

Software Requirements Specification

for

Artificial Intelligence and Data Science for Air Pollution Prediction and Visualization (AIDSAPPV)

Version 3.0 approved

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Revision History

Name	Date	Reason For Change	Version
Emmanuel Cocom Alejandro Alatorre	11-24-2021	Revised sections 1, 2, 3, 4, 5	2.0.0
Alejandro Alatorre Vidal Zazueta	5-10-2022	Revised Sections 1,2,3,4,5,6	3.0.0

1. Introduction

1.1 Purpose

The purpose of the software requirements specification document is to explain the functions that

the following applications will perform and to cover all aspects of the intended software.

I. Air Pollution in Los Angeles County Data Visualization (Web App)

- The current version of this app is 2.0.0. This is the first revision. There are no release numbers.

II. Air Pollution Personalized App (Android App)

- The current version of the mobile app is 3.0.0. This is the second revision. There are no release numbers.

1.2 Intended Audience and Reading Suggestions

The intended audience of the software requirements specification document are the software developers and government workers. Because the SRS document has many applications the Project Scope should be looked at prior to continuing. Software Developers pay close attention to Section 2.3, 1.5, and 2.8. 2.3 provides details regarding the functions of each product is intended to have while 1.5 and 2.8 to get a better understanding of the functions each product is intended to have as well as Section 1.5 and Section 2.8 is a list of references utilized during the development of the product and documentation.

Project managers should look closely at Section 2 to see design and implementation constraints, Sections 4 - 6 for requirements regarding each application. Legal considerations can also be found here. Testers should look closely at Section 3 to see all interfaces users will be able to interact with.

1.3 Product Scope

I. Air Pollution in Los Angeles County Data Visualization (Web App PWWB)

The APLAC application will consist of a dashboard that contains multiple maps that each house different data. The application will map the locations of common causes of air pollution surrounding Los Angeles county, the measured levels of air pollutants from several sensors in that area. The application offers several features such as a legend that showcases the symbols on the map and what they represent, the ability to toggle on and off certain datasets, as well as pop-up features that provide more information to the user. The goal of the application upon release is to inform users of potential health hazards around their area while also giving them general information about air pollution.

II. Air Pollution Personalized App (APPA)

The APPA application will consist of a GUI interface that contains multiple maps/layers that are able to display air pollution data. The APPA will accurately map the locations of common causes of air pollution surrounding Los Angeles county, the measured levels of

air pollutants from several sensors in that area, the current demographics of the people living in Los Angeles county, and the effects of prolonged exposure to air pollution. The **APPA** will also be able to display data based on a given location, as well as the user's GPS location. The goal of the **APPA** upon release is to inform users of potential health hazards around their area while also giving them general information about air pollution.

1.4 Definitions, Acronyms, and Abbreviations

The list below contains the definitions, acronyms, and abbreviations used for the software requirements specification document.

- **AIDSAPPV:** Artificial Intelligence and Data Science for Air Pollution and Data Visualization
- **APLAC:** Air Pollution in Los Angeles County Data Visualization
- **API:** Application Programming Interface
- **APPA:** Air Pollution Personalized App
- **HTTPS:** HyperText Transfer Protocol Secure
- **SDK:** Software Development Kit

1.5 References

The following table contains the references that are most referred to for this application.

Alias	Description
Android Studio SDK	Reference to Android Studio SDK: (TBA)

	https://developer.android.com/studio/intro
ArcGIS	All reference to ArcGIS services: https://doc.arcgis.com/en/
Python	All references to Python documentation: https://www.python.org/doc/versions/
scikit-learn	All references to tools and methods in the Python scikit-learn library: https://scikit-learn.org/stable/

2. Overall Description

The overall product shall satisfy the System Analysis, Product Perspective, Product Functions, User Classes and Characteristics, and Operating Environment. This application shall provide Documentation, inform users of any Constraints, Assumptions, Dependencies, as well as any Requirements that may be delayed.

2.1 System Analysis

I. Air Pollution in Los Angeles County Data Visualization

The goal of APLAC is to provide users, particularly in Los Angeles County, with air quality information. This includes providing historic data, current sensor data and future air pollution readings. This will then be displayed through various visualizations such as text, maps, graphs, and gauges. Additionally, general information will be provided about air pollution and its lasting effects.

Technical difficulties include projecting current and forecast data on a map in real time. This can be done by using ArcGis that allows you to create your custom Feature Layer using data science and machine learning techniques.

II. Air Pollution Personalized App To be Updated as Future Goal:

The goal of Air pollution mobile application is to provide users, particularly in Los Angeles County, with air quality information. This includes providing current sensor data and future air pollution readings. This will then be displayed through various visualizations such as text, maps, graphs, and gauges. The forecast air quality map will show the predicting air quality layers made out of tiff files from the aws bucket. These layers will show on the map for 24 hours, predicting the air quality in Los Angeles County.

2.2 Product Perspective

I. Air Pollution in Los Angeles County Data Visualization

The product is a visualization of air pollution data pertaining to the causes of air pollution, the measured levels of air pollutants, as well as the effects of air pollution. This

product relies on the ArcGIS Online JavaScript API as well as multiple Feature Layers that are all present in ArcGIS's Living Atlas. While there exist maps that contain data on air pollution and its effects, these maps are often separate from each other, do not offer an intuitive filtering system, and do not have a way to compare demographics to the measured levels of air pollution.

II. Air Pollution Mobile App

- This application should help the user be able to understand and see how the air pollution
- Different components to show different ways how air quality is.
- Maps show Air quality data

2.3 Product Functions

I. Air Pollution in Los Angeles County Data Visualization

- The application shall display real time air pollution sensor readings in Los Angeles County
- The application shall display air pollution sensor forecast readings in Los Angeles County
- The application shall display historical data of different Air Pollutants
- The application shall allow users to search air quality and weather readings using zip codes, city names.

II. Air Pollution Personalized App:

- The application shall display real time air pollution data graphs.
- The application shall display air pollution forecast readings on a map in Los Angeles County that will display predicting layers.
- The application shall display a map to show AQI values at a certain hour.

2.4 User Classes and Characteristics

The different classes and their characteristics for each application will be displayed here.

I. Air Pollution in Los Angeles County Data Visualization

- A. General Public: This user will be able to interact with features accessible in the application but will be unable to make any modifications to such features.
- B. Developer: This user will be able to interact and modify all current features accessible in the application.

II. Air Pollution Mobile App:

- The user will be able to interact with features accessible in the application but will be unable to make any modifications to such features.
- The Developer will be able to interact and modify features accessible for the

mobile application in android studio.

2.5 Operating Environment

I. Air Pollution in Los Angeles County Data Visualization

This application must be able to connect to ArcGIS due to dependencies involving the features from the Maps. It also must be able to connect to canvasJs APIs.

II. Air Pollution Mobile App

- This application must connect to ArcGIS dependencies and to the internet to be able to function correctly in getting every component in our mobile app.

2.6 Design and Implementation Constraints

The following operations and tasks may affect the product's timetable:

I. Air Pollution in Los Angeles County Data Visualization

- Learning the ArcGIS Online JavaScript API
- Learning React
- Generating real time tiff files to display current forecasts

II. Air Pollution Mobile App:

- Learning Android Studio
- Learning Kotlin language
- ArcGIS Android Implementation of maps

2.7 User Documentation

The list below contains user documentation for the applications mentioned in the SRS

I. ArcGIS Tutorials:

- React: <https://reactjs.org/tutorial/tutorial.html>
- CanvasJS content:
<https://canvasjs.com/react-charts/>
- Embedded maps:
<https://doc.arcgis.com/en/arcgis-online/share-maps/embed-maps-groups.htm>
- Real-time updates:
<https://learn.arcgis.com/en/projects/schedule-automated-near-real-time-data-updates/>

II. Android Studio Tutorials:

- Android Studio:
<https://developer.android.com/studio>
- CanvasJS content:

<https://canvasjs.com/react-charts/>

- **Kotlin for Android**

<https://kotlinlang.org/docs/basic-syntax.html#functions>

- **ArcGIS for Android**

<https://developers.arcgis.com/android/>

2.8 Assumptions and Dependencies

The following factors are assumptions that could affect the requirements

I. Air Pollution in Los Angeles County Data Visualization

- Data sets remain unchanged in the ArcGIS Living Atlas to display current air quality readings
- Developers have Pro Version of the ArcGIS license
- ArcGis and CanvasJS APIs remain unchanged and continue to be provided

II. Air Pollution Mobile App

- Developers have Pro Version of the ArcGIS license
- ArcGis and CanvasJS APIs remain unchanged and continue to be provided
- Kotlin

2.9 Apportioning of Requirements

In the case that the project is delayed, some requirements may be transferred to the next version of the application.

3. External Interface Requirements

The external interface requirements detail the User Interfaces, Hardware Interfaces, Software Interfaces, and Communication Interfaces of the application.

3.1 User Interfaces

The list below contains the requirements for the user interface of each application

I. Air Pollution in Los Angeles County Data Visualization

- Clicking on the Primary navbar will allow users access to Home, Graph, and Maps Page
- Clicking The Map's navbar shall provide users with the options of viewing a map displaying real time sensor values or a map showing forecast sensor values in their respective locations and video forecast map
- Clicking on the forecast map shall provide a submenu to toggle forecast hours and a play button to play it as a video.
- Clicking on either current or forecast map shall allow users to zoom or explore nearby locations.
- Clicking on a symbol on the air quality map shall provide more information to the user about that sensor reading
- Clicking on the Graphs menu will show historical graphs on air quality and current and forecast sensor readings in graph format
- Clicking on the Home menu will show current temperatures and current air quality using a gauge
- Clicking on the Forecast Video map shall show a video to have the user see easier predicting layers as a video on a certain hour..

II. Air Pollution Mobile App

- Clicking on different tabs on the navigational bottom navbar will allow users access to Home, Graph, and Maps Page
- Clicking on Air quality map it lets users to view a map displaying real time sensor values or a map showing forecast sensor values in their respective locations
- Clicking on the Forecast map shall provide a submenu to toggle predicted forecast layers on Air Quality for 24 hours and a play button to play it as a video.
- Clicking on either current or forecast map shall allow users to zoom or explore nearby locations.
- Clicking on the Graphs menu will show three graphs on air quality, Today's, Tomorrow, and Current AQI graphs. These are from AirNow and are updated every hour.

3.2 Hardware Interfaces

These applications do not have any hardware interface requirements

3.3 Software Interfaces

The list below contains the requirements for the software interface of each application

I. Air Pollution in Los Angeles County Data Visualization

- The application shall use the ArcGIS Online JavaScript API to visualize common causes of air pollution
- The application shall use Canvas JS React Javascript API App to visualize air pollution data in graph format
- The application shall use the ArcGIS Online JavaScript API to visualize measured levels of air pollution
- The application shall use the ArcGIS Online JavaScript API to visualize effects of air pollution
- The application shall use multiple Layers from ArcGIS's Living Atlas for common causes of air pollution data
- The application shall use multiple Layers from ArcGIS's Living Atlas for measured levels of air pollution data
- The application shall use custom made Layers for measured levels or air pollution data
- The application shall use multiple Layers from ArcGIS's Living Atlas for effects of air pollution data
- The application shall show gauges to show the different air pollutants like P.M 2.5 and many others in a certain location (still in process)
- The application shall use a forecast map to help predict air quality in a certain hour with the use of the slider in the map

II. Air Pollution Mobile App

- The application shall use the ArcGIS Online API to visualize common causes of air pollution
- The application shall use the ArcGIS Online API to visualize measured levels of air pollution
- The application shall use the ArcGIS Online API to visualize effects of air pollution
- The application shall use multiple Layers from ArcGIS's Living Atlas for common causes of air pollution data
- The application shall use multiple Layers from ArcGIS's Living Atlas for measured levels of air pollution data
- The application shall use custom made Layers for measured levels or air pollution data
- The application shall use multiple Layers from ArcGIS's Living Atlas for effects of air pollution data
- The application shall show graphs to show the different air pollutants like P.M 2.5 and many others in a certain location
- The application shall use a forecast map to help predict air quality in a certain hour with the use of the slider in the map for a 24 hour time period

3.4 Communications Interfaces

The list below contains the requirements for the communications interface of each application

I. Air Pollution in Los Angeles County Data Visualization Web App

- The application shall utilize HTTPS request to receive data

II. Air Pollution Mobile App App:

- Mobile UI - graphical and touch-sensitive display devices

4. Requirements Specification

The requirements specification details the Functional Requirements, External Interface Requirements, Logical Database Requirements, as well as any Design Constraints.

4.1 Functional Requirements

The table below contains the functional requirements for each application

I. Air Pollution in Los Angeles County Data Visualization Module

4.1.1	The system shall retrieve data Layers from ArcGIS's Live Atlas
4.1.2	The system should retrieve data for custom Feature Layers from air quality sensors and fill in data for census tracts
4.1.3	The system shall use the retrieved data to display symbols on the map
4.1.4	The system shall use the retrieved data to display polygons on the map
4.1.5	The system shall visualize measured levels of air pollution using colors based on air quality severity harm
4.1.6	The system shall visualize demographic statistics using colors based on air quality
4.1.7	The system shall display a popup window upon clicking on a symbol on the map
4.1.8	The system shall display a popup window upon clicking on a highlighted polygon on the map
4.1.9	The system shall remove the popup window upon clicking away from the info window
4.1.10	The system shall add Layers to the map, Forecast Map prediction on air quality
4.1.11	Forecast Map has slider to show predicting machine learning model layers that predict each hour

II. Air Pollution Mobile Application

4.1.1	The system shall retrieve data Layers from ArcGIS's Live Atlas
4.1.2	The system should retrieve data for custom Feature Layers from air quality sensors and fill in data for census tracts
4.1.3	The system shall use the retrieved data to display symbols on the map
4.1.4	The system shall use the retrieved data to display polygons on the map
4.1.5	The system shall visualize measured levels of air pollution using colors based on air quality severity harm
4.1.6	The system shall visualize demographic statistics using colors based on air quality
4.1.9	The system shall add Layers to the map, Forecast Map prediction on air quality
4.1.10	Forecast Map has slider to show predicting machine learning model layers that predict each hour

4.2 External Interface Requirements

The list below contains the external interface requirements for each application

I. Air Pollution in Los Angeles County Data Visualization

This interface shall display the data retrieved from Feature Layers in ArcGIS's Live Atlas as well as custom made Feature Layers from sensors around Los Angeles county. In addition it will separately display forecast data from a proprietary artificial intelligence and machine learning model. More information about the interface is further detailed in **Section 3**

II. Air Pollution Mobile App

- This interface shall display the data retrieved from Feature Layers in ArcGIS's

Live Atlas as well as custom made Feature Layers from sensors around Los Angeles county. In addition it will separately display forecast data from a proprietary artificial intelligence and machine learning model. More information about the interface is further detailed in **Section 3**

4.3 Logical Database Requirements

None of the applications require a logical database

4.4 Design Constraints

I. Air Pollution in Los Angeles County Data Visualization

- **Standard Limitation**
 - No prior experience using any ArcGIS application.
 - No prior experience using any React
 - No prior experience using Javascript
 - Limited design options when designing web application with ArcGIS
- **Hardware Limitation**
 - Application must run on browsers that support ArcGIS requirements
 - Web App must have access to the internet

II. Air Pollution Mobile App

- **Standard Limitation**
 - Had to switch to Kotlin as React was making ArcGIS map implementation difficult
 - No prior experience using Android Studio
 - No prior experience to Kotlin
 - No prior experience to App Development
- **Hardware Limitation**
 - App must be downloaded from the App store
 - Mobile App must have access to the Internet

5. Other Nonfunctional Requirements

5.1 Performance Requirements

I. Air Pollution in Los Angeles County Data Visualization

- Be able to process data in real time when the user wants.

II. Air Pollution Mobile Application

- Be able to process data in real time when the user wants

5.2 Safety Requirements

No safety requirements were identified for these applications

5.3 Security Requirements

The list below contains the security requirements for each application

I. Air Pollution in Los Angeles County Data Visualization

- No security requirements were identified at this time

II. Air Pollution Mobile App

- No security requirements were identified at this time

5.4 Software Quality Attributes

The list below contains the software quality attributes for each application

I. Air Pollution in Los Angeles County Data Visualization

- Adaptability: Currently only for desktop
- Availability: Accessible through a web application
- Correctness: Only displays data from the Feature Layers we have selected
- Reliability: Data from Feature Layers are accurate
- Maintainability: Data from Feature Layers update in real-time
- Usability: There is a simple User Interface for all users

II. Air Pollution Mobile App

- Adaptability: Currently only for smartphones
- Availability: Accessible through the App store
- Correctness: Only displays data from the Feature Layers we have selected
- Reliability: Data from Feature Layers are accurate
- Maintainability: Data from Feature Layers update in real-time
- Usability: There is a simple User Interface for all users

5.5 Business Rules

The list below contains the business rules for each application

I. Air Pollution in Los Angeles County Data Visualization

- All data from Feature Layers are open to the public

- All features are accessible to all users

II. Air Pollution Mobile App

- All data from the Features Layers are open to the public
- All features are accessible to all users

6. Legal and Ethical Considerations

No legal or ethical issues were identified for these applications.

Appendix A: Glossary

AIDSAPPV	Artificial Intelligence and Data Science for Air Pollution Prediction and Visualization
Air Pollution	the presence of substances in the atmosphere that are harmful to the health of humans and other living beings or cause damage to the climate
APLAC	Air Pollution in Los Angeles County Data Visualization
API	a computer interface that defines interactions between software immediaries
ArcGIS	Esri's all-in-one solution to work with geographic information
Artificial Intelligence	intelligence demonstrated by machines
Data Science	an interdisciplinary field that uses scientific methods, processes, algorithms, and systems to extract knowledge from data

Feature Layer	a grouping of similar geographic features that are used for visualizing data
HTTPS	application layer protocol that is used for secure communication over a computer network
Machine Learning	an application of artificial intelligence that provides systems the ability to automatically learn and improve

Appendix B: To Be Determined List

The following requirements are conditions are to be updated:

- Search bar in the mobile application
- Cross-platform dependency to iOS
- Add more map functionalities