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

Prepared by Mazel Fernandez, Rayan Hyder, Victor Raj, Jennifer Serrano-Perez, Funing Yang

NASA & LA City

05/13/2022

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
Jennifer Serrano	12/8/2021	Added to 7.1.1, 7.1.2, 7.1.3, 7.1.4, 7.1.4.1, 7.1.4.2, 7.1.4.3, 7.1.4.4. 7.1.4.5	1.3.0
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 design functions that the dashboard created for our project will perform. The document will inform readers as to what the dashboard was designed to do/display. The purpose of the application is to provide users with historical information about wildfires in the past two decades, as well as historical meteorological data to show the cause and effect of wildfires.

1.2 Document Conventions

Larger fonts will be the headers, followed by subheaders in a smaller font size. This will be 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. It is recommended to read the purpose of the application to understand the design of the several functions of our application, as described in section 6 and section 7.

1.4 System Overview

This website application is used to show the cause and effect of wildfires, by the visualizations of wildfires in the past two decades, alongside meteorological data. 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 maps using ArcGis Online and ArcGis Pro 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 to display current news articles relating to wildfires.

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

- Assumes that our maps will remain public and on ArcGis Online's servers.
- A license for ArcGis Pro is needed to edit some maps.

- Developed maps by gathering data sets from CalFire, NASA, etc.

2.2 General Constraints

- **Software Environment**
  ○ Developers are required to have a functioning ArcGIS license (including for ArcGis Pro).
  ○ 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 UI.
- **End-User Environment**
  ○ A computer with any web browser to interact with the dashboard.
  ○ A mouse, keyboard, monitor, and desktop/laptop are required for user inputs and outputs
- **Interoperability requirements**
  ○ Data is gathered from various sources
  ○ Data for current news is gathered from various APIs
- **Performance requirements**
  ○ The application should load maps and their information as quickly as possible, depending on the user's computer hardware.
  ○ The application should load news articles quickly, especially with a faster internet connection.

2.3 Goals and Guidelines

- The data gathered from several sources, including CalFire should be accurate
- The news 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 first work on a prototype website and then split the pages and work into groups. The team split their tasks and requirements among their members to effectively complete the project requirements. Some members focused on gathering datasets, and creating accurate maps, while the other team members focused on creating a user-friendly dashboard, and embedding the maps. Weekly meetings were held to ensure team members remained on track.

3. Architectural Strategies

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

    - ArcGIS

    - JavaScript

    - HTML

    - CSS

    - 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 wildfire sizes

    - Gather datasets from sources like CalFire

    - User interface paradigms

4. System Architecture

Level 0 DFD:
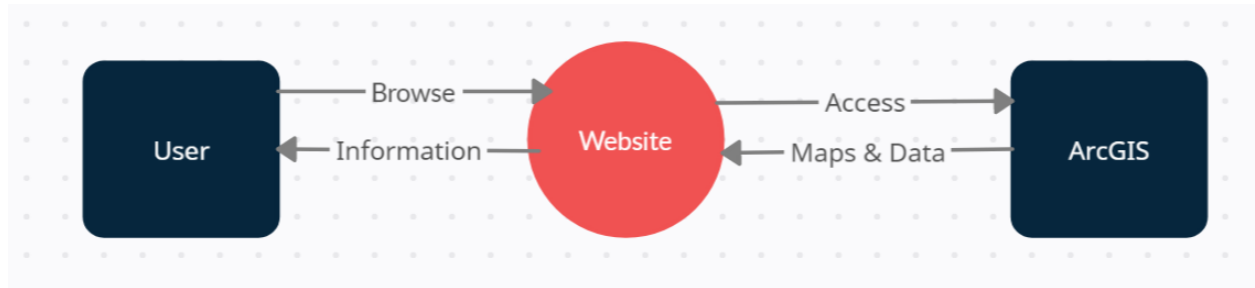
The user browses the website, the website accesses maps and geographical data from ArcGIS and returns information to the user.

5. Policies and Tactics

5.1 Choice of which specific products used

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

5.2 Plans for ensuring requirements traceability

The requirements for traceability of the project shall be seen via our CodeSandbox page, as well as on our Github repository.

5.3 Plans for testing the software

The software shall be tested as maps are embedded onto the dashboard, or new research is added onto the website.

6. Detailed System Design

6.1 Dashboard Maps (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 page uses are the datasets saved onto ArcGis servers to display the data.

6.1.6   Interface/Exports

The visualized data will be displayed on the Wildfire Data Visualization application by embedding ArcGis Online maps.

7. Detailed Lower level Component Design

7.1 Historical Wildfires

7.1.1 Classification
A class component for visualizing historical 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 historical 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 dashboard from the navigation bar.

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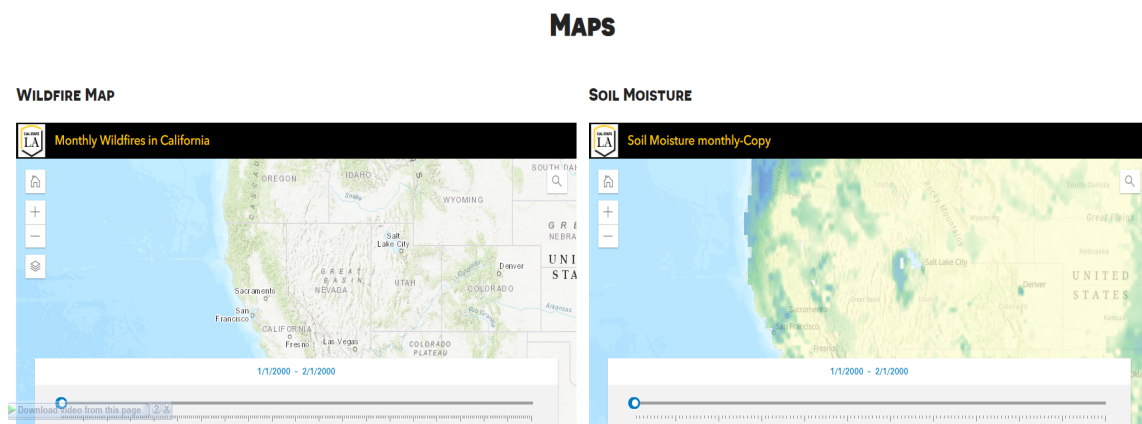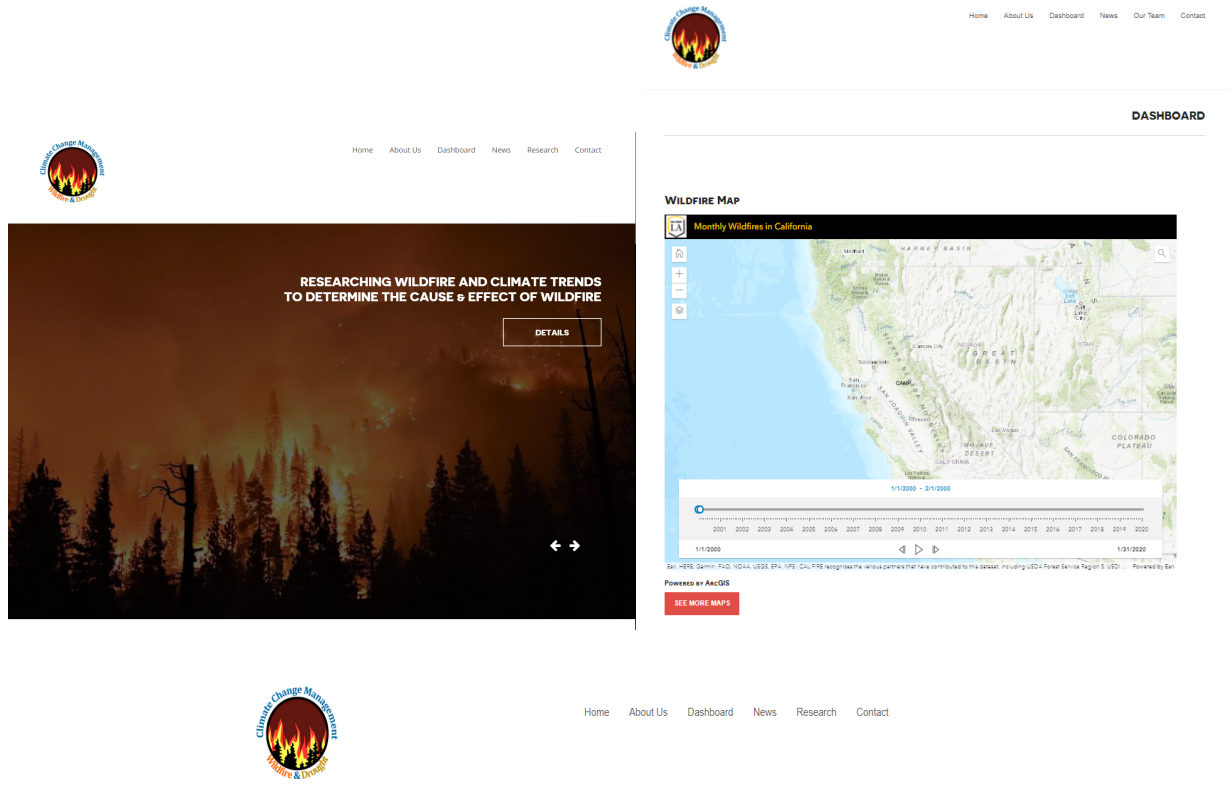
The web application can be used just like any other website. No extensive learning or extra knowledge required.

The interface comprises of:
- Home Page
- Navigation Bar
- About Us Section
- Dashboard Section
- News Page
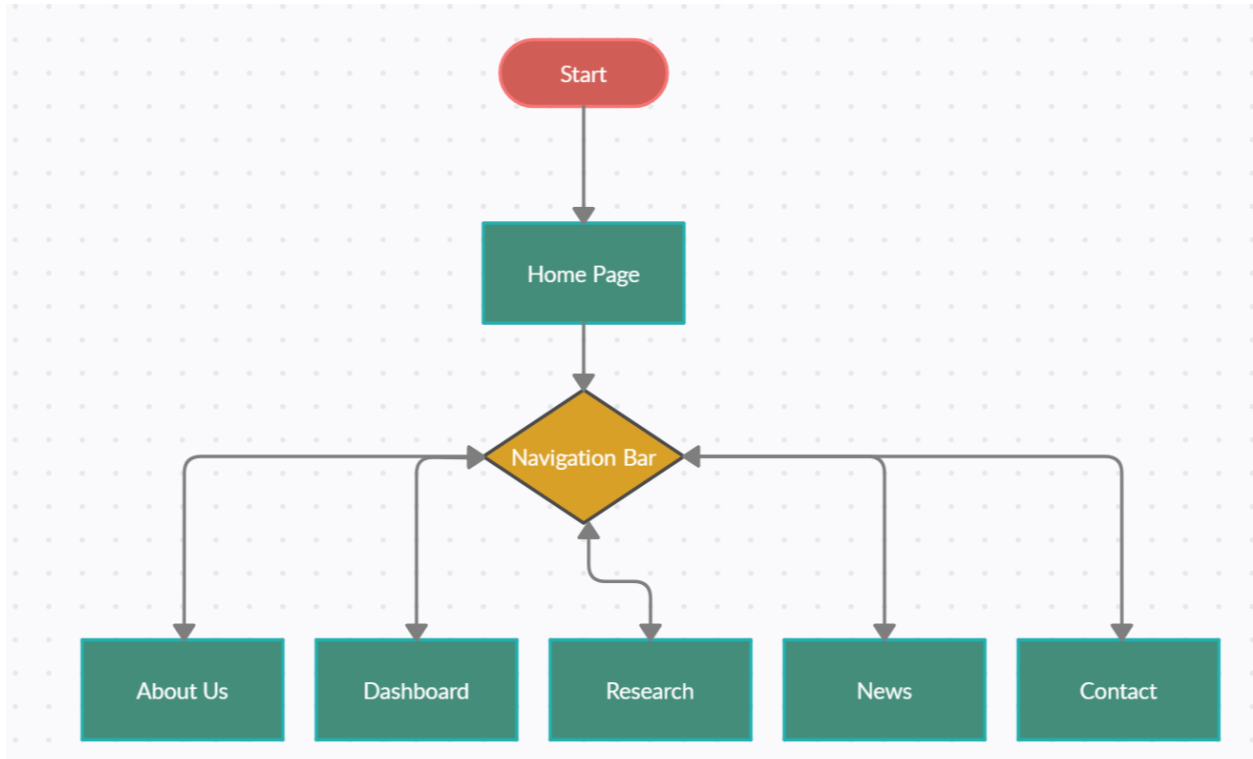- Research Page
- Contact Info Section

9.2 Screen Frameworks or Images

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

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 maps from ArcGIS's Online	Dashboard Maps and Historical Wildfires satisfies the requirement	Tested by accessing the hosted web application
4.1.2	The system shall use the retrieved data to display symbols on the map	Dashboard Maps and Historical Wildfires satisfies the requirement	Tested by accessing the hosted web application
4.1.3	The system shall use the retrieved data to display shape areas on the map	Historical Wildfires satisfies the requirement	Tested by accessing the hosted web application
4.1.4	The system shall visualize drought levels using different colors	Dashboard Maps satisfies the requirement	Tested by accessing the hosted web application
4.1.5	The system shall display a popup window for more information	Historical Wildfires satisfies the requirement	Tested by accessing the hosted web application
4.1.6	The system shall allow for toggle on and off feature fayers in the map	Dashboard Maps satisfies the requirement	Tested by accessing the hosted web application
4.1.7	The maps shall visualize the datasets given	Dashboard Maps and Historical Wildfires 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/
- HTML/CSS/JavaScript: https://www.w3schools.com/