Software Requirements Specification

for

Artificial Intelligence and Data Science for Air Pollution Prediction and Visualization

(AIDSAPPV)

Version 1.1.2 approved

Prepared by Micky Chan, Eric Chan, Peter Gatsby, Larry Gutierrez, Jose Landa

NASA and LA City

May 21, 2021

**Table of Contents**

Table of Contents................................................................................................................. pg 2

Revision History................................................................................................................... pg 3

 1. Introduction................................................................................................................ pg 4

 1.1. Purpose........................................................................................................... pg 4

 1.2. Intended Audience and Reading Suggestions................................................ pg 4

 1.3. Product Scope................................................................................................ pg 4

 1.4. Definitions, Acronyms, and Abbreviations .................................................. pg 5

 1.5. References...................................................................................................... pg 5

 2. Overall Description.................................................................................................... pg 7

 2.1. System Analysis…......................................................................................... pg 7

 2.2. Product Perspective........................................................................................... pg 7

 2.3. Product Functions........................................................................................... pg 8

 2.4. User Classes and Characteristics.................................................................... pg 8

 2.5. Operating Environment.................................................................................. pg 9

 2.6. Design and Implementation Constraints........................................................ pg 9

 2.7. User Documentation...................................................................................... pg 10

 2.8. Assumptions and Dependencies.................................................................... pg 10

 2.9. Apportioning of Requirements...................................................................... pg 10

 3. External Interface Requirements............................................................................... pg 11

 3.1. User Interfaces............................................................................................... pg 11

 3.2. Hardware Interfaces....................................................................................... pg 11

 3.3. Software Interfaces........................................................................................ pg 11

 3.4. Communications Interfaces........................................................................... pg 12

 4. Requirements Specification....................................................................................... pg 13

 4.1. Functional Requirements............................................................................... pg 13

 4.2. External Interface Requirements................................................................... pg 14

 4.3. Logical Database Requirements.................................................................... pg 15

 4.4. Design Constraints......................................................................................... pg 15

 5. Other Nonfunctional Requirements........................................................................... pg 16

 5.1. Performance Requirements............................................................................ pg 16

 5.2. Safety Requirements...................................................................................... pg 16

 5.3. Security Requirements................................................................................... pg 16

 5.4. Software Quality Attributes........................................................................... pg 16

 5.5. Business Rules............................................................................................... pg 17

 6. Legal and Ethical Considerations.….......................................................................... pg 18

Appendix A: Glossary........................................................................................................ pg 19

Appendix B: To Be Determined List................................................................................. pg 20

Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| Name | Date | Reason For Changes | Version |
| Micky Chan, Eric Chan  | 10/12/2020 | Revised sections 1, 2, 3 | 1.0.0 |
| Peter Gatsby, Larry Gutierrez, Jose Landa | 11/23/2020 | Revised sections 4, 5 | 1.0.1 |
| Micky Chan, Eric Chan, Peter Gatsby, Larry Gutierrez, Jose Landa | 12/7/2020 | Revised sections 1, 2, 3, 4, 5 | 1.0.2 |
| Micky Chan, Eric Chan, Peter Gatsby, Larry Gutierrez, Jose Landa | 3/20/2021 | Revised sections 1, 2, 3 | 1.1.1 |
| Micky Chan, Eric Chan, Peter Gatsby, Larry Gutierrez, Jose Landa | 4/28/2021 | Revised sections 1, 2, 3, 4, 5 | 1.1.2 |
| Micky Chan, Eric Chan, Peter Gatsby, Larry Gutierrez, Jose Landa | 5/13/2021 | Revised sections 1, 2, 3, 4, 5 | 1.1.2 |

**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.

1. **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
2. **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**

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

The APLAC application will consist of different components that together form a dashboard. The components in the dashboard include: an air quality and weather component, a map component, a graphs component, and an articles component. The air quality and weather component is responsible for displaying the current air quality and weather conditions in a designated area. The map component is responsible for mapping the locations of common causes of air pollution as well as the measured levels of air pollutants in Los Angeles county. The graphs component is responsible for displaying a variety of graphs pertaining to air quality and air pollution. The articles component is responsible for displaying current articles pertaining to air quality and air pollution. The goal of this application upon release is to inform users of the harmful effects of air pollution, the current and future air quality, as well as potential health hazards around their area.

1. **Air Pollution Personalized App (APPA)**

The **APPA** application consists 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 forecasted air quality data.

**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: <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**

1. **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.

1. **Air Pollution Personalized App**

The goal 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 long term goal is to be able to integrate machine learning into the app in efforts of forecasting data. 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**

1. **Air Pollution in Los Angeles County Data Visualization**

The product is an all-in-one dashboard application that helps visualize air pollution data as well as the harmful effects of air pollution. This product relies on the ArcGIS JavaScript API as well as multiple Feature Layers that are all present in ArcGIS’s Living Atlas. This product also relies on reliably and accurately generated data from multiple sites and APIs. While there exists many other applications that contain maps or graphs to visualize data on air quality and air pollution or contain a list of articles pertaining to air quality or air pollution, there exists no application that combines all of these features together in an efficient manner that is simple to use and easy to understand.

1. **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 a Feature Layer extracted from 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**

1. **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 measured air quality of a user specified location
	* The application shall display weather conditions of a user specified location
	* The application shall display current articles pertaining to air quality and air pollution
	* The application shall display graphs that visualize current air quality conditions
	* The application shall display graphs that visualize air quality trends
	* The application shall display graphs that visualize the harmful effects of air pollution
2. **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
	* The application shall display weather conditions of a user specified location in the dashboard
	* The application shall display current articles pertaining to air quality and air pollution
	* The application shall display the user’s location and a card with details about air quality in the city the user is in

**2.4 User Classes and Characteristics**

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

1. **Air Pollution in Los Angeles County Data Visualization**
	1. 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.
	2. 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. **Air Pollution Personalized App**
	1. 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.
	2. 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**

1. **Air Pollution in Los Angeles County Data Visualization**

The application uses the ArcGIS JavaScript API as well as Feature Layers that are hosted by ArcGIS and therefore requires the application to be able to connect to ArcGIS. The application uses a variety of APSs to gather data and therefore requires a stable internet connection.

1. **Air Pollution Personalized App**

The application uses the ArcGIS runtime SDK as well as a Feature Layer that is hosted by ArcGis and therefore requires the application to be able to connect to ArcGIS. The application utilizes some APIs to gather data and articles and therefore requires a stable internet connection.

**2.6 Design and Implementation Constraints**

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

1. **Air Pollution in Los Angeles County Data Visualization**
	* Learning the ArcGIS JavaScript API
	* Learning ReactJS
	* Finding real-time data
	* Generating real-time data
	* Developing machine learning models
2. **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

1. **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: <https://learn.arcgis.com/en/projects/schedule-automated-near-real-time-data-updates/>
2. **Android Studio Tutorials:**
	* Creating Starter map: <https://developers.arcgis.com/labs/android/create-a-starter-app/>
	* 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

1. **Air Pollution in Los Angeles County Data Visualization**
	* Data sets remain unchanged in the ArcGIS Living Atlas
	* Data gathered from sensors are accurate
	* Data gathered from APIs are accurate
	* Usage of APIs do not exceed the call limit
	* Developers are provided with an ArcGIS license
2. **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

1. **Air Pollution in Los Angeles County Data Visualization**
	* A submission box will allow users to enter a zip code to change the location of focus for current air quality and weather conditions
	* Clicking a symbol on the map shall provide more information to the user
	* A sidebar button shall allow the user to toggle on and off Feature Layers in a Layer List
2. **Air Pollution Personalized App**
	* A search bar on top of the map tab will allow users to enter an address to change the location of focus for current air quality and weather conditions
	* A set of buttons on the bottom of the app shall allow the user to navigate the app’s different tabs
	* A button allowing the user to add cities in the dashboard along with a button that allows you to delete the city on each card in the dashboard

**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

1. **Air Pollution in Los Angeles County Data Visualization**
	* The application shall use an API to gather data on current air quality conditions
	* The application shall use an API to gather data on current weather conditions
	* The application shall use the ArcGIS JavaScript API to visualize common causes of air pollution
	* The application shall use the ArcGIS JavaScript API to visualize measured levels 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 an API to gather articles on air pollution
2. **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 a Feature Layer from ArcGIS’s database for measured levels of air pollution data
	* The application shall use a custom made Feature Layer for measured levels or air pollution data
	* The application shall use an API to gather articles on air pollution

**3.4 Communications Interfaces**

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

1. **Air Pollution in Los Angeles County Data Visualization**
	* The application shall receive data using HTTPS requests in a web browser
2. **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

1. **Air Pollution in Los Angeles County Data Visualization**

|  |  |
| --- | --- |
| 4.1.1 | The system shall retrieve data for Feature Layers from ArcGIS’s Living Atlas |
| 4.1.2 | The system shall use the retrieved data to display symbols on the map |
| 4.1.3 | The system shall visualize measured levels of air pollution using colors based on severity |
| 4.1.4 | The system shall display a popup window upon clicking on a symbol on the map |
| 4.1.5 | The system shall remove the popup window upon clicking away from the info window |
| 4.1.6 | The system shall toggle on and off Feature Layers in the map |
| 4.1.7 | The system shall retrieve data for air quality conditions |
| 4.1.8 | The system shall retrieve data for weather conditions |
| 4.1.9 | The system shall display the weather conditions |
| 4.1.10 | The system shall display symbols based on the weather conditions |
| 4.1.11 | The system shall display information on air quality conditions |
| 4.1.12 | The system shall display information on air quality trends |
| 4.1.13 | The system shall retrieve news articles data |
| 4.1.14 | The system shall display news articles data |

1. **Air Pollution Personalized App**

|  |  |
| --- | --- |
| 4.1.16 | The system shall allow you to login with an email and password |
| 4.1.17 | The system shall allow the user to type in their specified location into a search bar |
| 4.1.18 | The system shall display the specified location the user typed in on the map |
| 4.1.19 | The system shall retrieve data for Feature Layers from ArcGIS’s Database |
| 4.1.20 | The system shall use the retrieved data to display information about the pollutants on the map |
| 4.1.21 | The system shall allow the user to switch between different tabs for different information |
| 4.1.22 | The system shall allow the user to add cities in a dashboard to get more information on that city |
| 4.1.23 | The system shall allow the user to delete cities from the dashboard |
| 4.1.24 | The system shall display cards pertaining to the cities added into the dashboard |
| 4.1.25 | The system shall allow the user to search for another location while displaying the map |
| 4.1.26 | The system shall retrieve relevant news article data |
| 4.1.27 | The system shall provide display links to the news article data |
| 4.1.28 | The system shall pinpoint your location in the profile tab |
| 4.1.29 | The system shall display a card that has extra information about your current city |
| 4.1.30 | The system shall display a minimap of your city |
| 4.1.31 | The system shall allow you to log out from the profile tab |

**4.2 External Interface Requirements**

The list below contains the external interface requirements for each application

1. **Air Pollution in Los Angeles County Data Visualization**

This interface shall display the data retrieved from Feature Layers in ArcGIS’s Living Atlas. This interface shall display data on air quality and weather conditions, air quality trends, and news articles gathered from various APIs. More information about the interface is further detailed in **Section 3**.

1. **Air Pollution Personalized App**

This interface shall display the data retrieved from the Feature Layer in ArcGIS’s Database as well as display in depth information when displaying certain cities in the dashboard. 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**

1. **Air Pollution in Los Angeles County Data Visualization**
	* **Standard Limitation**
		+ No prior experience using any ArcGIS application
		+ No prior experience using ReactJS
		+ APIs have limited number of calls
	* **Hardware Limitation**
		+ Application must run on browsers that support ArcGIS requirements
		+ System must have access to the internet
2. **Air Pollution Personalized App**
	* **Standard Limitation**
		+ No prior experience using any ArcGIS application or Android Studio.
		+ Dashboard is limited to cities in California
	* **Hardware Limitation**
		+ System must have access to the internet

**5. Other Nonfunctional Requirements**

**5.1 Performance Requirements**

1. **Air Pollution in Los Angeles County Data Visualization**
* Able to retrieve air quality data in real time
* Able to retrieve weather data in real time
* Able to retrieve news articles in less than 3 seconds
1. **Air Pollution Personalized App**
	* Be able to process and update data in real time when the user asks for it.
	* Able to retrieve dashboard cities quickly
	* Able to retrieve news articles quickly

**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

1. **Air Pollution in Los Angeles County Data Visualization**
	* No security requirements were identified at this time
2. **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

1. **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
2. **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

1. **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
	* All articles retrieved are given proper credit
2. **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