GONZAGA UNIVERSITY
School of Engineering and Applied Science
Center for Engineering Design and Entrepreneurship

Wildfire Resource Simulator

Project Overview
Plan Section 01

Release:
Draft v0.1

PROJECT PLAN DRAFT STAGE DOCUMENT
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The D Squad

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1 Project Overview

1.1 Project Summary

The project aims to demonstrate the effectiveness of aircraft-based resources in combating wildfires. The goal of Fire Armada is to benefit fire agency management by developing better fire prevention and suppression tactics, as well as show to local and state representatives that the strategic usage of aircraft can improve response times, costs, and fire containment. Since potential Congressional supporters are hesitant about the reliability of this approach, this project serves as one means to convince them using mathematically sound and data-driven simulations.

The project will provide a graphic simulator that leverages existing flight data for firefighting aircraft and historical wildfire data in the United States in the last few years. The simulator should be capable of mapping aerial movements to corresponding wildfires and visually representing the progression of both, as well as estimating the time spent suppressing fires and other time in flight or refueling. Additionally, the project should provide forecast simulations to measure the outcomes of improved resource coordination, which includes preventative fire detection and resource estimation for target metrics.

1.2 Project Objectives

- Utilize the simulator to estimate resource distribution required to achieve targeted fire suppression metrics.
- Run simulations on historical US wildfire data and forecasted models to achieve improved resource strategies.
- Run simulations on actively developing wildfires to effectively predict where and how quickly it could spread.
- Package data in accordance with state regulation and in a format that is digestible for response aircraft and associated systems.
- Build a graphic simulator that can re-trace the paths of all aerial firefighting vehicles and the progression of fires throughout the country for 2021 or 2022.
    - The data for the movement of the aerial fire fighters should be researched and filtered by the team using data such as tail number, call signal, or radar footprint through the ADS Exchange or similar historical registry.
- Use the historical simulator to identify the following metrics.
    - Value-added time (dropping suppressant vs flying waiting, filling, on hold).
    - Time to start responding.
    - Time to reach fires.
    - Suppressant and other resource access time.
- Leverage the historical simulator to build a graphic simulator which can simulate new flight paths to apply some or all of the following methodologies to demonstrate improvements utilizing existing firefighting resources:
    - Early fire detection.
    - Lean, Six-Sigma, and Theory of Constraints (TOC).
    - Other organizational strategies the team identifies.

- Leverage the second simulator to determine what additional resources would be needed to extinguish US-based wildfires within the first 12-hours (or team and sponsor agreed upon impact minimizing timeline).

1.3 Project Stakeholders
The current stakeholders for this project are the following:
- The Developers (Gonzaga University):
  - Kevin Dang
  - Vincent Do
  - Kole Davis
  - Claire Yegian
  - Drew Bogdan.
- The Sponsors (Fire Armada):
  - Michael Marzetta
  - Christy Marzetta
- Our Faculty Advisor:
  - Jasmine Jans
- Design Advisory Board Member(s):
  - Jesse Phillips
- Congressional Individuals:
  - Local Eastern Washington Politicians
- Target Users:
  - Aerial Firefighting Organizations & First Responders
  - People/organizations setting target fire suppression metrics
  - Firefighting resource providers

1.4 Project Deliverables
Possible Deliverables (Ideas):
- Project Plan Deliverable
  - Details of the project will be documented and delivered to the sponsor.
- Data Retrieval Deliverable
  - Interactions with APIs and fire data from live databases to ensure fire metrics are passed into the simulations database. Deliverable will be available on the working repository.
- Data Passing and Basic Running of Simulation Deliverable
  - The simulation should be able to display information, whether it is accurate or not, for the user. The application databases should be able to pass necessary fire data to the simulation. Deliverable will be available on the working repository.
- Improved Fire Resource Simulation Deliverable
  - The simulation should be able to display information accurately utilizing fire data from live fire-tracking databases.
- Fire Resource Simulation Documentation Deliverable
  - Documentation on the simulation will be documented with any relevant information like credentials, simulation usage, and fire data.

- Full Simulation and Data Deliverable
  - o The simulation should have the minimum viable product of the sponsor's wishes. All documentation will be updated for any relevant information on the application. This may be deployed to a server holding the simulation.

1.5 Project Scope

Currently this project specifically has no existing aspects. There are multiple other slightly similar projects, but also differ on certain ideas that Fire Armada wanted in this product. But as for what code or project work has been done, we only have the project proposal from Fire Armada. The rest of the project will be developed from scratch this year and likely continue for years to come.
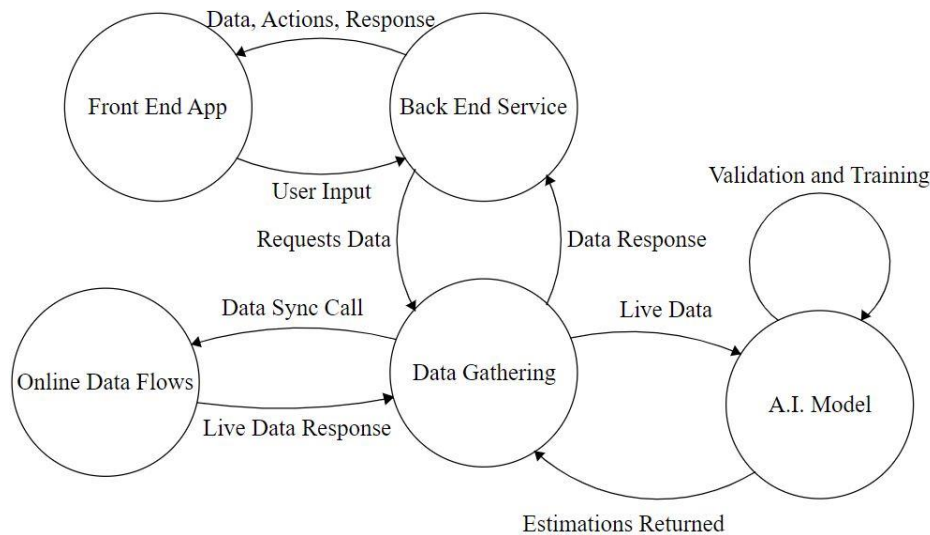

Figure 1: Context Diagram

1.6 Related Work
Existing Systems
- Watch Duty | https://www.watchduty.org/how-it-works/overview
  - o Mobile application offering real-time wildfire alerts and reports throughout the western United States. Provides information related to wildfire perimeters, air quality monitoring, wind direction, and so on.
  - o Run by volunteers manually obtaining information from 911 dispatch centers and official first responder reports.
  - o Similarities: Wildfire monitoring and awareness, information systems
  - o Differences: Not specific for aircraft, only uses real-time data, restricted to western US states, volunteer-driven data.
- FIRMS | https://firms.modaps.eosdis.nasa.gov/
  - o Uses satellites to gather, document, and display real-time fire hotspot data across the United States, Canada, and other spots across the globe.
  - o Similarities: Actively collects and charts wildfire data
  - o Differences: Utilizes satellite technology that is outside of this project's scope, provides global fire data

Three approaches to wildfire prediction: physics-based, statistical, machine learning
Supervised and unsupervised learning
Uses of ML in wildfire science: fire detection, perimeter and severity mapping, susceptibility
Data used: images, numerical, maps, GIS

Similarities to the tools we investigated: data driven, for decision making, predictive.
Differences: many of the tools we found were for real-time response during ongoing wildfires.