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Fire Alert System Using Cctv Surveillance

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Abstract - Fire accidents are a common occurrence in farm fields, especially during summer. Since farmers cannot monitor the fields round-the-clock, our system uses fire detection sensors to identify fire incidents in the farm field. Upon detection, an alert message is sent to the farmer via SMS, along with the IP address of the connected camera, enabling the farmer to view live footage of the field. Additionally, the system incorporates smoke detection, which serves as an early warning mechanism. When smoke is detected, an alert message is displayed on the LCD, allowing preventive action before a fire breaks out.

Key words: Fire detection, Smoke sensors, Alert system Live camera feed, SMS notification, Farm fire prevention.

1. INTRODUCTION

Fire accidents in agricultural fields are a significant concern, especially during dry and hot seasons. These incidents can lead to severe financial losses, environmental damage, and disruptions in food production. Traditional fire monitoring methods, such as manual observation, are inefficient and unreliable due to the vastness of farmland and the unpredictability of fire outbreaks. To address this challenge, automated fire detection systems have gained importance in modern agriculture.

Grade I. Background & Motivation: Fire accidents frequently occur in farm fields, especially during summer, causing significant damage. Since farmers cannot monitor their fields all the time, our system uses fire and smoke detection sensors to identify potential fire hazards. When fire is detected, the system sends an SMS alert to the farmer with a live camera link to monitor the field. Smoke detection provides an early warning by displaying an alert on an LCD, allowing preventive action before a fire starts.

Grade II. The Need for an Automated System: Fire hazards in farm fields are a common problem, particularly in hot weather conditions. To address this issue, our system integrates fire and smoke detection sensors to monitor fields continuously. Upon detecting fire, the system immediately sends an SMS alert to the farmer, including an IP address for live camera access. Additionally, the system detects smoke at an early stage and displays an alert on an LCD, allowing preventive measures to be taken before the fire escalates.

Grade III: Fire accidents pose a major risk to agricultural fields, especially during summer, leading to financial losses and environmental damage. This paper presents an automated fire detection system utilizing sensors for real-time monitoring. Additionally, an early-warning smoke detection mechanism is incorporated, where an LCD alert is displayed upon detecting smoke, facilitating timely intervention before fire outbreak. The proposed system enhances farm safety and minimizes fire-related losses through real-time monitoring and rapid response mechanisms.

Grade IV: Fire incidents in agricultural landscapes present severe threats to crop production, infrastructure, and rural ecosystems. Traditional monitoring methods are ineffective due to the vastness of farmland and the unpredictability of fire outbreaks. This paper proposes a smart fire monitoring and alert system utilizing fire and smoke detection sensors for real-time field surveillance. The system is designed to autonomously detect fire and send an SMS notification to the farmer, including an IP address link to a live camera feed for remote monitoring. Moreover, a proactive smoke detection mechanism triggers an LCD warning message, providing early intervention opportunities before fire escalation

2. LITERATURE REVIEW

Recent advancements in fire detection and prevention systems for agricultural and residential settings have significantly leveraged IoT technologies and AI-driven models. In 2023, Manjunatha et al. introduced an IoT-based system designed for farmland fire detection and prevention. This system employs a network of sensors to monitor environmental conditions, triggering alarms and activating sprinklers upon detecting fire hazards, while also providing real-time updates via a web-based dashboard.

In the same year, Alqourabah et al. developed a smart fire detection system integrating IoT technology with automatic water sprinklers. This approach utilizes interconnected sensors to detect early signs of fire, such as smoke and heat, and responds by activating sprinklers and sending alerts to relevant authorities, thereby enhancing response times and minimizing potential damage.

The application of AI in wildfire prediction has also seen notable progress. In 2024, Ardid et al. developed an AI-based model that analyzes weather data every 30 minutes to forecast wildfire danger in real-time. Tested in Queensland, Australia, this model achieved a 47% improvement in predicting critical pre-fire conditions compared to traditional indices, offering a cost-effective solution for enhancing community safety and resilience.

Additionally, AI-powered satellite monitoring has been employed to revolutionize wildfire management. By analyzing satellite imagery and environmental data, these systems can detect wildfires up to 95% faster than traditional methods, enabling proactive risk assessment and timely interventions to protect vulnerable areas.

These developments underscore the critical role of integrating IoT and AI technologies in enhancing fire detection and prevention strategies across various environments, thereby improving safety and mitigating potential losses.

3. SYSTEM DESIGN

Existing system:

Current fire monitoring in agricultural fields relies on manual observation or basic sensor-based fire alarms, which are often ineffective for large areas. Some farms use CCTV cameras, but they lack automated fire detection and alert systems. IoT-based fire detection exists, but most systems only send SMS alerts without live monitoring. Additionally, existing solutions struggle with false alarms and connectivity issues in remote locations. There is a need for a smart system that ensures real-time detection, early warning, and remote accessibility to prevent fire damage effectively

Proposed system:

The proposed system is an IoT-based smart fire detection and prevention solution for agricultural fields. It integrates fire and smoke sensors to detect early signs of fire and minimize false alarms. Upon detection, an SMS alert is sent to the farmer, including the IP address of a connected live camera for real-time monitoring. An LCD display also provides immediate smoke alerts, allowing preventive action before a fire breaks out. The system ensures 24/7 surveillance and reduces manual monitoring efforts. To enhance safety, automatic water sprinklers can be integrated for fire suppression. The use of IoT enables remote access, allowing farmers to monitor their fields from anywhere. This system provides a cost-effective, reliable, and scalable solution for farm fire prevention. With real-time alerts and early warning mechanisms, it minimizes fire-related losses and improves agricultural safety.This innovative approach leverages IoT technology to provide a proactive fire prevention mechanism, ensuring timely intervention and reducing potential damage. By integrating automation and remote monitoring, the system enhances agricultural safety, offering farmers peace of mind and improved crop protection.

4. METHODOLOGY

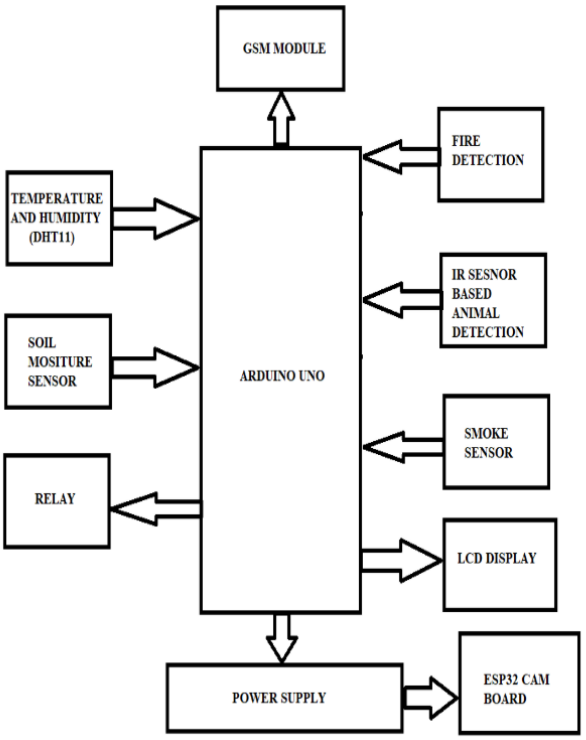

Fig -1: Dataflow Diagram.

The Arduino microcontroller is the core of the system, integrating multiple sensors for smart farm monitoring. An IR sensor detects animals in the farm field, mainly at night, and sends an SMS alert to the farmer along with the ESP32-CAM's live feed IP address. The farmer must activate the animal detection mode before leaving the field to prevent crop damage. The fire detection sensor identifies flames, triggering an SMS alert and allowing the farmer to access the live camera feed for real-time monitoring. A smoke sensor detects smoke in the field, displaying an alert on the LCD screen for immediate action. The DHT11 sensor continuously measures temperature and humidity, updating real-time values on the LCD screen. Additionally, a soil moisture sensor ensures automated irrigation by turning the water pump on when moisture drops below a set level and off once it is sufficient. The GSM module facilitates instant SMS notifications for fire, smoke, or animal detection, enabling remote access to the ESP32-CAM live feed. The system ensures 24/7 remote surveillance, reducing manual monitoring while providing fire prevention, animal detection, and automated irrigation. The LCD screen displays crucial farm updates, including smoke detection, temperature, and humidity levels. With real-time alerts and continuous monitoring, farmers can respond to threats efficiently from anywhere. This cost-effective, scalable, and reliable solution enhances farm security, minimizes losses, and improves agricultural safety.

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5. FUTURE DIRECTIONS

The integration of AI and machine learning can enhance fire prediction by analyzing environmental patterns and historical data, enabling proactive measures. Upgrading fire and smoke sensors with advanced infrared and gas sensors can improve detection accuracy and reduce false alarms caused by dust or fog. Drone-based surveillance, equipped with thermal cameras, can provide real-time aerial monitoring for large agricultural fields, enhancing fire detection and prevention efforts. Cloud-based data storage allows for long-term fire risk analysis by storing sensor and camera data, aiding in preventive decision-making. A smart mobile application can be developed to provide farmers with real-time alerts, access to live footage, and remote control over preventive measures. IoT-based automated sprinkler systems can be integrated to activate water sprinklers automatically upon fire detection, ensuring quick response. Blockchain technology can be utilized to secure IoT data transmission, ensuring reliable communication and data integrity. Integration with weather forecasting systems using APIs can help predict high-risk fire conditions based on temperature, humidity, and wind speed. Energy-efficient power solutions, such as solar-powered or battery-operated systems, can ensure continuous monitoring in remote areas where power supply is limited. Implementing LoRaWAN technology can enable long-range, low-power communication, making it suitable for areas with poor network connectivity. Lastly, deploying edge computing can process sensor data locally, reducing latency in fire detection and response, ultimately improving overall system efficiency and assistance.

6. CONCLUSIONS

The proposed IoT-based fire detection system ensures early fire detection and rapid response through real-time monitoring, SMS alerts, and live camera access. The LCD-based smoke alert feature acts as an early warning mechanism, reducing fire risks. Remote access enables farmers to monitor their fields from anywhere, minimizing manual efforts. Automatic sprinklers and AI-driven analytics enhance fire prevention capabilities. IoT and wireless technologies ensure effectiveness even in remote areas. Future advancements like drone surveillance and smart apps can further improve functionality. This system reduces fire-related losses, enhances agricultural safety, and supports sustainable farming.

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