicates a fire.
7. Activate Buzzer: If a fire is detected, the buzzer is turned on to sound an alarm.
8. Display "Fire Detected" on LCD: A message indicating fire detection is displayed on the LCD screen.
9. Activate Humidifier: The humidifier is turned on, potentially to help suppress the fire in its initial stages.
10. Activate Water Pump (via L293D): The water pump is activated through the L293D motor driver, allowing for control of the pump's operation (on/off, speed, direction if applicable).

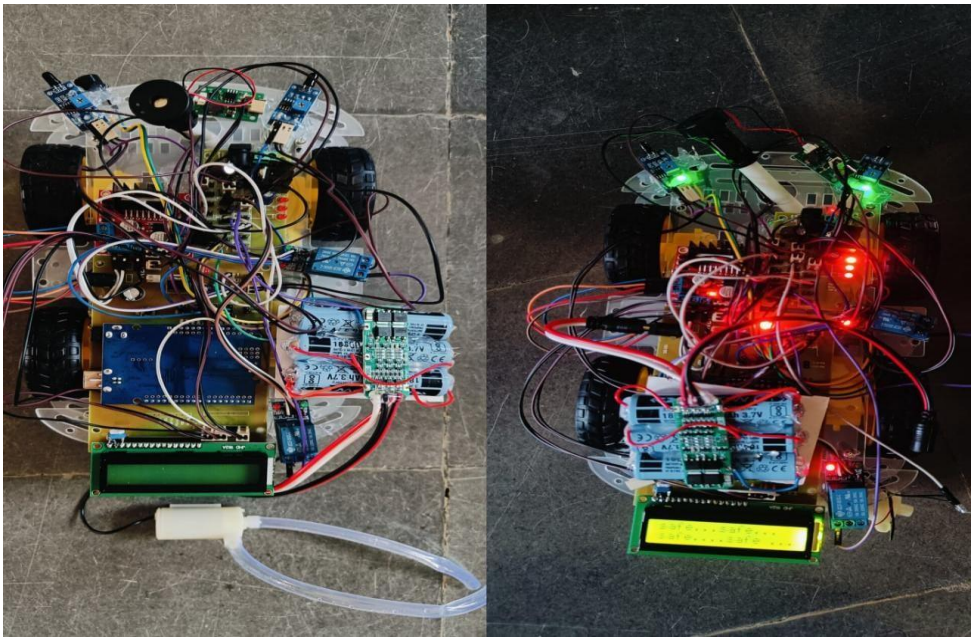

Figure 1: Circuit Board

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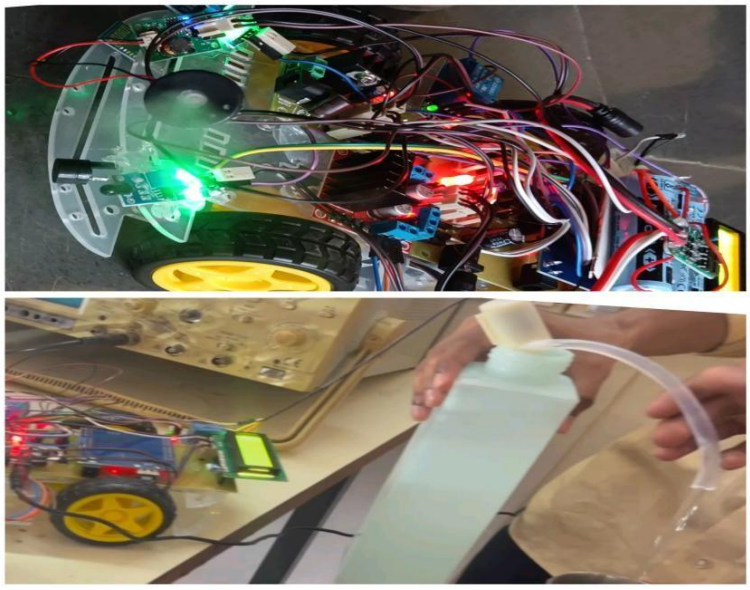

Figure 2: Result

VIII. CONCLUSION

A dual-mode fire extinguishing robot represents a significant advancement in fire safety and emergency response. By integrating both autonomous and manual operation modes, this robot can efficiently navigate hazardous environments, detect fires using advanced sensors, and extinguish flames using multiple suppression techniques.

Its ability to function autonomously enhances speed and precision in fire containment, while the manual control mode allows human operators to intervene in complex situations requiring specialized decision-making. Equipped with thermal imaging, mobility enhancements, and adaptive extinguishing mechanisms, this robot can significantly reduce risks to firefighters and improve overall firefighting effectiveness.

The development and deployment of such robots mark a transformative step in emergency management, ensuring rapid response and enhanced safety in fire-prone areas. Future improvements may focus on increasing AI-driven decision-making, refining mobility in challenging terrains, and integrating more sustainable fire suppression materials for optimal performance.

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