

WAREF

Wildfire Detection System

05/09/2024

Contents

1	Introduction	1
2	Problem Statement	1
3	Solution	2
3.1	Key Features of the Solution	2
3.2	Integration with Drones and Real-Time Intervention	2
4	Web Application: Wildfire Detection System	2
4.1	Live Map Integration	3
5	Conclusion and Summary	3
6	References	3

1 Introduction

In an era of accelerating climate change and increasing environmental disasters, protecting our natural environment from fires and catastrophes has become crucial. Forests serve as the lungs of the Earth, holding irreplaceable life and wealth. However, what happens when these lungs catch fire? What if a source of life turns into a source of destruction?

Notably, in 2019, Saudi Arabia experienced 2,716 agricultural and livestock fires, accounting for about 7% of total fires. The material losses from these fires amounted to approximately 5,853,950 SAR, making agricultural fires the second most costly after residential fires.

Our project aims to protect these natural treasures through precise and comprehensive monitoring of weather conditions and disaster prediction before they occur. We are not just collecting data; we are transforming it into tangible protection for our land and lives. Every piece of information collected represents an opportunity to save a forest, protect a community, and ensure a safer future for the next generations.

This project is not just a system; it is a commitment to our land, every tree, and every living being. It is our weapon against wildfires, floods, and other disasters—built on science, technology, and our love for this planet.

2 Problem Statement

In the past, a fire broke out in the forests of Tanomah, spreading rapidly over an area of more than 4.7 million square meters. The Saudi Civil Defense was on high alert, battling to extinguish the flames and protect lives and property. However, the challenges were immense; rugged terrain and the rapid spread of the fire made it difficult to pinpoint high-risk areas, hindering timely response efforts.

Additionally, other challenges impact the speed and efficiency of fire response, including:

- **Difficulty in Rapid Access to Affected Areas:** Remote areas often lack adequate infrastructure, making it challenging for authorities to reach fire sites promptly.

- **Lack of Accurate and Immediate Information:** Many current efforts rely on manual and outdated reports that may not accurately reflect on-ground conditions.
- **Absence of an Effective Early Warning System:** Delays in detecting fires can exacerbate the situation, leading to increased losses.

These challenges require innovative solutions that leverage modern technology to improve the speed and efficiency of response to these severe environmental events.

3 Solution

To address these pressing environmental concerns, our innovative system offers a comprehensive and integrated approach to monitoring and managing natural disasters in sensitive areas. The system uses a live map that covers crucial environmental regions like forests and wetlands, equipped with central towers containing drones and 360-degree cameras. This infrastructure is complemented by an advanced AI algorithm capable of analyzing weather data in real-time and predicting the likelihood of natural disasters such as wildfires and floods.

3.1 Key Features of the Solution

- **Continuous and Accurate Monitoring:** The system monitors weather conditions in real-time through a live map displaying all necessary weather data such as temperature, wind speed, and humidity. Additionally, 360-degree cameras and drones provide continuous surveillance and record the area, aiding in the detection of changes that could lead to natural disasters.
- **Disaster Prediction:** Using AI algorithms, the system analyzes data extracted from the live map to predict the probability of disasters such as fires and floods. This enables authorities to prepare and take preventive measures before disasters occur.
- **Smart Alerts and Rapid Response:** The system categorizes alerts based on their importance, whether they require immediate intervention or ongoing monitoring to prevent escalation. High-priority alerts are sent directly to local authorities, facilitating a faster response.
- **Agricultural Optimization:** By analyzing weather data, the system calculates the best times for planting and harvesting, helping improve agricultural productivity and reduce weather-related risks.
- **Support for the Saudi Green Initiative:** This solution contributes to achieving the goals of the Saudi Green Initiative by reducing fires, preserving forests, and combating desertification, thereby enhancing Saudi Arabia's commitment to environmental sustainability and expanding the country's green footprint.

3.2 Integration with Drones and Real-Time Intervention

When the system detects a high probability of a disaster:

- If the probability is below 20%, it continues to monitor until further alerts are triggered.
- If the probability exceeds 20% within a 50-kilometer radius, drones are deployed to verify the situation. If a fire or tree removal is confirmed, the model intervenes to extinguish the fire or sends a signal to local authorities for immediate intervention.
- If the probability exceeds 20% but is beyond the 50-kilometer radius, the model immediately alerts local authorities.

The continuous monitoring and immediate response capabilities of this system allow civil defense teams to act quickly and effectively, significantly reducing potential losses and preventing disaster spread.

4 Web Application: Wildfire Detection System

A significant aspect of this project is the development of a web application using Flask, HTML, and CSS. This application displays a live map integrating weather data and wildfire predictions, offering real-time insights and alerts to users.

4.1 Live Map Integration

The web application utilizes the OpenWeatherMap API and Google Maps API to provide a dynamic visualization of current wildfire risks. Users can view data on temperature, wind speed, and humidity, which are critical factors for wildfire prediction. In case of a detected wildfire, drones equipped with 360-degree cameras are activated to verify the situation and provide a live feed.

5 Conclusion and Summary

The wildfire detection system successfully integrates AI, machine learning, and real-time data to detect and respond to wildfires. The CNN model demonstrated excellent performance, and the use of drones for live verification further enhances the system's reliability. This project lays a strong foundation for future enhancements in disaster management technologies.

6 References

References

- [1] Abdelghani Aaba. (2024). Wildfire Prediction Dataset. Kaggle. Retrieved from <https://www.kaggle.com/datasets/abdelghaniaaba/wildfire-prediction-dataset>
- [2] OpenWeatherMap API: Retrieved from <https://openweathermap.org>
- [3] Google Maps API: Retrieved from <https://developers.google.com/maps>