Software Design Document

for

Artificial Intelligence and Data Science for Climate Change Management with Focus on Drought and Wildfire in California

Version 1.3.1 approved

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Revision History

Name	Date	Reason For Changes	Version
Mazel Fernandez	11/16/21	Added to 1.1, 1.3	1.0.0
Mazel Fernandez	11/18/21	Added to 1.4, 2.1, 2.2, 2.3, some of 3, 5.1, 5.2, 6.1.1, 6.1.2, 6.1.5	1.0.1
Rayan Hyder	12/6/21	Added to 1.2, 2.4, 5.3, 6.1.3, 6.1.4, 6.1.6	1.1.0
Funing Yang	12/7/21	Added to 9.1, 9.2	1.2.0
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Funing Yang	12/8/2021	Added to 4, 9.3	1.2.1
Jennifer Serrano	12/10/2021	Added to Glossary, 10, 12, Edited 2.4, 5.1	1.3.1

1. Introduction

1.1 Purpose

This document is to explain in detail the functions that the following applications will perform. The document will inform readers as to what the applications will do. The purpose of these applications is to provide users with general information about climate change in their area. These applications will also provide predictions on the levels of air pollution and air quality with a focus on drought and wildfire using machine learning and data science techniques.

1.2 Document Conventions

Roman numerals will indicate which application is being talked about, the website or an app(Plan for future). Followed by bullet points to indicate what each section is talking about. External links will be underlined in blue.

1.3 Intended Audience and Reading Suggestions

The intended audience of the software requirements specification document are developers and government workers. Due to there being multiple applications included in the SRS, it is recommended to read through the Project Scope to understand the applications before proceeding. If you are a developer, it is recommended to read over Section 2.3 to get a better understanding of the functions each product is intended to have as well as Section 1.5 and Section 2.8 to obtain a list of all the references that were used while developing the applications as well as user documentation. If you are a project manager, it is recommended to read over Section 2 to get a better understanding of the product perspective as well as any design and implementation constraints. It is also recommended to read over Sections 4 to Sections 6 to look over the different types of requirements for each application as well as any legal or ethical considerations. For testers, it is recommended to read over Section 3 for the full list of all the interfaces the user will be able to interact with and their functionalities.

1.4 System Overview

This website application is used to show the cause and effect of wildfires, as well as measured levels of air pollutants as well as some common causes of air pollution around Los Angeles County. In more detail, this application's main focus is on providing the necessary information and resources for the awareness of wildfires in California. We are implementing data and feature layers from ArcGIS's Living Atlas to display an assortment of maps relating to wildfire such as vegetation, wind speed, temperature, etc. We are also using data gathered from various APIs in conjunction with data science and machine learning techniques to generate live and accurate measurements as well as generating predictions.

2. Design Considerations

The following section details the Assumptions and Dependencies, General Constraints, Goals and Guidelines as well as the Development Method of the applications.

2.1 Assumptions and Dependencies

- Uses the ArcGIS Online JavaScript API and assumes that any browser allows the proper permissions for it to work
- Uses the ArcGIS Living Atlas and assumes that the Feature Layers used remain public and in the same format
- Uses the ArcGIS Living Atlas to gather data and assumes developers have an ArcGIS license
- Developed by gathering data from various APIs and assumes that API keys are provided to the developers

2.2 General Constraints

- **Software Environment**
  ○ Developers are required to have a functioning ArcGIS license
  ○ Developers are required to have basic knowledge of HTML
  ○ Developers are required to have basic knowledge of CSS 6
  ○ Developers are required to have basic knowledge of the JavaScript language
  ○ Developers are required to have knowledge of the React framework
  ○ Developers are required to have knowledge of the UI.
- **End-User Environment**
  ○ A web browser is required to use and view the web application
  ○ A mouse, keyboard, monitor, and desktop/laptop are required for user inputs and outputs
- **Interoperability requirements**
  ○ Data is gathered from ArcGIS's Living Atlas
  ○ Data is gathered from various APIs
- **Performance requirements**
  ○ Application should load maps and their datasets in less than 5 seconds
  ○ Application should load graphs in less than 5 seconds
  ○ Application should load news articles in less than 5 seconds

2.3 Goals and Guidelines

- The data gathered from ArcGIS's Living Atlas should be accurate
- The data gathered from the various APIs should be accurate
- The GUI should be user-friendly
- The application should be able to effectively visualize climate change and wildfire data for users

2.4 Development Methods

The method used was to work on a protocol website and split the pages in groups. The team split their tasks and requirements among their members to effectively complete the multitude of components that the project requires. Regular, weekly meetings are conducted to assess the progress of the group and decide what components or modules should be finished next.

3. Architectural Strategies

- Use of a particular type of product (programming language, database, library, etc.)

    ○ ArcGIS

    ○ JavaScript

    ○ HTML

    ○ CSS

    ○ React

    ○ Python

    ○ Pandas library

    ○ scikit-learn library

    ○ Bootstrap 4

- Reuse of existing software components to implement various parts/features of the system

  ○ This software is the first version

  ○ Future plans for extending or enhancing the software

  ○ Adding predictions of air quality conditions

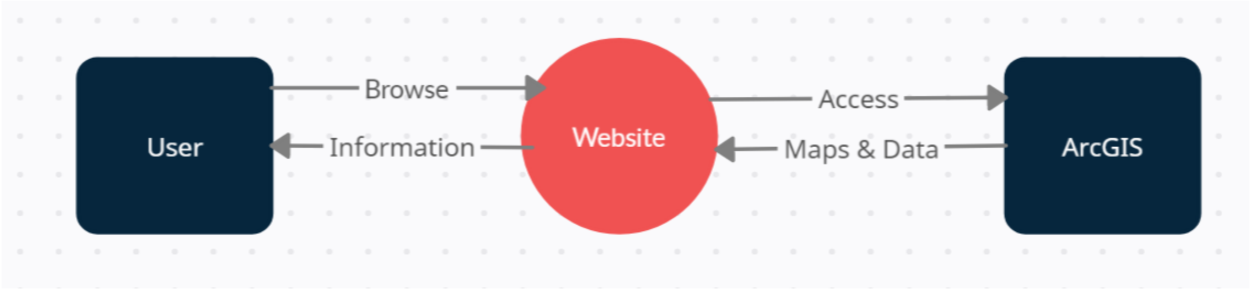
  ○ Collect data in real time to implement into the application

  ○ User interface paradigms

  ○ A computer and internet connection is required to use the application as well as a mouse to navigate the web application

4. System Architecture

Level 0 DFD:



The user browses the website, the website accesses maps and geographical data from ArcGIS and returns information to the user.

5. Policies and Tactics

5.1 Choice of which specific products used

- Programming Languages:
  - HTML
  - CSS
  - Javascript
- ArcGis
- CodeSandbox
- Vercel - Deployment

5.2 Plans for ensuring requirements traceability

The requirements of the project shall be traceable via the source code posted using GitHub version control. Requirements will be checked frequently in coordination with the software requirements specification document.

5.3 Plans for testing the software

The software shall be tested as requirements for the software are completed and as features and functionalities are added.

6. Detailed System Design

6.1 App.js (Module)

6.1.1 Responsibilities

The primary responsibility of this module is to visualize data on a map and translate the data into UI elements such as symbols or polygons. This module should also ensure that all symbols are unique and that all polygons are colored based on intensity.

6.1.2 Constraints

Some datasets used for this module are not up to date or do not update in real-time which may lead to inaccurate representation. Datasets that are up to date may also have null fields which may cause certain data to not appear on the map.

6.1.3 Composition

The list below details the use and meaning of the subcomponents used in this module:

- **Legend**: shows the different symbols and their meanings as well as the different colors for the polygons and their meanings

6.1.4 Uses/Interactions

This module will be used to visualize the common causes and effects of wildfire.

6.1.5 Resources

The resources this module uses are datasets of Feature Layers that are present within ArcGIS's Living Atlas as well as data gathered from various sensors surrounding Los Angeles county.

6.1.6 Interface/Exports

The visualized data will be displayed on the Wildfire Data Visualization application via the use of the ArcGIS Online JavaScript API.

7. Detailed Lower level Component Design

7.1 FindWildfires.jsx

7.1.1 Classification

A class component for visualizing current wildfires on a map.

7.1.2 Processing Narrative (PSPEC)

The application renders an ArcGis Map onto an HTML Iframe using a source link provided by ArcGis.

7.1.3 Interface Description

The current wildfires map is centered on the page. The legend for the map, and a search bar to find locations within the map is provided.

7.1.4 Processing Detail

The wildfire map is rendered when users click on the current wildfires page.

7.1.4.1 Design Class Hierarchy

Child class.

7.1.4.2 Restrictions/Limitations

The data from ArcGis must remain public and available.

7.1.4.3 Performance Issues

There are no known performance issues.

7.1.4.4 Design Constraints

Design constraints include having a map legend, the map must be fully functional.

7.1.4.5 Processing Detail For Each Operation

When the wildfires page is launched, data must be passed from ArcGis to correctly map wildfire data.

8. Database Design

No database is currently being used in the Web App.

9. User Interface

9.1 Overview of User Interface

The design approach to the web application interface is very straight forward. The user can simply click on the navigation bar to switch pages. The maps on the wildfire and information page are relatively interactive, providing simple zoom functions and geographical details.

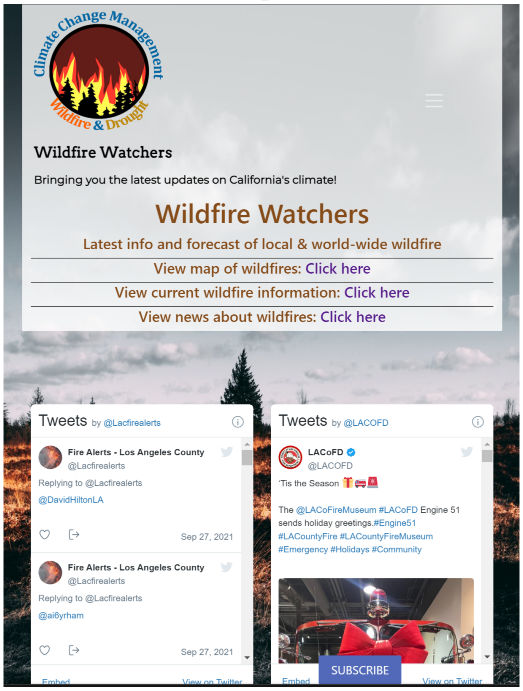
The web application can be used just like any other website. No extensive learning or extra knowledge required.

The interface comprises of:

- Home Page
- Navigation Bar
- Mission Page
- Wildfire Map
- Information Page
- News Page
- Email Subscription

9.2 Screen Frameworks or Images

These can be mockups or actual screenshots of the various UI screens and popups.



Wildfire Watchers

Bringing you the latest updates on California's climate!

Wildfire Watchers

Latest info and forecast of local & world-wide wildfire

View map of wildfires: Click here

View current wildfire information: Click here

View news about wildfires: Click here

Tweets by @Lacfirealerts

Fire Alerts - Los Angeles County
@Lacfirealerts

Replying to @Lacfirealerts

@DavidHiltonLA

Sep 27, 2021

Fire Alerts - Los Angeles County
@Lacfirealerts

Replying to @Lacfirealerts

@ai6yrham

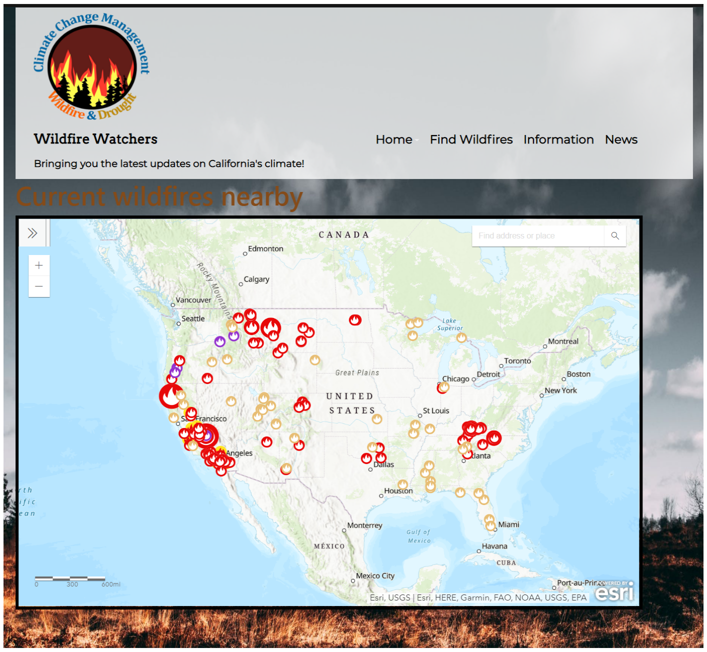
Sep 27, 2021

Tweets by @LACOFD

LACoFD
@LACOFD

'Tis the Season 🎁🚒🚨

The @LACoFireMuseum #LACoFD Engine 51 sends holiday greetings.#Engine51 #LACountyFire #LACountyFireMuseum #Emergency #Holidays #Community



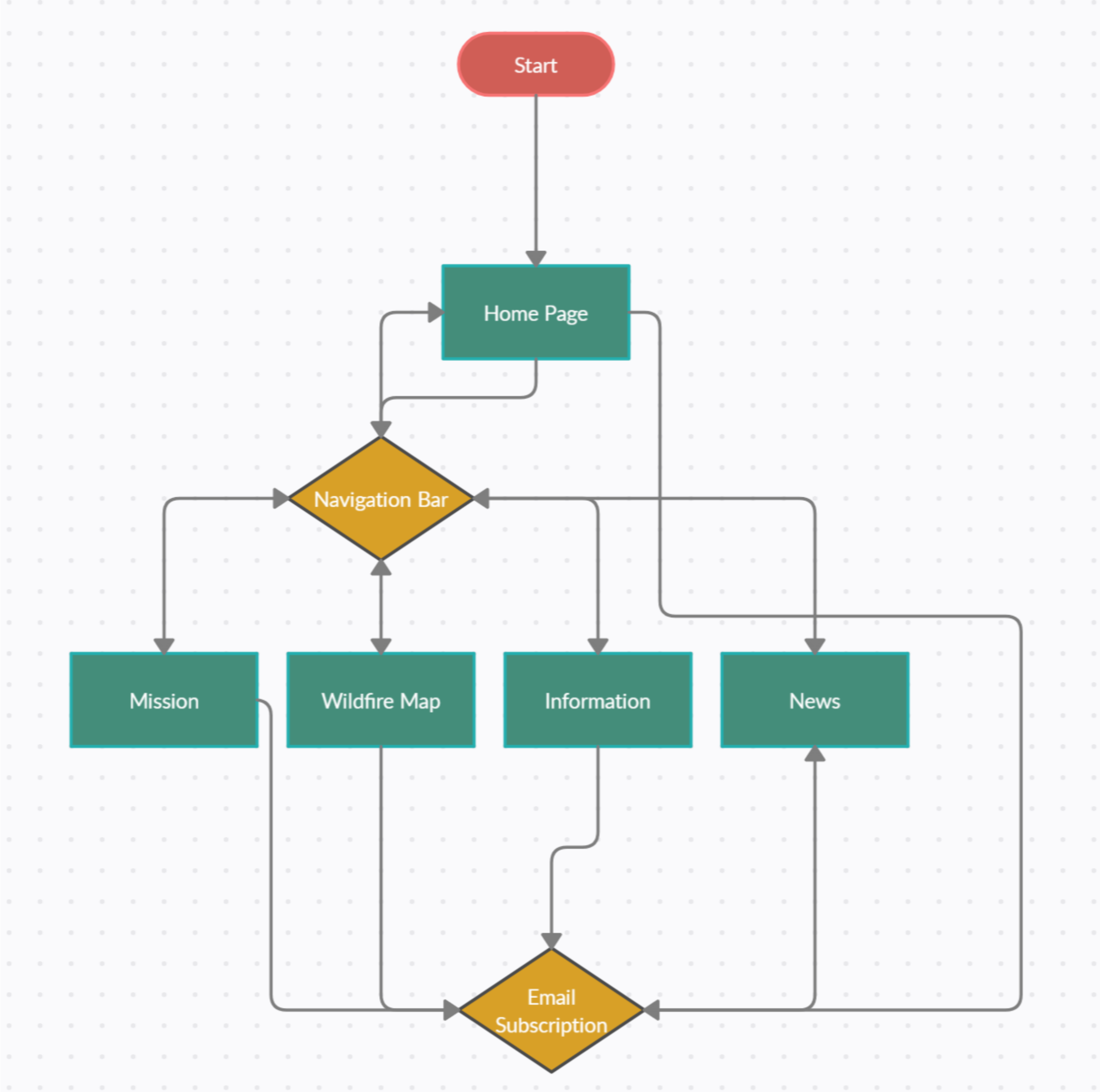
Wildfire Watchers

Bringing you the latest updates on California's climate!

Current wildfires nearby

9.3 User Interface Flow Model

A discussion of screen objects and actions associated with those objects. This should include a flow diagram of the navigation between different pages.



10. Requirements Validation and Verification

4.1.1	The system shall retrieve data for Feature Layers from ArcGIS's Living Atlas	App.js Module satisfies the requirement	Tested by accessing the hosted web application
4.1.2	The system should retrieve data for custom Feature Layers from sensors and fill in data for census tracts		
4.1.3	The system shall use the retrieved data to display symbols on the map	App.js Module satisfies the requirement	Tested by accessing the hosted web application
4.1.4	The system shall use the retrieved data to display polygons on the map	App.js Module satisfies the requirement	Tested by accessing the hosted web application
4.1.5	The system shall visualize measured levels of heat using colors based on severity	App.js Module satisfies the requirement	Tested by accessing the hosted web application
4.1.6	The system shall visualize demographic statistics using colors based on		
4.1.8	The system shall display a popup window upon clicking on a highlighted polygon on the map	App.js Module satisfies the requirement	Tested by accessing the hosted web application
4.1.10	The system shall toggle on and off Feature Layers in the map	App.js Module satisfies the requirement	Tested by accessing the hosted web application
4.1.11	The system shall add Feature Layers to the map	App.js Module satisfies the requirement	Tested by accessing the hosted web application

11. Glossary

Climate Change	A change in global or regional climate patterns
Data Science	Field where the goal is to extract knowledge from data to use for future purposes such as prediction
Wildfire	Unplanned large fire that spreads quickly in a natural area

12. References

Brad Appleton <brad@bradapp.net> http://www.bradapp.net

https://www.cs.purdue.edu/homes/cs307/ExampleDocs/DesignTemplate_Fall08.doc

- Esri Documentation: https://doc.arcgis.com/en/
- React.js Documentation: https://reactjs.org/docs/getting-started.html