Remote Sensing for Forest Fires

Requirements

UBC Cloud Innovation Centre

Capstone Team CG-23

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Executive Summary

This document outlines the requirements for the development of a Forest Fire Prevention and Detection System. It defines the product's purpose, functionality, and constraints, providing clear guidance for the project team. The goal of this system is to effectively prevent and detect forest fires, utilising open-source technologies, AWS infrastructure, IoT sensors, and real-time data analysis.

1. Project Context

In response to the escalating threat of forest fires, our project aims to design and develop a cutting edge remote forest fire sensing device. The increasing frequency and intensity of wildfires pose a significant risk to both the ecosystem and to human settlements. This increases the need for more effective early detection and monitoring solutions. Our Client and team recognizes the urgent need for innovative technology to enhance fire prevention and management efforts. By leveraging advanced sensors, data analytics, and communications systems we intend to create a device capable of predicting and remotely detecting wildfires, providing vital information to firefighting agencies and communities. Such fires can be predicted through soil moisture levels, geographical terrain and wind direction. Using the temperature and humidity of the environment will further aid in detecting forest fires. This project seeks to contribute to improved forest fire management and enhanced safety for vulnerable regions.

2. Project Outcome

The successful implementation of the "Remote Sensing for Forest Fires" project offers clients and end-users the opportunity to deploy an open-source solution that empowers municipalities and small business owners to take proactive measures for safeguarding lives and assets against the devastating impact of forest fires. This project utilises early detection technologies such as Artificial intelligence, this will ensure timely responses but also supports cost-effective prevention strategies. Through web-based apps and notifications, it mitigates risk for workers and residents in high risk areas and allows forest firefighters to be better equipped to control forest fires from spreading and prevent future forest fires from starting. The notification would be within 10 min of signs of fire such as smoke or flames. The information will be sent through an app that will warn users of the app if their location or property has a high chance or is currently on fire.

3. Client Preferences:

3.1. Open Source: The project will adhere to open-source principles, promoting collaboration and transparency. By making its source code accessible to the public, it fosters a collective effort, allowing diverse contributors to enhance and scrutinise the project for the benefit of all.

3.2. GitHub Repository: Utilise the provided GitHub Repository "UBC-CIC/Forest-Fire-Sensing" for version control and collaboration.This repository will serve as the backbone for managing the project's development, enabling a structured and efficient workflow for the entire team involved in the Forest Fire Sensing initiative.

3.3. AWS Infrastructure: The system will be hosted on AWS cloud services to ensure scalability and reliability. This project can efficiently scale resources as needed, providing a resilient and flexible foundation for the hosting environment.

3.4. AWS IoT Core / AWS Greengrass Integration: Integrate with AWS IoT Core and AWS Greengrass for efficient IoT device communication and management. This streamlines integration with AWS IoT Core and AWS Greengrass for efficient IoT device communication and management.

3.5. SMS notification: Implement SMS notifications to promptly alert users affected by forest fires, providing crucial information and ensuring timely communication during emergency situations. This feature enhances user safety by sending SMS text messages to convey real-time updates and relevant alerts, fostering a proactive and responsive approach to safeguarding individuals in the vicinity of forest fires.

3.6. Data Transmission: Use LoRaWAN technology to transmit data efficiently from remote areas, allowing for long-range communication with low power consumption. This approach enables the seamless transfer of information from sensors or devices in distant locations, contributing to a reliable and energy-efficient data transmission system for the Forest Fire Sensing project.

4. Requirements:

4.1. Functional

4.1.1. Data Display: Implement a web-based data display for near real-time monitoring and analysis.the web interfaces enhance the accessibility and usability of the device. This allows user to easily read and interpret data

4.1.2. Forest Fire Notifications: Develop a comprehensive alert system that utilises both mobile applications and SMS notifications to promptly inform individuals and authorities about forest fires. This system ensures real-time alerts to users with detailed information and SMS notifications. By integrating these communication channels, the Forest Fire Sensing project enhances the effectiveness in promptly notifying the stakeholders during emergency situations.

4.1.3. Sensor Redundancy: Implement backup solutions for sensors to ensure system reliability in case of sensor failures. In addition we will use the data from both sensors to verify that the data collection is correct. This will improve the accuracy of the device.

4.1.4. Real-Time data streaming: The data is transmitted in real-time(15 min delay) to a web server. This will allow the user to take the necessary steps to reduce the damage of forest fires in their property.

4.1.5. Data Storage: Implement a system that will store historical data for training the AI or for trend identification for scientific use.

4.1.6. Mobile app compatibility: Ensure that the web-based display is accessible through mobile devices either through a website or dedicated app.

4.1.7. Sensor Placement: Ensure comprehensive sensor coverage in remote forested areas by strategically placing sensors to cover the specified area with overlap, minimising the risk of missing any critical zones risk.

4.2. Non Functional

4.2.1. Easy-to-Read Data Format: Ensure the displayed data is presented in a clear and user-friendly format.

4.2.2. Data Viewable on Map: Enable users to view the data on a map. Therefore clients will be able to quickly look up fire risk for their property.

4.2.3. Rural Area Compatibility: The system must account for rural areas with limited or no Wi-Fi connectivity. This will expand the usability of the device and ensure that all devices can operate remotely.

4.2.4. Scalability: The system must allow us to add additional sensors to the device with minimal overhaul of software. Additionally, additional units can be added without reduction in prediction and sensing capabilities.

4.2.5. Security (Use SSO with the CLI): Implement robust security measures, including Single Sign-On (SSO) for CLI access. This will prevent unauthorised users access to the databases.

4.2.6. Clear and Important Notifications: Define clear and important notification content, including alerting individuals and authorities of fire and potential high risk areas for forest fires to start. Having streamlined data will allow users to quickly decipher data so that they can take necessary steps.

4.2.7. Data Privacy: Ensure that sensitive data is not made publicly accessible.

4.2.8. Low-power Consumption: Device and software is designed to minimise power usage to extend the battery life and reduce maintenance frequency.

4.2.9. Weatherproof Device: Design a weatherproof housing for the device, ensuring its durability and protection against environmental elements, while also sourcing sensors resilient to weather exposure to maintain functionality in adverse conditions. This will enhance the reliability of the Forest Fire Sensing system in difficult environments. This will improve overall the effectiveness of the device.

4.2.10. Longevity: This device must be kept outdoors for an extended period of time outdoors without human intervention. This period should be a minimum of 1-year.

4.2.11. Mounting Mechanism: Specify how the system will be mounted in remote forested areas to ensure optimal sensor placement.

4.2.12. Power Supply: Implementing a sustainable power supply for the microcontroller and its sensors 1 year without changing the battery.

5. Constraints:

5.1. Budget ($650): The project must adhere to a strict budget limit of $650 for development and deployment.

5.2. Testing and Validation: Due to a lack of dedicated lab resources, all testing must be artificial or simulated.

5.3. Department and client resources: Utilise on-campus labs for development, testing, and validation purposes.

5.4. Project Timeline: Develop a working prototype within two school terms.

5.5. Scalability Restricted by Architecture: The system's scalability is limited by the chosen architecture and technology stack.

5.6. Size of Detection: Define the specific parameters that determine the size of the detection area for effective prevention and rapid response.

5.7. Size of Device: Define the size and form factor of the device housing the system components.

5.8. Sensor Types: Choosing a combination of sensors that can detect various aspects of potential fires.

5.9. Communication Infrastructure: Without a stable communication important information such as fire starting will be unable to be sent to the server, and notification of fire will not be sent to the user.

6. Conclusion

This Requirements Document serves as a roadmap for the development of a Forest Fire Prevention and Detection System, aligning with client preferences, objectives, and constraints. It provides a clear foundation for project planning and execution, ensuring the system's effectiveness in preventing and detecting forest fires.