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DESIGN AND IMPLEMENTATION OF FIRE EXTINGUISHING

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Abstract

Safety is a paramount concern across all sectors, with fire safety measures becoming essential in every environment. Particularly in industrial zones, fire incidents are prevalent and often result in significant harm to both human lives and property. This review examines the primary causes of these fire incidents and evaluates the technological solutions currently in place to mitigate them. Presently, many safety protocols, enhanced by the Internet of Things (IOT), are implemented post-incident initiation. However, the system proposed in this paper focuses on preemptive fire safety protocols specifically designed for the fireworks industry. By identifying and addressing the foundational causes of fires, the system aims to prevent fire incidents before they occur. Such proactive measures could significantly reduce hazardous incidents and save numerous lives.

Keywords:

Internet of Things (IoT), fire incidents, preemptive safety.

1. INTRODUCTION

Historically, the operation of firefighting robots was constrained by the use of basic electronic controls that limited their functionality. However, recent technological breakthroughs have paved the way for more advanced robotic systems, which are now managed through Android applications. This enhancement significantly boosts the operational efficiency of firefighters, particularly in mobility and critical response capabilities. Through the integration of an Android application, firefighters can more accurately locate and tackle fires. Additionally, these robots are outfitted with ultrasonic sensors that allow them to identify and avoid obstacles effectively. The utilization of robotics in fire management is vital for reducing health and safety risks to individuals in high-risk environments. Implementing such technology in areas prone to fires can drastically cut down on human casualties and avert a range of adverse incidents. As technology continues to evolve, there is an ongoing push to innovate and expand the variety of robots used in both residential and commercial settings. Robots are generally characterized as systems capable of executing tasks or acting in ways that mimic human behavior. Current research is focused on developing dependable and efficient technologies for constructing autonomous firefighting robots that can independently identify and suppress fires, thus minimizing the threat of harm to people.

2. PROPOSED METHOD

The primary goal of this system is to enhance forest fire detection and management using advanced IoT technology.

By integrating various components such as the ESP8266 Wi-Fi microchip, temperature sensors, GPS

modules, smoke sensors, and buzzers, the system provides a comprehensive solution to monitor environmental conditions accurately and in real-time

The ESP8266 enables seamless network connectivity, allowing the system to send instant alerts and data to forest officers via the internet.

Temperature and smoke sensors detect any abnormal changes in the environment that may indicate a fire, triggering alerts that are swiftly communicated through the system's Wi-Fi capabilities. The GPS

module pinpoints the exact location of the disturbance, ensuring quick response and precise navigation for emergency teams

Overall, this setup is designed to offer a robust and

efficient response to forest fires, aiming to minimize damage and enhance safety by providing timely information and alerts to the appropriate personnel.

3. Literature survey

Fire Extinguisher Robot Systems

Fire Extinguisher Robot with IoT Integration

In their research, the team from AISSMS's Institute of Information Technology in Maharashtra, India, developed a fire-extinguishing robot that leverages the Internet of Things (IoT). The robot is equipped with sensors capable of detecting fires. When a fire is detected, the robot sends real-time notifications to users through the Blinks App. Users can remotely control the robot, directing it to the fire site and activating its water pump. This system enhances fire safety by providing an automated response to fire incidents.

Feature Selection for Intelligent Firefighting Robot

Jong-Hwan Kim proposed a humanoid robot designed specifically for firefighting tasks. The robot utilizes thermal infrared images to locate fires. By analyzing thermal patterns, it distinguishes between fire, smoke, and thermal reflections. This intelligent robot assists firefighters in identifying fire sources and planning effective strategies for containment and extinguishment.

Automatic Fire Extinguisher Systems

Design and Testing of an Automatic Fire Extinguisher

Researchers have explored the development of automatic fire extinguisher systems. These systems combine advanced sensors, artificial intelligence, and rapid response mechanisms. The goal is to create a reliable and efficient solution that activates automatically upon fire detection. Such systems minimize human intervention and reduce response time, crucial for preventing fire escalation.

Multi-Purpose Fire Extinguisher Robots

Design and Development of Multi-Purpose Fire Extinguisher Robot

Another study focuses on a multi-purpose fire extinguisher robot. This robot is not limited to firefighting; it can perform additional tasks such as surveillance, search and rescue, and hazardous material handling. By integrating multiple functionalities, researchers aim to create versatile robots that enhance emergency response capabilities.

Innovative Approaches

Acoustic Wave-Based Fire Extinguisher

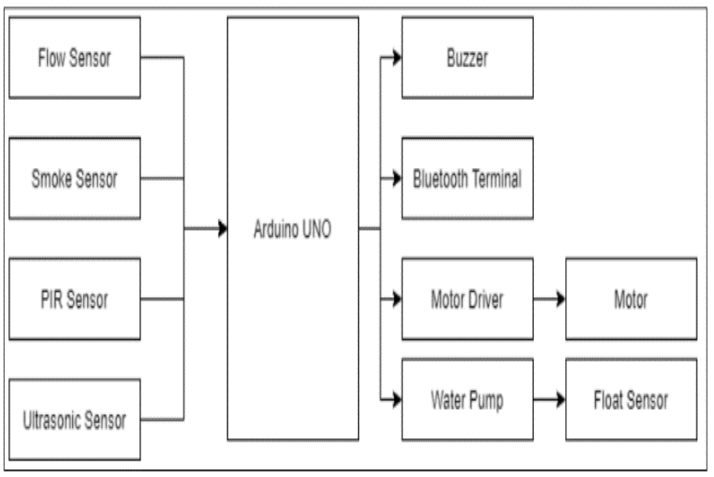
In an effort to minimize environmental impact, a project explored an acoustic wave-based fire extinguisher. Unlike traditional chemical-based extinguishers, this handheld device operates without harmful chemicals. It emits acoustic waves that disrupt the combustion process, effectively extinguishing fires. The acoustic fire extinguisher is safe for both users and the environment.

4. System Overview and Specification:

Our system is designed to detect forest fires using advanced IoT technology. It employs a microcontroller to manage operations and includes sensors that detect and pinpoint fire locations. This information is relayed to nearby forest officers. The setup is entirely monitored online, allowing officers to view and analyze data continuously. Key Components: Microcontroller (Arduino): Controls the system's functions. Sensors: Temperature and smoke sensors detect changes in the forest environment. Solar Power: The system is powered by a solar panel with a battery backup, ideal for remote forest locations where conventional power

sources are unavailable. Functionality: The sensors monitor temperature and smoke levels, sending real-time updates to the Arduino. If critical thresholds are reached, the Arduino triggers an alert and communicates the fire's location using its Wi-Fi capability. This approach ensures efficient monitoring and quick response to forest fires, enhancing our ability to protect these vital ecosystems.

5. Block Diagram



System Architecture:

The proposed system comprises several key components interconnected to form a cohesive framework for fire detection and suppression. These components include

Flow sensor :

Flow sensors in fire suppression systems measure water flow rates, ensuring efficient delivery during firefighting. Employing technologies like turbines or ultrasonics, they provide real-time feedback on water movement, optimizing extinguishing efforts. Crucial for detecting anomalies, they alert to leaks or blockages, enhancing system reliability.

Smoke sensor:

Smoke sensors detect smoke particles, serving as early warning systems in fire detection setups. They utilize optical or ionization methods to detect the presence of smoke, triggering alarms or initiating suppression actions. Crucial for rapid response, they enhance safety by alerting occupants and authorities to potential fire incident.

PIR Sensor:

PIR (Passive Infrared) sensors detect infrared radiation changes caused by heat sources or movement, crucial in fire detection systems. They trigger alerts upon sensing such changes, aiding in early fire detection. PIR sensors play a vital role in enhancing system sensitivity to fire incidents, ensuring swift response and minimizing potential damage

Ultrasonic sensor:

The ultrasonic sensor measures distance by emitting ultrasonic waves and analyzing their reflection, facilitating proximity detection and obstacle avoidance.

Buzzer:

The buzzer generates audible alerts or alarms to notify occupants or authorities of fire incidents or system malfunctions. Buzzers, or beepers, are audio signaling devices used in various applications such as alarms and timers. They can be mechanical, electromechanical, or piezoelectric, and are commonly used to signal user interactions or alerts.

Bluetooth terminal

The Bluetooth terminal enables wireless communication between the system and external devices, such as smartphones or tablets, for remote monitoring and control

Arduino UNO:

The Arduino UNO serves as the central processing unit in fire detection and suppression systems, responsible for data acquisition, sensor interfacing, decision-making, and actuator control. Its versatility and programmability make it an ideal platform for managing various system functions, from processing sensor data to executing control algorithms. Equipped with a range of input/output pins and communication interfaces, the Arduino UNO enables seamless integration of sensors, actuators, and external devices. Its user-friendly programming environment and extensive community support facilitate system development and customization, empowering users to create tailored solutions for fire safety applications.

Motor driver:

A motor driver acts as an intermediary between the control unit, such as an Arduino UNO, and the motor in fire suppression systems. It regulates the flow of power to the motor, translating low-power control signals into high-power output signals required to drive the motor. By controlling voltage, current, and direction, the motor driver ensures precise control over motor speed and rotation. Additionally, it incorporates protective features to safeguard both the motor and the control system from damage or malfunction. Motor drivers play a crucial role in facilitating smooth and efficient operation of motorized components, enhancing the overall reliability and performance of fire suppression systems.

Temperature Sensor:

Temperature sensors measure environmental temperatures and come in various types, such as thermocouples. Thermocouples are known for their accuracy and quick response, using a pair of different metals that generate a voltage reflecting temperature changes

Motor :

The motor drives the water pump to deliver water from the source to the targeted area for fire suppression.

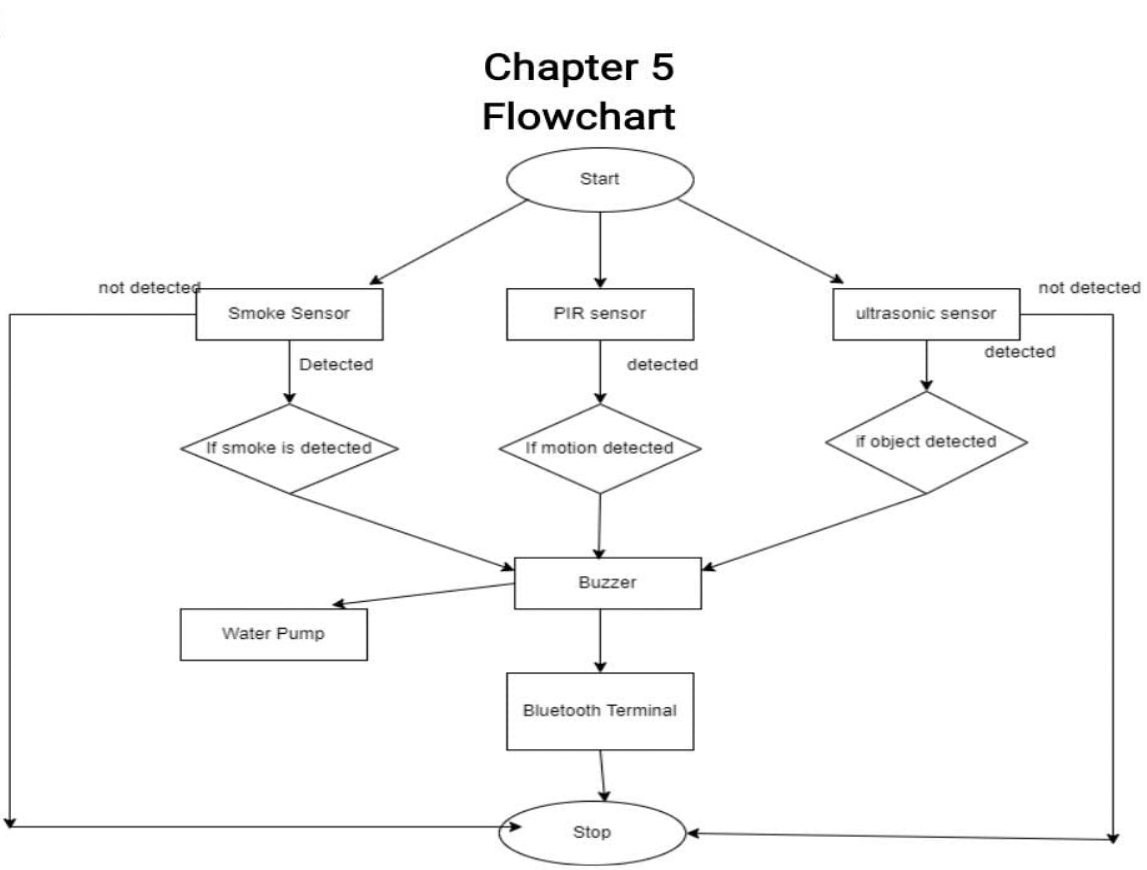
Water pump :

The water pump plays a pivotal role in fire suppression systems by drawing water from a reservoir or supply source and delivering it to the targeted area to extinguish fires. Utilizing mechanical means such as impellers or pistons, water pumps create pressure to propel water through pipelines or hoses, ensuring efficient distribution. Their reliable performance and high flow rates enable rapid response to fire incidents, effectively mitigating risks and minimizing damage. Water pumps are available in various types and capacities to suit different applications, providing flexibility and adaptability in fire safety systems to ensure adequate water supply for firefighting operations.

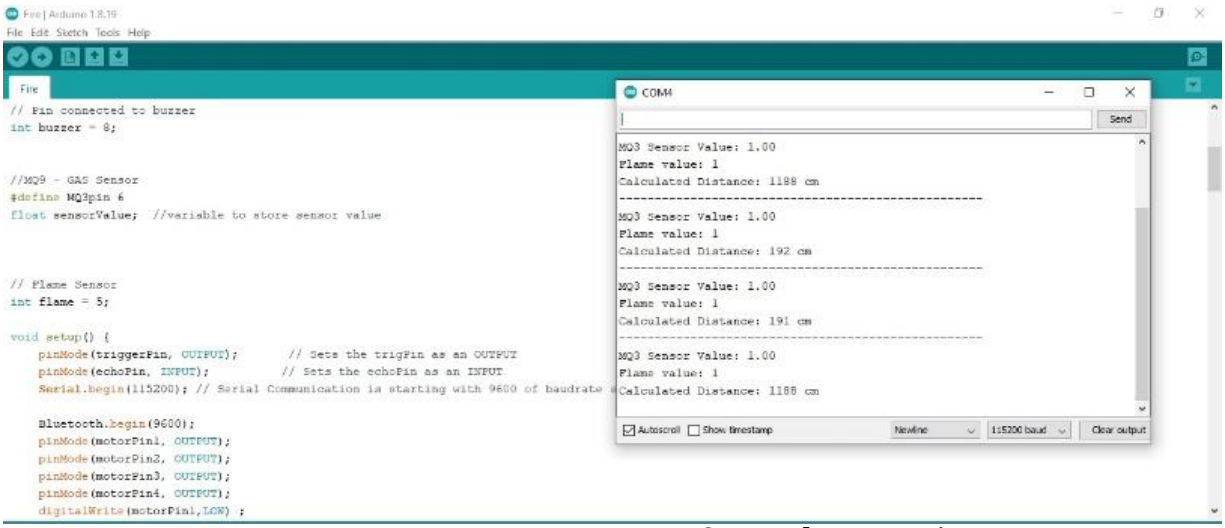
Float sensor :

The float sensor detects the water level in reservoirs or supply sources, ensuring adequate water availability for fire suppression operations. Consisting of a buoyant element attached to a switch mechanism, the float sensor activates when water levels rise or fall beyond preset thresholds. Upon detection, it triggers alerts or control actions to maintain optimal water levels for firefighting. Float sensors play a critical role in preventing water shortages or overflows, optimizing the performance and reliability of fire suppression systems. By monitoring water levels in real time, they facilitate timely replenishment and ensure continuous availability of water resources for effective firefighting efforts.

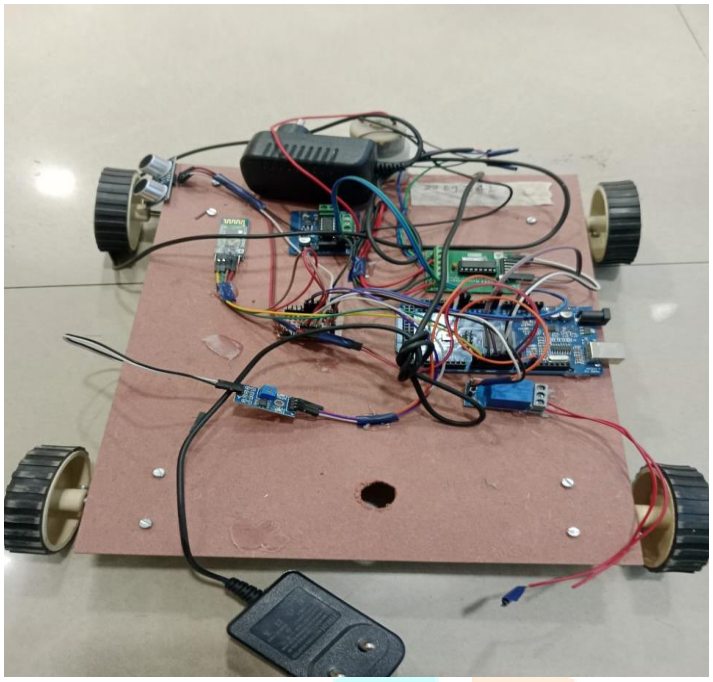
6. Flow Diagram



7. Result



8. Hardware Design



9. Conclusion

Our system is designed to promptly detect gas leaks and fires, alerting users via SMS. It stands out for its accuracy, affordability, and secure design, effectively addressing issues of transparency. By utilizing an advanced controller that monitors environmental conditions, the system gathers precise data from upgraded sensors. This data is processed through Python scripts, ensuring timely updates and actions based on the sensor readings. With its versatility, our system can be adapted for various applications, promising to deliver enhanced performance and reliable outcomes in safety management.

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