Software Requirements Specification

for

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

Version 1.0.2 approved

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Revision History

Name	Date	Reason For Changes	Versio
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Micky Chan,	10/12/2020	Revised sections 1, 2, 3	1.0.0
Eric Chan			
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Gatsby, Larry			
Gutierrez, Jose			
Landa			
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1. Introduction

1.1 Purpose

The purpose of the software requirements specification document is to explain the functions that the following applications will perform as well as cover all aspects of the software for each application.

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

• The current version of this app is 1.0.0. There are currently no revisions or release numbers

II. Air Pollution Personalized App (Android App)

• The current version of this app is 1.0.0. There are currently no revisions or release numbers

1.2 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 moving further. 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.

1.3 Product Scope

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

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 current demographics of the people living in Los Angeles county, and the effects of prolonged exposure to air pollution. 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, the ability to add your own 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:

	https://developer.android.com/studio/intro
ArcGIS	All reference to ArcGIS services: <u>https://doc.arcgis.com/en/</u>
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: <u>https://scikit-learn.org/stable/</u>

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 goals of APLAC is to provide users with general information surrounding air pollution such as the common causes of air pollution, the measured levels of air pollutants, as well as the lasting effects of air pollution. Some major technical hurdles that will be associated with this project is being able to find real-time data of air pollution or to be able to generate real-time data from live sensors in key locations. This can be done by using ArcGIS's Living Atlas where they have datasets pre packaged into Feature Layers or can be done by generating your own Feature Layer using data science and machine learning techniques.

II. Air Pollution Personalized App

The goals of APPA is to provide users with a more convenient way to access general information surrounding air pollution and track measured levels of certain air pollutants. A major technical hurdle that will be associated with this project is finding real-time data of each pollutant and inserting all of the data into the app. This can be done by using ArcGIS's SDK where they have tools that allow you to use the data as a Feature Layer and load it into the map

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 exists 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 Personalize App

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 extracted that are all present in ArcGIS's Living Atlas. Although the data is provided, it is impossible to always be accessed through a Desktop, which is why the product is necessary. In addition, data prediction and visualization are not as efficient, so they require a better GUI interface for them.

2.3 **Product Functions**

I. Air Pollution in Los Angeles County Data Visualization

- The application shall display locations of common causes of air pollution
- The application shall display the measured levels of air pollutants
- The application shall display the current demographics of the area
- The application shall display statistics on asthma
- The application shall display statistics on cardiovascular disease

II. Air Pollution Personalized App

- The application shall display locations of common causes of air pollution
- The application shall display the measured levels of air pollutants
- The application shall allow the user to choose between displayed air pollution information

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 all current features available in the application but will not be able to change any of the features.

B. Developer: This user will be able to interact with all current features available in the application and will be able to change any of the existing features or add new features.

II. Air Pollution Personalized App

- A. General Public: This user will be able to interact with all current features available in the application but will not be able to change any of the features.
- B. Developer: This user will be able to interact with all current features available in the application and will be able to change any of the existing features or add new features.

2.5 Operating Environment

I. Air Pollution in Los Angeles County Data Visualization

The application uses the ArcGIS Online JavaScript API as well as Feature Layers that are hosted by ArcGIS and therefore requires the application to be able to connect to ArcGIS.

II. Air Pollution Personalized App

The application uses the ArcGIS runtime SDK as well as Feature Layers that are hosted by ArcGis and therefore requires the application to be able to connect to ArcGIS.

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 4.13
- Finding real-time data
- Generating real-time data

II. Air Pollution Personalized App

- Learning Android Studio
- Setting up the connection between the application and the ArcGIS SDK
- Finding real-time data

2.7 User Documentation

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

I. ArcGIS Tutorials:

• Sharing content: https://doc.arcgis.com/en/arcgis-online/share-maps/share-items.htm

- Embedded maps: https://doc.arcgis.com/en/arcgis-online/share-maps/embed-maps-groups.htm
- Real-time updates: <u>https://learn.arcgis.com/en/projects/schedule-automated-near-real-time-data-updat</u> <u>es/</u>

II. Android Studio Tutorials:

- Creating Starter map: <u>https://developers.arcgis.com/labs/android/create-a-starter-app/</u>
- Adding Layers: https://developers.arcgis.com/labs/android/add-layers-to-a-map/

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
- Data gathered from sensors are accurate
- Developers are provided with an ArcGIS license

II. Air Pollution Personalized App

- Data sets from the ArcGIS database will be updated hourly and correctly
- Data gathered from the database is accurate
- Developers are provided with an ArcGIS license

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 a symbol on the map shall provide more information to the user
- A sidebar button shall allow the user to view the Legend
- A sidebar button shall allow the user to toggle on and off Feature Layers in a Layer List
- A sidebar button shall allow the user to add Feature Layers

II. Air Pollution Personalized App

- Tapping on one of the circled areas of the map shall provide more information to the user
- A set of buttons on the top shall allow the user to toggle visibility of different layers

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 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 Feature Layers from ArcGIS's Living Atlas for common causes of air pollution data
- The application shall use multiple Feature Layers from ArcGIS's Living Atlas for measured levels of air pollution data

- The application shall use custom made Feature Layers for measured levels or air pollution data
- The application shall use multiple Feature Layers from ArcGIS's Living Atlas for effects of air pollution data

II. Air Pollution Personalized App

- The application shall use the ArcGIS Runtime SDK to visualize measured levels of air pollution
- The application shall use the ArcGIS Runtime SDK to visualize effects of air pollution
- The application shall use multiple Feature Layers from ArcGIS's database for measured levels of air pollution data
- The application shall use custom made Feature Layers for measured levels or air pollution data

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

• The application shall receive data using HTTPS requests in a web browser

II. Air Pollution Personalized App

• The application shall receive data from the updated feature layer whenever the app is opened

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 for Feature Layers from ArcGIS's Living Atlas
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
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 severity
4.1.6	The system shall visualize demographic statistics using colors based on
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 toggle on and off Feature Layers in the map
4.1.11	The system shall add Feature Layers to the map
4.1.12	The system shall switch between maps

II. Air Pollution Personalized App

4.1.13	The system shall allow the user to type in their specified location into a search bar
4.1.14	The system shall display the specified location the user typed in on the map
4.1.15	The system shall retrieve data for Feature Layers from ArcGIS's Database
4.1.16	The system shall use the retrieved data to display information about the pollutants on the map
4.1.17	The system shall allow the user to toggle the visibility of each feature layer
4.1.18	The system shall allow the user to tap on a specified area to display more in depth information about certain pollutants
4.1.19	The system shall allow the user to search for another location while displaying the map

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 Living Atlas as well as custom made Feature Layers from sensors around Los Angeles county. More information about the interface is further detailed in **Section 3**

II. Air Pollution Personalized App

This interface shall display the data retrieved from Feature Layers in ArcGIS's Database as well as display in depth information when tapping certain areas of the feature layer. 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.

• Limited design options when designing web application with ArcGIS

• Hardware Limitation

- Application must run on browsers that support ArcGIS requirements
- System must have access to the internet

II. Air Pollution Personalized App

- Standard Limitation
 - No prior experience using any ArcGIS application or Android Studio.

• Hardware Limitation

• System 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 asks for it.

II. Air Pollution Personalized App

 \circ $\,$ Be able to process and update data in real time when the user asks for it.

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 Personalized 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 Personalized App

- Adaptability: Currently only for Android devices
- Availability: Accessible through an Android 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 hourly 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 Personalized App

- All data from Feature 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
APPA	Air Pollution Personalized App
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
SDK	collection of software development tools in one installable package

Appendix B: To Be Determined List

The following requirements are conditions are to be determined

• Using data science and machine learning techniques to perform predictive analysis of air pollution