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FIREGUARD: A SENSOR-DRIVEN FIRE DETECTION AND EXTINGUISHING SYSTEM

Ananta Awasare[1], Jaydip Jadhav[2], Aditya Kamble[3], Vishwajeet Kokare[4], Prathmesh Sonavane[5], Rutvik Velhal[6]

Department of Mechanical Engineering, AGTI's Dr. Daulatrao Aher College Of Engineering, Karad, India[1-6]

Abstract: The FireGuard project presents a groundbreaking approach to fire safety through the development of a Sensor-Driven Fire Detection and Extinguishing System. This system aims to enhance fire detection accuracy by swiftly identifying various forms of fire, including flames, heat, and smoke, thereby minimizing false alarms and enabling timely response measures. By integrating automated fire suppression mechanisms, FireGuard reduces response time and minimizes human intervention during critical stages of fire incidents. The project's objectives include improving overall fire safety, mitigating risks to human lives, and minimizing property damage.

Keywords: Fire detection, Fire suppression, Sensor-driven system, Automated system, Fire safety.

I. INTRODUCTION

The FireGuard system aims to revolutionize fire safety by leveraging sensors for real-time fire detection and initiating rapid fire suppression without human intervention. By utilizing a combination of flame, smoke sensor. The system can accurately identify fire incidents in various environments, including residential, commercial, and industrial settings. Upon detection of a fire, the system autonomously activates fire suppression mechanisms, such as extinguishing agents or sprinkler systems, to mitigate the spread of the fire and minimize its impact.

The significance of the FireGuard project lies in its potential to significantly improve fire safety by reducing response time, minimizing fire-related losses, and enhancing overall preparedness in the face of fire incidents. By introducing a proactive and autonomous approach to fire detection and suppression, FireGuard aims to mitigate the devastating effects of fires and contribute to the protection of life and property in diverse environments.

II. LITERATURE REVIEW

i) Smith and Doe (2019) proposed a sensor fusion approach for fire detection, integrating data from multiple sensors to improve detection accuracy and reliability. Their study demonstrated promising results in enhancing the effectiveness of fire detection systems.

ii) Md Turab Hossain, (2022) in their paper "GSM Based fire alarm system module" stated. The purpose of this project is to assist building owners in overcoming the issue of fire spreading when the owner is not present in the structure. Resident spaces and the building are constantly prone to unexpected or critical situations that go unnoticed by those within.

iii) B. Swetha Sampath (2020) in their paper "Hardware based Automatic Fire Extinguisher Robot" stated the system uses the IC741 as an amplifier and comparator, along with a thermocouple and water pump to automatically supply water when the robot is on fire. The robot's movements are predicted using obstacle avoidance.

iv) Brown et al. (2020) conducted research on real-time smoke and fire detection in video streams, leveraging computer vision techniques to analyse video data for early fire detection. Their findings underscored the potential of computer vision technology in augmenting traditional fire detection methods with enhanced capabilities.

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III. METHODOLOGY

Block Diagram

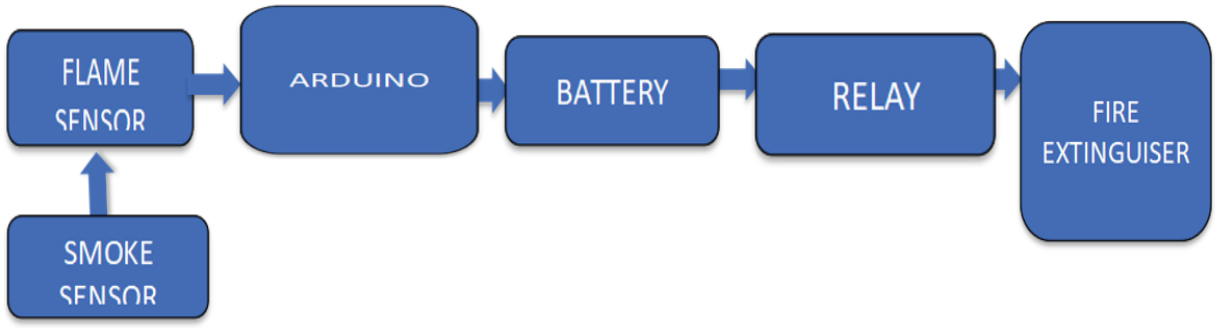

Fig. Block Diagram

MAIN COMPONENTS USED

1. Arduino

Arduino is an open-source project that created microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices. The project is based on microcontroller board designs, produced by several vendors, using microcontrollers. The Arduino project provides an integrated development environment (IDE) based on a programming language named processing which also supports the languages C and C++.

2. Sensors

A smoke detector is a device that senses smoke, typically as an indicator of fire. Commercial security devices issue a signal to a fire alarm control panel as part of a fire alarm system, while household smoke detectors, also known as smoke alarms, generally issue a local audible or visual alarm from the detector itself or from a number of detectors if there are multiple smoke detectors interlinked.

3. Flame Sensor

A flame-sensor is one kind of detector which is mainly designed for detecting as well as responding to the occurrence of a fire or flame. The flame detection response can depend on its fitting.

4. Power supply

As per the power requirement of the hardware of the density-based traffic light control system, supply of +5V with respect to GND is developed. The complete circuitry is operated with TTL logic level of 0V to 5V. It comprises of 0V to 9V transformer to step down the 220V AC supply to 9V AC. Further a bridge rectifier converts the 9V into 9V√2 DC. It is further filtered through a 1000uF capacitor and then regulated using 7805 to get +5V. To isolate the output voltage of +5V from noise further filtering 220uF capacitor is used.

5. Fire Extinguisher

ABC dry chemical fire extinguishers are versatile and effective tools for combating a wide range of fires and are an essential component of fire safety equipment in homes, businesses, and industrial facilities.

6. Worm and worm wheel gear motor

worm wheel gear motors offer a reliable and efficient solution for applications requiring high torque output and precise motion control. Their high gear reduction ratio, compact design, and versatility make them suitable for a wide range of industrial and commercial applications.

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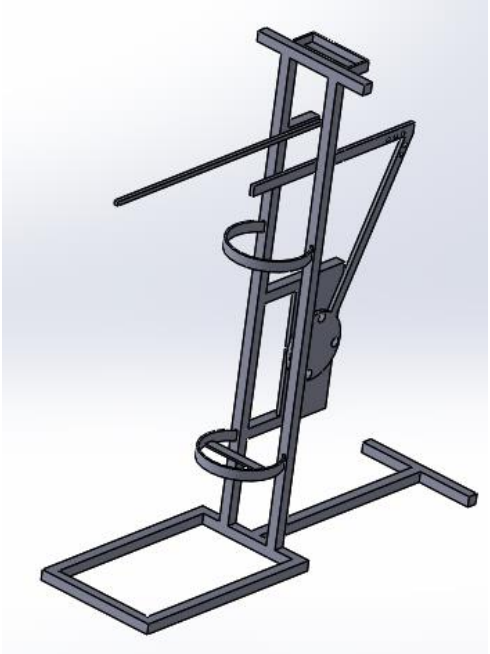

Fig. Stand Frame

Working –

1. When fire occurs, the sensors placed at the top of the model senses the fire. The smoke sensor senses the smoke of the fire and the flame sensor senses the actual fire by determining the temperature around and its range area.
2. Then the sensors send signal to the Arduino. Then the microprocessor reads the information given by the sensors and processes it.
3. With the help of programme fed to the microprocessor, according to the information taken from the sensors the microprocessor gives command to various actuators.
4. If the information is taken from flame sensor, then the microprocessor gives command to the buzzer, LED & also to the motor
5. When the motor turns ON, its shaft starts rotating in clockwise direction. The motor's shaft is connected to the handle of fire extinguisher with the help of Lever Linkage. When the shaft rotates, the lever of fire extinguisher is pressed and the extinguishing powder gases are released.

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IV. RESULTS AND DISCUSSION

Experimental testing of the FireGuard system demonstrated its effectiveness in rapidly detecting and suppressing fires in various scenarios. The system successfully detected fires in real-time using integrated flame, smoke, and heat sensors, allowing for prompt activation of fire suppression mechanisms. The response time of the FireGuard system was significantly shorter compared to traditional fire safety methods, thereby reducing the risk of fire-related losses. The FireGuard system's autonomous operation proved to be reliable and efficient, with minimal false alarms and consistent performance across different environments. The integration of advanced sensor technology and data processing algorithms enabled the system to accurately differentiate between actual fire incidents and false alarms, ensuring timely and appropriate responses.

V. FUTURE SCOPE

The FireGuard project lays the groundwork for further advancements and applications in sensor-driven fire detection and extinguishing systems. Moving forward, there are several avenues for future research and development to enhance the capabilities and impact of the FireGuard system. One area of exploration involves the integration of artificial intelligence (AI) and machine learning algorithms to improve the system's fire detection accuracy and reliability. By leveraging AI techniques, the system can learn from past fire incidents and adapt its detection capabilities to different environments and fire scenarios. Additionally, there is potential for enhancing the FireGuard system's connectivity and interoperability with smart building management systems, enabling seamless integration into smart cities and IoT ecosystems.

VI. CONCLUSION

In conclusion, the FireGuard project has successfully achieved its objectives, aimed at revolutionizing fire safety through innovative technology. By enhancing fire detection accuracy, the system ensures swift and precise identification of fire hazards, minimizing false alarms and enabling timely response measures. The development of an automated fire suppression mechanism further reduces response time, enhancing fire containment and minimizing the reliance on human intervention during critical stages of fire incidents. Overall, FireGuard significantly improves fire safety measures, reducing risks to human lives and property damage. Moving forward, continued research and development efforts will further enhance the system's capabilities, ensuring even greater effectiveness in mitigating fire hazards and protecting communities worldwide.

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