

**Software Design  
Document**  
for  
**Artificial Intelligence and Data  
Science for Air Pollution Prediction  
and Visualization  
(AIDSAPPV)**

**Version 1.2 approved**

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## Revision History

| Name | Date      | Reason For Changes     | Version |
|------|-----------|------------------------|---------|
| Team | 12/7/2020 | First draft of SDD     | 1.0.0   |
| Team | 4/8/2021  | Revised SDD            | 1.1.0   |
| Team | 5/14/2021 | Final revisions of SDD | 1.1.1   |

# 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 air quality and air pollution in their area. These applications will also provide predictions on the levels of air pollution and air quality using machine learning and data science techniques.

## 1.2 Document Conventions

Roman numerals will indicate which application is being talked about, the website or mobile application. 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 project managers. It is suggested to look at the table of contents first in order to find any topics that you may be looking for. If not, quickly skimming through the document will allow the reader to obtain a general understanding of the project. If you are a project manager, it is recommended to read **section 2 to section 6** to further understand the requirements and constraints of the project. If you are a developer, it is recommended to read **section 8 to section 12** to get a list of references, glossary, as well as any interfaces and requirements. For testers, it is recommended to read **section 10** to get a list of requirements and how they are to be validated or verified.

## 1.4 System Overview

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

- This application is used to show the measured levels of air pollutants as well as some common causes of air pollution around Los Angeles County. Currently, we plan on using data and feature layers from ArcGIS's Living Atlas to display current conditions on air quality and air pollution. Moving forward, we plan on 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.

### II. Air Pollution Personalized App (Android App)

- The application is used to show the measured levels of air pollutants around Los Angeles County. This is done by using feature layers that rely on sensors around Los Angeles County. Currently for the mobile app, we plan on using data from

ArcGIS's Database to measure certain levels of different air pollutants. Moving forward we plan on integrating machine learning techniques into the software to be able to not only provide real time data, but forecasted air quality data as well.

## 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

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

- The following software uses the ArcGIS Online JavaScript API and assumes that any browser allows the proper permissions for it to work
- The following software is reliant on the ArcGIS Living Atlas and assumes that the Feature Layers used remain public and in the same format
- The following software is reliant on using ArcGIS Living Atlas to gather data and assumes developers have an ArcGIS license
- The following software is developed by gathering data from various APIs and assumes that API keys are provided to the developers

#### II. Air Pollution Personalized App (Android App)

- The following application assumes the user will have a compatible phone/android version
- The following software assumed the data remain updating, to display on the app
- The following software is reliant on the ArcGIS database and assumes that the Feature Layer used remain public and in the same format
- The following software is developed using ArcGIS and Esri and assumes that all developers have a ArcGIS license

### 2.2 General Constraints

Listed below are the general constraints for each application of this project.

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

##### • 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
- Developers are required to have basic knowledge of the JavaScript language
- Developers are required to have knowledge of the React framework

##### • 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
- II. Air Pollution Personalized App (Android App)**
- **Software Environment**
    - Developers are required to have a functioning ArcGIS license
  - **End-User Environment**
    - A mobile device is required to use and view the application
  - **Interoperability requirements**
    - Data is gathered from ArcGIS's Layer Database
    - Data is gathered from various sensors surrounding Los Angeles County
  - **Performance requirements**
    - Application should load maps and their datasets in less than 5 seconds
    - Application should load added cities from the dashboard in less than 5 seconds
    - Application should load news articles in less than 5 seconds

## 2.3 Goals and Guidelines

- I. Air Pollution in Los Angeles County Data Visualization**
- 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 air pollution data for users
- II. Air Pollution Personalized App**
- The data retrieved from the ArcGIS database should be accurate
  - The GUI should be user-friendly
  - The application should be able to effectively visualize air pollution data for users



## **2.4 Development Methods**

The method to develop the two applications in AIDSAPPV is similar to the Agile Development Method. The developers have split into two teams; one team is responsible for the development of the web application while the other team is responsible for the mobile application. Both teams 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 both applications and decide what components or modules should be finished next.

### 3. Architectural Strategies

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

- Use of a particular type of product (programming language, database, library, etc.)
  - ArcGIS
  - JavaScript
  - HTML
  - CSS
  - React
  - Python
  - pandas library
  - scikit-learn library
- 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

#### II. Air Pollution Personalized App (Android App)

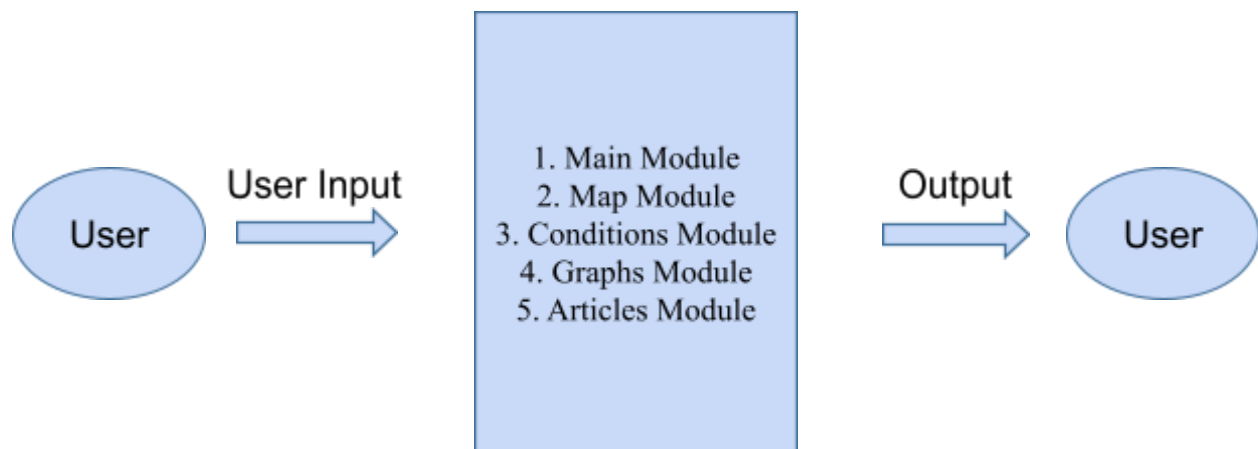
- Use of a particular type of product (programming language, database, library, etc.)
  - ArcGIS
  - Java
  - Firebase
- Reuse of existing software components to implement various parts/features of the system
  - This software is the first version
- Future plans for extending or enhancing the software
  - Collect data in real time to implement into the application
- User interface paradigms
  - A mobile device and internet connection is required to use the application

## 4. System Architecture

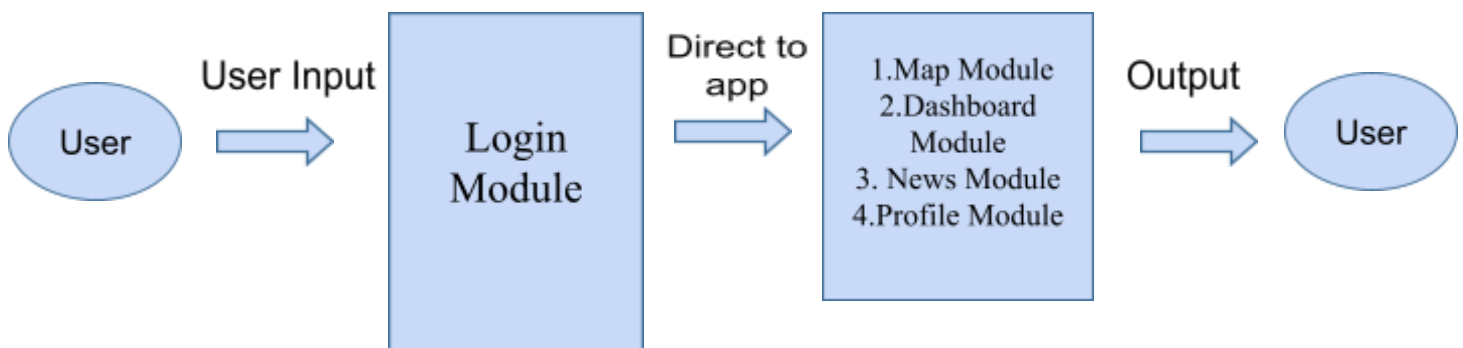
This section details the system architecture for the **AIDSAPPV** project. As there are two different applications in this project, there will be separate DFDs for both applications as their architectures will differ from each other.

Below details the Level-0 DFDs for both applications. A more indepth look into both applications will be provided in **subsection 4.1 and 4.2**.

**Air Pollution in Los Angeles County Data Visualization - Level-0 DFD**



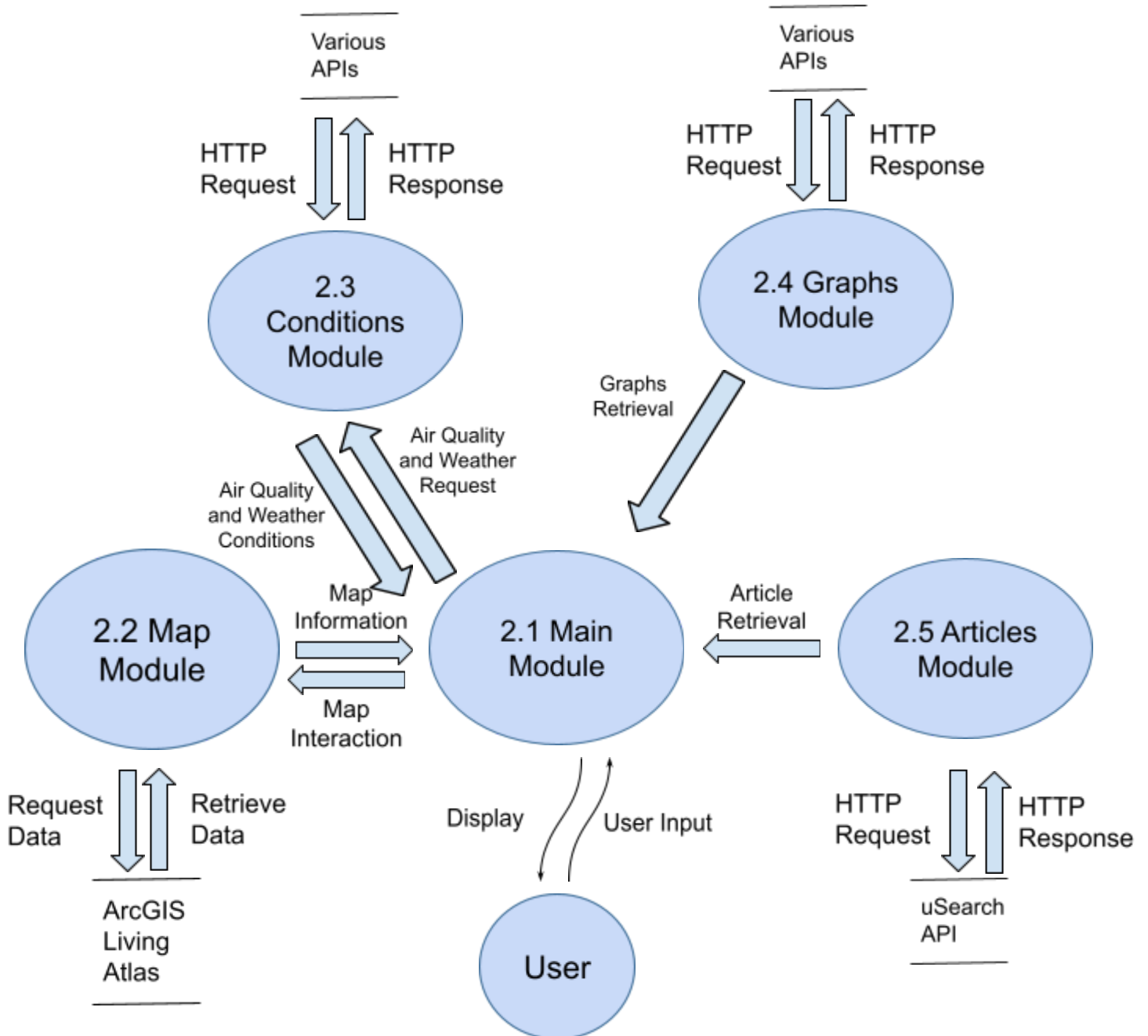
**Air Pollution Personalized App - Level-0 DFD**



## 4.1. Higher Level System Architecture - Web Application

This subsection details a higher level system architecture for the **Air Pollution in Los Angeles County Data Visualization** application. Each module and their responsibilities will be detailed in their respective subsections. For a more detailed look into each module's responsibilities, please refer to **section 6.1**.

**Air Pollution in Los Angeles County Data Visualization - Level-1 DFD**



#### **4.1.1. The Main Module**

The Main Module of the web application is responsible for taking in user input and displaying information to the user. The information that is displayed to the user can change based on the user input. The Main Module also connects to the other modules in the application and passes them user input information where they will then handle that user input.

#### **4.1.2. The Map Module**

The Map Module of the web application is responsible for connecting to the ArcGIS Living Atlas database and passing that information to the Main Module where the information will then be displayed to the user as a map. This module is also responsible for taking in user input from the Main Module and altering map information or showing specific information based on user input.

#### **4.1.3. The Conditions Module**

The Conditions Module of the web application is responsible for connecting to various APIs, specifically, the WeatherBit API and the OpenWeatherMap API, to gather information on the current air quality and weather conditions and passing this information to the Main Module where the information will then be displayed to the user. This module is also responsible for taking in user input from the Main Module and altering air quality and weather condition information based on user input.

#### **4.1.4. The Graphs Module**

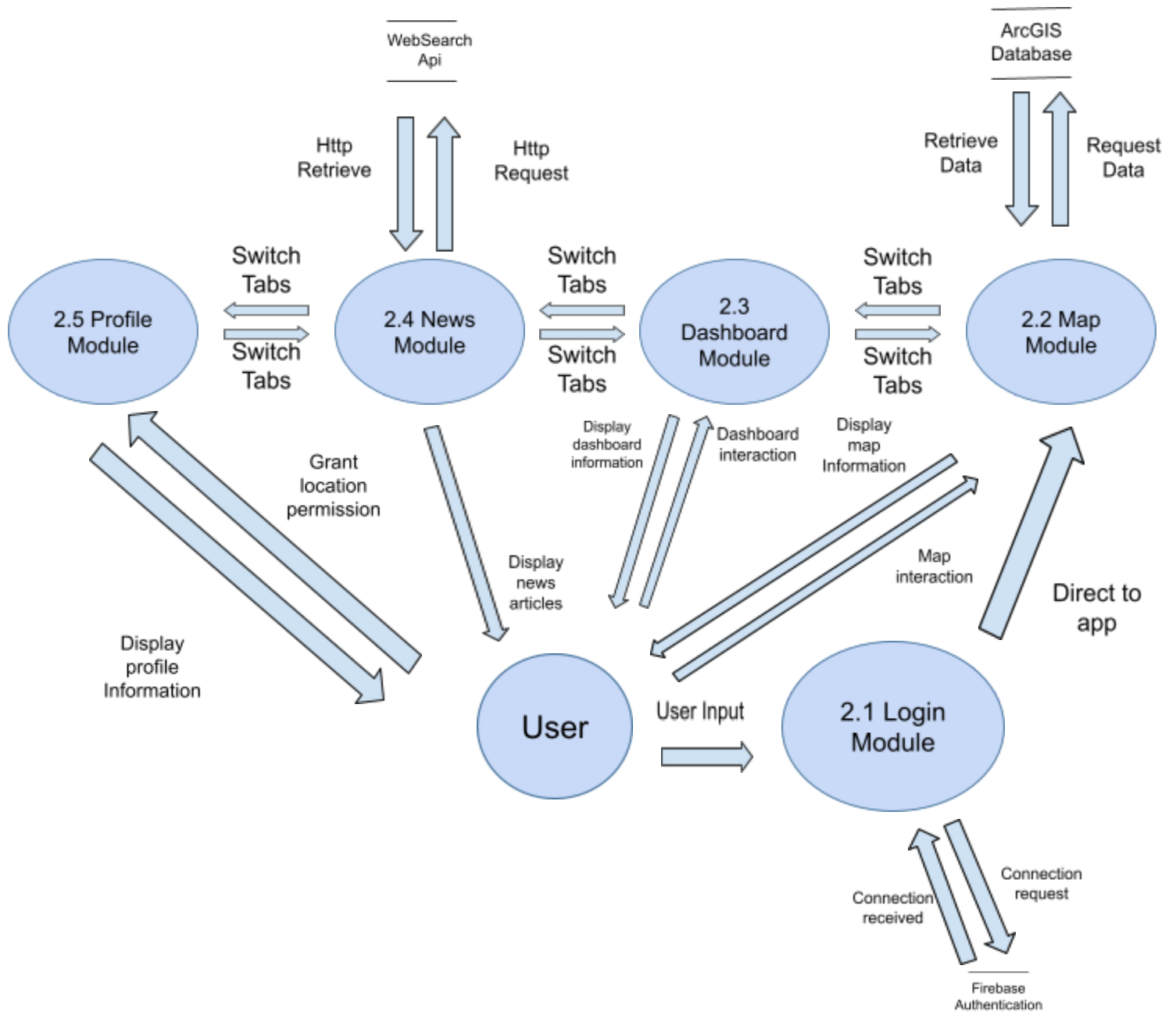
The Graphs Module is responsible for connecting to various APIs, specifically, the OpenWeatherMap API and the OpenAQ API, to gather information on current air quality conditions as well as gather information on air quality trends and passing this information to the Main Module where the information will then be displayed to the user as a graph.

#### **4.1.5. The Articles Module**

The Articles Module is responsible for connecting to the uSearch API to gather information on current articles relating to air quality and air pollution. The Articles Module then passes this information to the Main Module where it'll be displayed to the user.

## 4.2. Higher Level System Architecture - Mobile Application

This subsection details a higher level system architecture for the **Air Pollution Personalized App** application. Each module and their responsibilities will be detailed in their respective subsections. For a more detailed look into each module's responsibilities, please refer to **section 6.2**.



#### **4.2.1. The Login Module**

The Login Module of the web application is responsible for either the login of the user or the registration of the user. The user's email will be stored within the firebase database so that it can be authenticated whenever the user decides to log in to the application

#### **4.2.2. The Map Module**

The Map Module of the mobile application is responsible for connecting to the ArcGIS database and passing that information to the Main Module where the information will then be displayed to the user as a map. This module is also responsible for taking in user input and directing the user to a specific address.

#### **4.2.3. The Dashboard Module**

The Dashboard Module is responsible for creating cards of specific cities based on user input. The information that is displayed to the user can change depending on the user's wishes to keep or delete the data displayed.

#### **4.2.4. The News Module**

The News Module is responsible for connecting to the WebSearch API to gather information on current articles relating to air quality and air pollution. The News Module then displays a list of article links to the user.

#### **4.2.5. The Profile Module**

The Profile Module is responsible for getting the permission of the user to access their location from their mobile device. Once permission is granted, the Profile Module will display an information card and a mini map of their location.

## **5. Policies and Tactics**

This section details the choice of specific products that were used, plans for ensuring requirements traceability, as well as plans for testing the software.

### **5.1 Choice of which specific products used**

- Programming languages used:
  - Python
  - Java
  - JavaScript
- ArcGIS
- Android Studio

### **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.

### **5.4 Plans for maintaining the software**

The plans to maintain the software include collecting more data as well as updating data in real-time. The data collected must also be checked to ensure that all data gathered is accurate and reliable.



## 6. Detailed System Design

This section details a more indepth look into each module of both the **Air Pollution in Los Angeles County Data Visualization** application and the **Air Pollution Personalized App** application. For the higher system system architecture of both applications and the base responsibilities of their modules, please refer to **section 4.1 and 4.2**.

### 6.1 Detailed System Design - Web Application

This subsection details each module of the **Air Pollution in Los Angeles County Data Visualization** application and offers an indepth look at their responsibilities, constraints, composition, uses/interactions, as well as their interface/exports.

#### 6.1.1 Map Module

##### A. Responsibilities

The primary responsibility of this module is to visualize data on a map and translate that data into UI elements such as symbols or polygons. This module should ensure that all data being used should be displayed in a way that is user friendly and easy to understand.

##### B. Constraints

Some datasets used for this module are not up to date or do not update in real-time which may lead to an inaccurate representation of the data being used. There is a lack of available datasets that can be used for this module. Lastly, datasets that are up to date may have null fields which may cause certain data to not appear on the map.

##### C. Composition

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

- **Legend:** shows a list of all datasets being used as well as the symbols, colors, and polygons that are used in that respective dataset and what they represent
- **Filter:** allows for certain datasets to be filtered on/off for a more indepth look
- **Popup Template:** allows for a more detailed summary of specific data points

##### D. Uses/Interactions

This module interacts with the Main Module which is responsible for passing user input information to this module. This module processes the user input and changes information based on the user input which is detailed in **section C**. This module then passes the new information back to the Main Module to be displayed to the user.

## **E. Resources**

The resources this module uses are datasets, which are Feature Layers, that are present within ArcGIS's Living Atlas.

## **F. Interface/Exports**

This module uses many imports from a collection of classes that is provided by the ArcGIS Javascript API. Refer to **section 12** of this document for any documentation pertaining to the API used.

### **6.1.2 Conditions Module**

#### **A. Responsibilities**

The primary responsibility of this module is to gather air quality and weather conditions from various APIs and display them in a way that is user-friendly.

#### **B. Constraints**

This module uses a free-tier of the various APIs and thus is limited to a certain number of calls. This module is restricted to only be used in the U.S.

#### **C. Composition**

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

- **Search:** allows for the search of air quality and weather conditions of a specific zip code or city.

#### **D. Uses/Interactions**

This module interacts with the Main Module which is responsible for passing user input information to this module. This module processes the user input and changes information based on the user input which is detailed in **section C**. This module then passes the new information back to the Main Module to be displayed to the user.

#### **E. Resources**

This module uses resources from various APIs that gather data from a variety of data sources

#### **F. Interface/Exports**

This module does not use any imports

### **6.1.3 Graphs Module**

#### **A. Responsibilities**

The primary responsibility of this module is to gather air quality and weather conditions from various APIs and display them in the form of a graph.

#### **B. Constraints**

This module uses a free-tier of the various APIs and thus is limited to a certain number of calls. This module is restricted to only be used in the U.S.

### **C. Composition**

This module does not use any subcomponents

### **D. Uses/Interactions**

This module does not interact with any other module

### **E. Resources**

This module uses resources from various APIs that gather data from a variety of data sources

### **F. Interface/Exports**

This module uses an external collection of classes called Canvas.JS. Refer to **section 12** of this document for any documentation pertaining to the classes used.

## **6.1.4 Articles Module**

### **A. Responsibilities**

The primary responsibility of this module is to gather articles pertaining to air quality and air pollution from an API and display them to the user.

### **B. Constraints**

This module uses a free-tier of the various APIs and thus is limited to a certain number of calls.

### **C. Composition**

This module does not use any subcomponents.

### **D. Uses/Interactions**

This module does not interact with any other module.

### **E. Resources**

This module uses resources from various APIs that gather data from a variety of data sources

### **F. Interface/Exports**

This module does not use any imports

## **6.1 Detailed System Design - Mobile Application**

This subsection details each module of the **Air Pollution Personalized App** and offers an indepth look at their responsibilities, constraints, composition, uses/interactions, as well as their interface/exports.

### **6.2.1 Login Module**

#### **A. Responsibilities**

The primary responsibility of this module is to allow the user to login through firebase authentication to access the application or allow the user to register with a new email. This module should ensure that the user's email and password are safely stored in the firebase database.

#### **B. Constraints**

The user must have a valid email and password stored within the firebase database to use this application. If an email that is not valid has been entered in the initial login screen, firebase will deny access to the app unless the user creates a new email or uses one stored in firebase

#### **C. Composition**

This module does not use any subcomponents.

#### **D. Uses/Interactions**

This module grants full access to the other modules in the app.

#### **E. Resources**

The primary resource this module uses is the firebase authentication database which allows the storage of user emails and passwords .

#### **F. Interface/Exports**

This module does not use any imports

### **6.2.2 Map Module**

#### **A. Responsibilities**

The primary responsibility of this module is to visualize feature layer data on a map. This module should ensure that all data being used should be displayed in a way that is user friendly and easy to understand.

#### **B. Constraints**

The feature layer used for this module does not update in real-time which may lead to an inaccurate representation of the data being used. While the feature layer does update

itself, it updates hourly which would mean that the data represented on the map might not be accurate to the current time.

### **C. Composition**

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

- **Search:** allows for the search of air quality and weather conditions at a specific address.

### **D. Uses/Interactions**

This module does not interact with any other module

### **E. Resources**

The resource that this module uses is a Feature Layer, that is present within ArcGIS's Database.

### **F. Interface/Exports**

This module uses many imports from a collection of classes that is provided by the ArcGIS runtime SDK for android. Refer to **section 12** of this document for any documentation pertaining to the SDK used.

## **6.2.3 Dashboard Module**

### **A. Responsibilities**

The primary responsibility of this module is to display cards of air quality information and weather information to the user. The module is also responsible for the tracking of which cities are currently in the user's dashboard

### **B. Constraints**

This module is restricted to adding only cities within California.

### **C. Composition**

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

- **Cards:** Displays a specific city's air quality data including various weather data such as wind speed, humidity and pressure

### **D. Uses/Interactions**

This module does not interact with any other module.

### **E. Resources**

This module uses resources from the firebase database for a personalized dashboard saved for each user.

## **F. Interface/Exports**

This module does not use any imports

### **6.2.4 News Module**

#### **A. Responsibilities**

The primary responsibility of this module is to gather articles pertaining to air quality and air pollution from an API and display a list of links for the user to access.

#### **B. Constraints**

This module only takes a limit of four recent news articles of air quality

#### **C. Composition**

This module does not use any subcomponents.

#### **D. Uses/Interactions**

This module does not interact with any other module.

#### **E. Resources**

This module uses resources from various APIs that gather data from a variety of data sources

## **F. Interface/Exports**

This module does not use any imports

### **6.2.5 Profile Module**

#### **A. Responsibilities**

The primary responsibility of this module is to pinpoint the location of the user and display a card and mini map based on the user's location. This module also allows the user to log out if needed

#### **B. Constraints**

This module requires the user to grant permission for the use of their location.

#### **C. Composition**

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

- **Cards:** Displays a specific city's air quality data including various weather data such as wind speed, humidity and pressure
- **Mini-map:** Displays a specific city's location based on the user's current location

#### **D. Uses/Interactions**

This module does not interact with any other module.

#### **E. Resources**

The resource that this module uses is Feature Layer, that is present within ArcGIS's Database.

#### **F. Interface/Exports**

This module uses many imports from a collection of classes that is provided by the ArcGIS runtime SDK for android. Refer to **section 12** of this document for any documentation pertaining to the SDK used.

## **7. Detailed Lower level Component Design**

### **7.1 Name of Class or File**

#### **7.1.1 Classification**

Locations of current air quality, as well as causes of air pollution in certain areas. Visualization of this is all shown in a map.

#### **7.1.2 Processing Narrative (PSPEC)**

##### **I. Air Pollution in Los Angeles County Data Visualization**

Web Application gets the data from ArcGIS which is then displayed on our maps. The data obtained from ArcGIS can be toggled on and off in the maps.

##### **II. Air Pollution Personalized App**

Mobile Application gets the data from the ArcGIS database which is then displayed on the map tab in the app.

#### **7.1.3 Interface Description**

Multiple Maps created with legends to understand the meaning of symbols. As well as a toggle on and off option in order to see more specific information on certain options available.

#### **7.1.4 Processing Detail**

Being able to obtain information that is wanted and needed in our maps. Certain data can be pulled from ArcGIS and added to our maps.

##### **7.1.4.1 Design Class Hierarchy**

The parent classes are mainly containers for the child classes. As such, the child classes are the most important aspect of our applications.

##### **7.1.4.2 Restrictions/Limitations**

Currently only have access to what ArcGIS has to offer.

##### **7.1.4.3 Performance Issues**

Web application dashboard takes a while for everything to load together as well as updating the weather might take a second or two.

##### **7.1.4.4 Design Constraints**



Just like Restrictions/Limitations we can only use what is available with ArcGIS.

#### **7.1.4.5 Processing Detail For Each Operation**

Each operation shall not require a lot of processing power.

## **8. Database Design**

This section details any databases used within the app. As there are two separate applications, There will be two sections to detail the use of any database for both the web application and the mobile application if there are any used

### **8.1 Web application**

No database is currently being used in the Web App.

### **8.2 Mobile application**

The Database used here is the firebase database. The database is used to store the user's email and password for authentication which should contain the user's personal dashboard and whether or not the user has given permission for the profile to use their location. The personal dashboard should contain a list of cities that the user has added over time.

## 9. User Interface

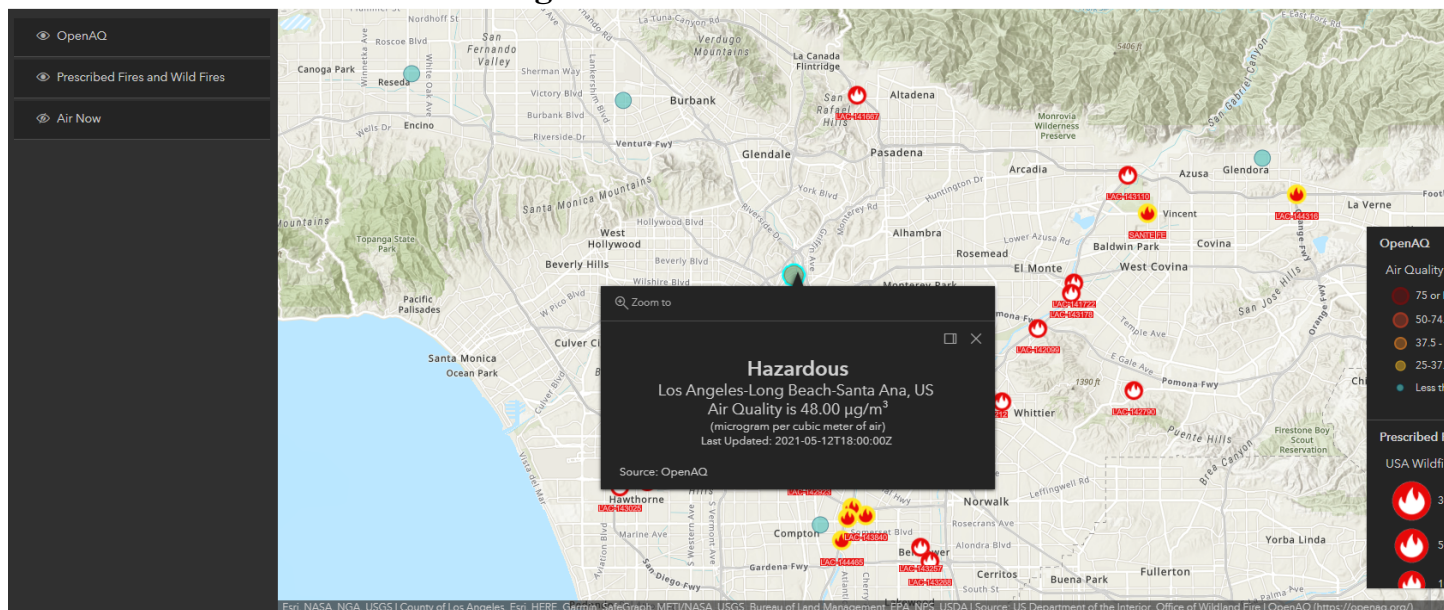
### 9.1.1 Overview of User Interface for Web Application

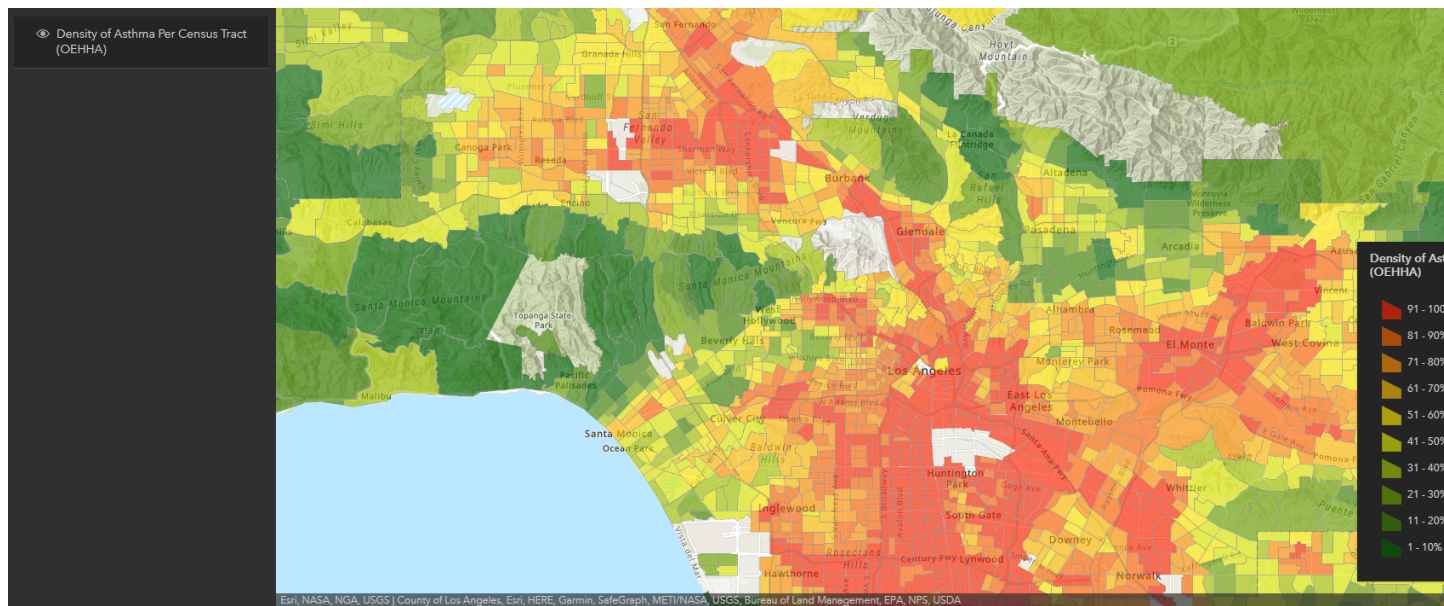
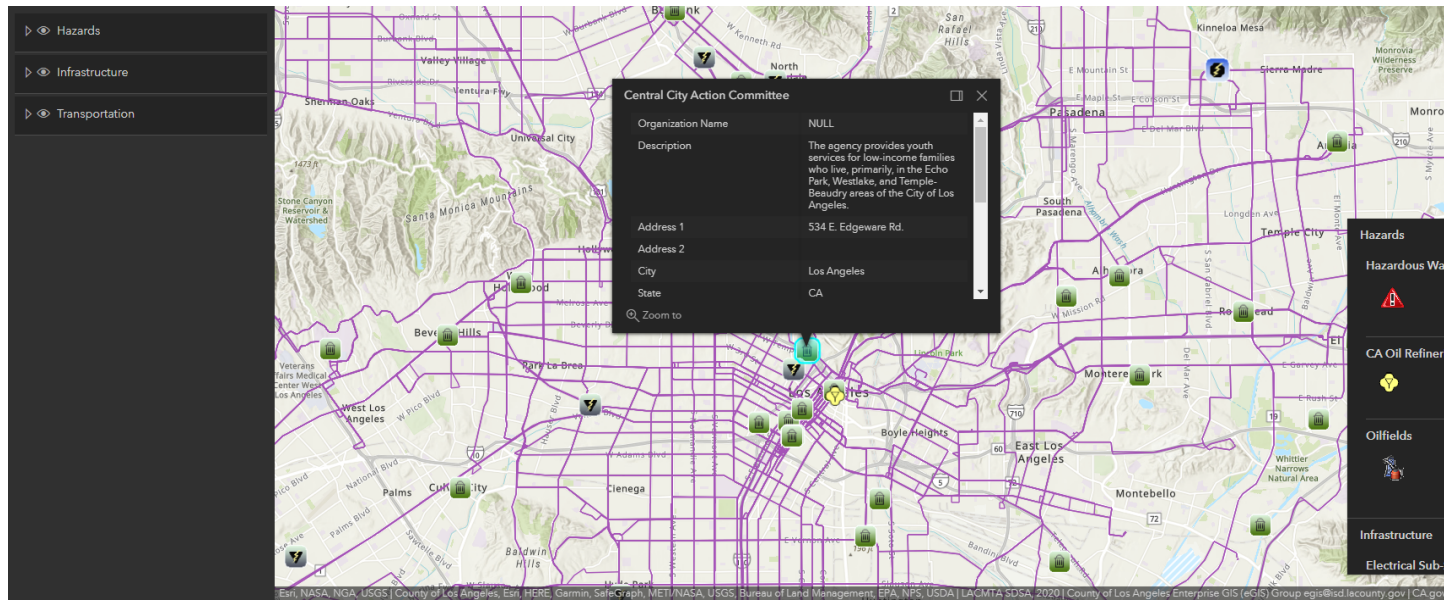
Availability:

- Clicking on markers in the map to display information about that marker
- Able to zoom in and out
- Toggling Air Quality off and on on map
- Toggling prescribed fires and wildfires on and off
- Toggling Air Now air quality on and off
- Toggling Hazards, Infrastructure and Transportation on and off on Pollution Sources Map
- Toggling Density of Asthma per Census Tract on and off

Describe the functionality of the system from the user's perspective. Explain how the user will be able to use your system to complete all the expected features and the feedback Information that will be displayed for the user. This is an overview of the UI and its use. The user manual will contain extensive detail about the actual use of the software.

### 9.1.2 Screen Frameworks or Images

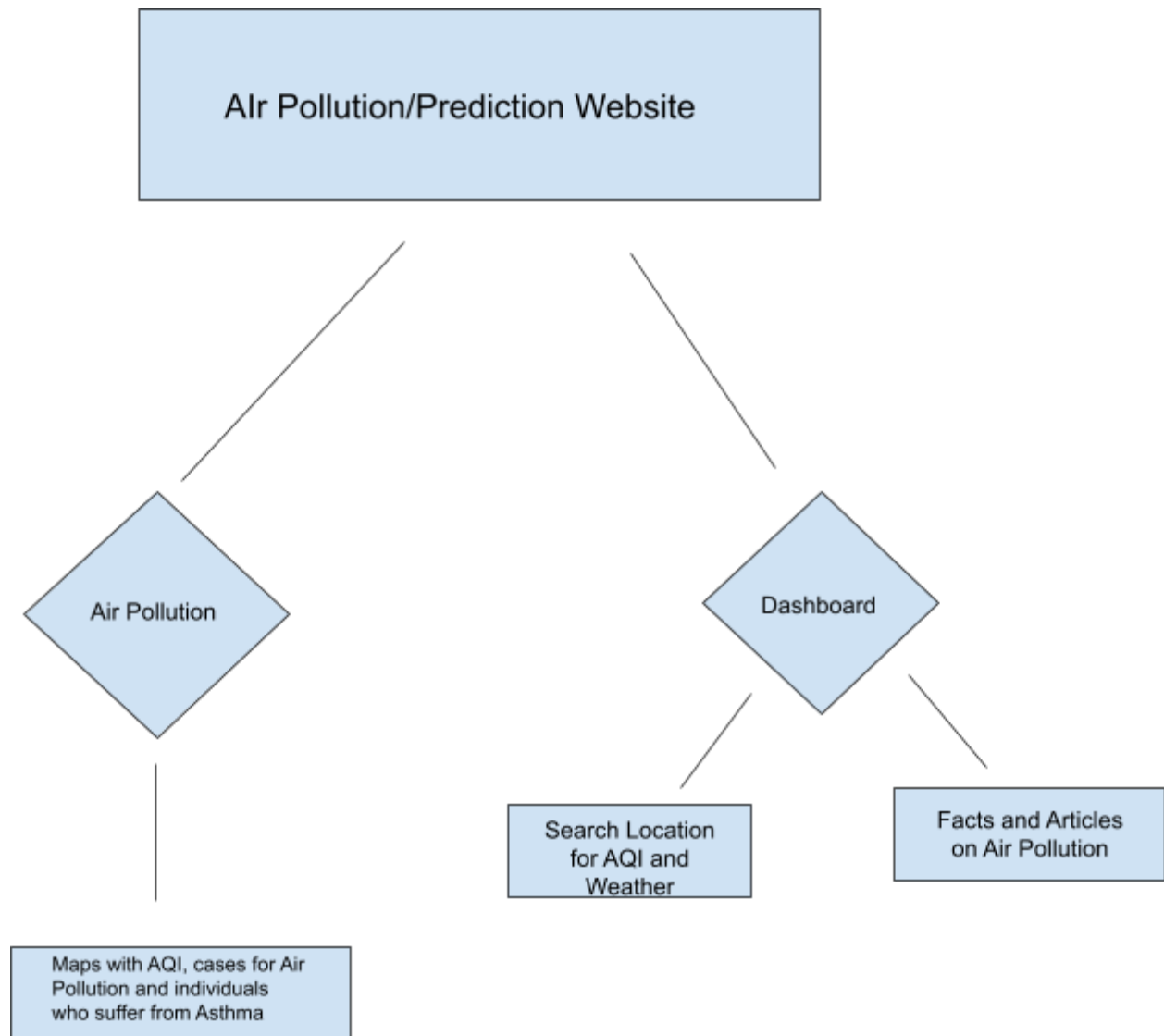




These can be mockups or actual screenshots of the various UI screens and popups.

### 9.1.3 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.



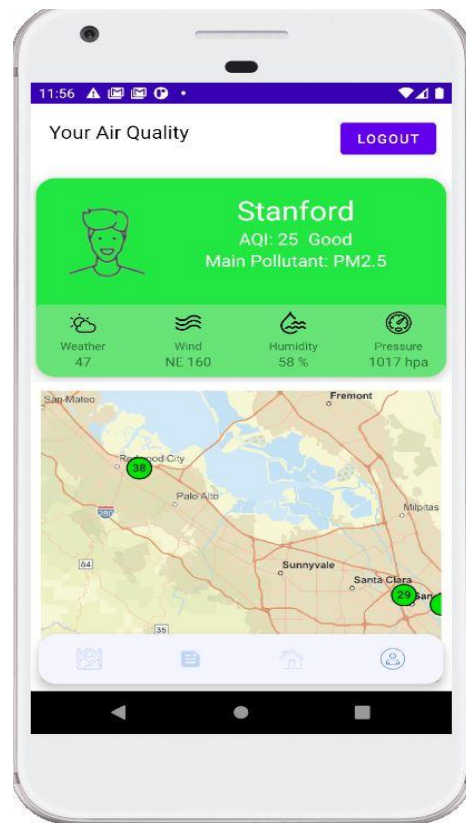
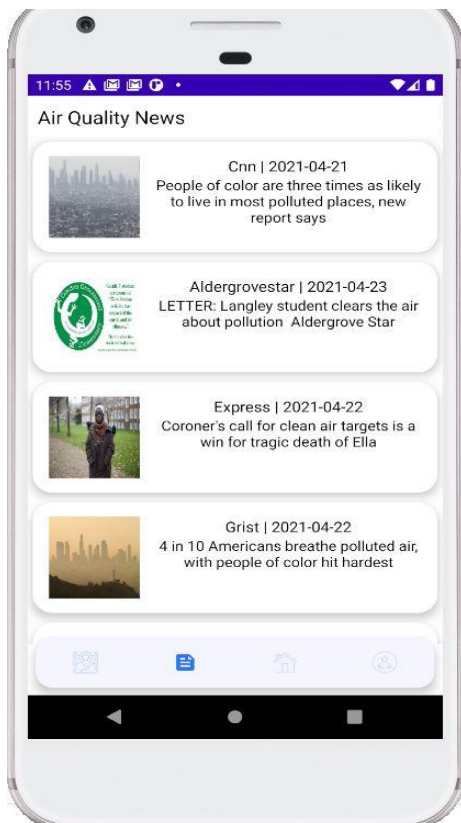
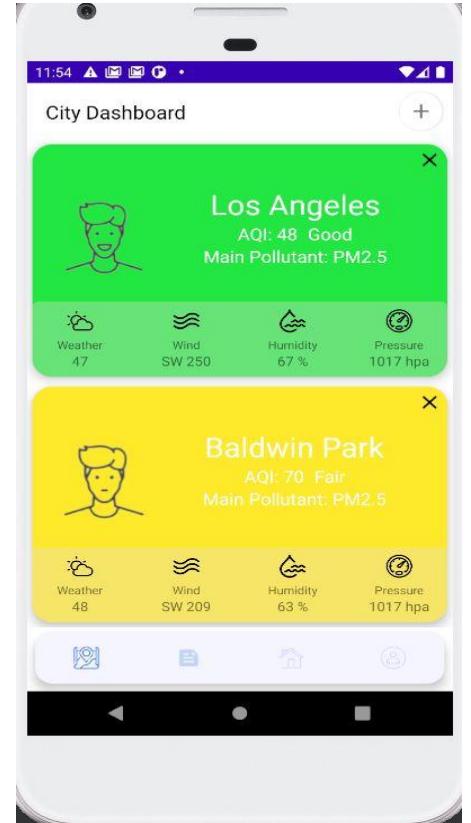
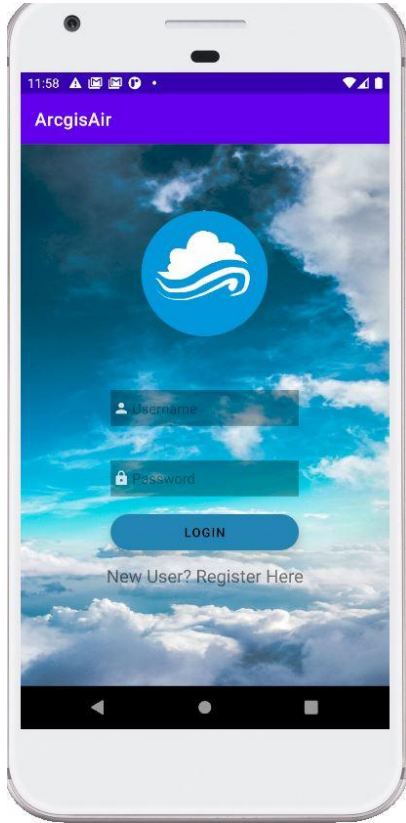
### 9.2.1 Overview of User Interface for Mobile Application

#### Availability:

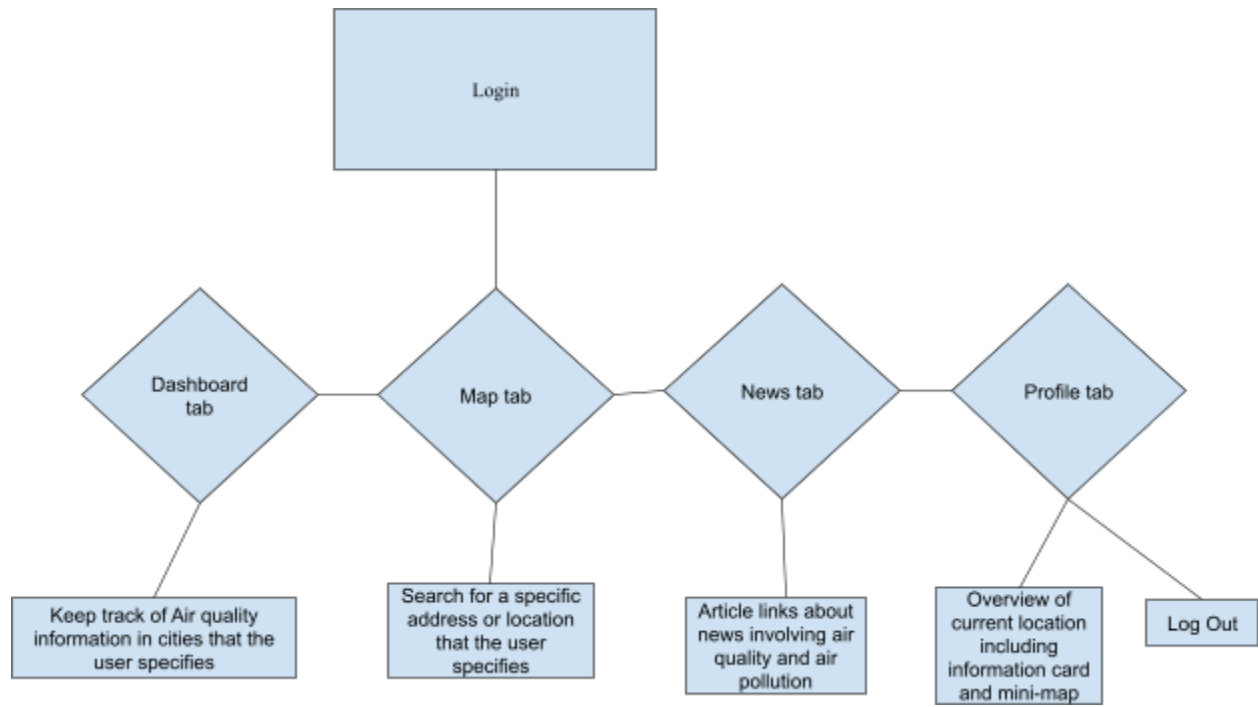
- Login using email and password
- Usage of the Search bar
- Able to zoom in and out on map
- Switch tabs on the bottom of each tab
- Addition and deletion of cities in dashboard tab
- Logout from Profile tab



## 9.2.2 Screen Frameworks or Images



### 9.2.3 User Interface Flow Model



## 10. Requirements Validation and Verification

Create a table that lists each of the requirements that were specified in the SRS document for this software.

For each entry in the table list which of the Component Modules and if appropriate which UI elements and/or low level components satisfies that requirement.

For each entry describe the method for testing that the requirement has been met.

### I. Air Pollution in Los Angeles County Data Visualization

|       |                                                                                            |                                                  |                                                |
|-------|--------------------------------------------------------------------------------------------|--------------------------------------------------|------------------------------------------------|
| 4.1.1 | The system shall retrieve data for Feature Layers from ArcGIS's Living Atlas               | The Map Module satisfies this requirement        | Tested by running the application on localhost |
| 4.1.2 | The system shall use the retrieved data to display symbols on the map                      | The Map Module satisfies this requirement        | Tested by running the application on localhost |
| 4.1.3 | The system shall visualize measured levels of air pollution using colors based on severity | The Map Module satisfies this requirement        | Tested by running the application on localhost |
| 4.1.4 | The system shall display a popup window upon clicking on a symbol on the map               | The Map Module satisfies this requirement        | Tested by running the application on localhost |
| 4.1.5 | The system shall remove the popup window upon clicking away from the info window           | The Map Module satisfies this requirement        | Tested by running the application on localhost |
| 4.1.6 | The system shall toggle on and off Feature Layers in the map                               | The Map Module satisfies this requirement        | Tested by running the application on localhost |
| 4.1.7 | The system shall retrieve data for air quality conditions                                  | The Conditions Module satisfies this requirement | Tested by running the application on localhost |



|        |                                                                  |                                                  |                                                |
|--------|------------------------------------------------------------------|--------------------------------------------------|------------------------------------------------|
| 4.1.8  | The system shall retrieve data for weather conditions            | The Conditions Module satisfies this requirement | Tested by running the application on localhost |
| 4.1.9  | The system shall display the weather conditions                  | The Conditions Module satisfies this requirement | Tested by running the application on localhost |
| 4.1.10 | The system shall display symbols based on the weather conditions | The Conditions Module satisfies this requirement | Tested by running the application on localhost |
| 4.1.11 | The system shall display information on air quality conditions   | The Graphs Module satisfies this requirement     | Tested by running the application on localhost |
| 4.1.12 | The system shall display information on air quality trends       | The Graphs Module satisfies this requirement     | Tested by running the application on localhost |
| 4.1.13 | The system shall retrieve news articles data                     | The Articles Module satisfies this requirement   | Tested by running the application on localhost |
| 4.1.14 | The system shall display news articles data                      | The Articles Module satisfies this requirement   | Tested by running the application on localhost |

## II. Air Pollution Personalized App

|        |                                                                                       |                                             |                                  |
|--------|---------------------------------------------------------------------------------------|---------------------------------------------|----------------------------------|
| 4.1.16 | The system shall allow you to login with an email and password                        | The Login Module satisfies this requirement | Enter a valid email and password |
| 4.1.17 | The system shall allow the user to type in their specified location into a search bar | The Map Module satisfies this requirement   | Use Search bar in Map Module     |

|        |                                                                                                   |                                                                      |                                                |
|--------|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------|
| 4.1.18 | The system shall display the specified location the user typed in on the map                      | The Map Module satisfies this requirement                            | Use Search bar in Map Module                   |
| 4.1.19 | The system shall retrieve data for Feature Layers from ArcGIS's Database                          | The Map Module satisfies this requirement                            | Login                                          |
| 4.1.20 | The system shall use the retrieved data to display information about the pollutants on the map    | The Map Module satisfies this requirement                            | Login                                          |
| 4.1.21 | The system shall allow the user to switch between different tabs for different information        | The Map,Dashboard,News, and Profile Modules satisfy this requirement | Use toolbar on the bottom to navigate each tab |
| 4.1.22 | The system shall allow the user to add cities in a dashboard to get more information on that city | The Dashboard Module satisfies this requirement                      | Use the plus on top right of the dashboard tab |
| 4.1.23 | The system shall allow the user to delete cities from the dashboard                               | The Dashboard Module satisfies this requirement                      | Use the x on the top right of each card        |
| 4.1.24 | The system shall display cards pertaining to the cities added into the dashboard                  | The Dashboard Module satisfies this requirement                      | Add a city into the dashboard                  |
| 4.1.25 | The system shall allow the user to search for another location while displaying the map           | The Map Module satisfies this requirement                            | Use Search Bar                                 |
| 4.1.26 | The system shall retrieve relevant news article data                                              | The News Module satisfies this requirement                           | Go to News Tab                                 |

|        |                                                                                    |                                               |                                                               |
|--------|------------------------------------------------------------------------------------|-----------------------------------------------|---------------------------------------------------------------|
| 4.1.27 | The system shall provide display links to the news article data                    | The News Module satisfies this requirement    | Go to News Tab                                                |
| 4.1.28 | The system shall pinpoint your location in the profile tab                         | The Profile Module satisfies this requirement | Go to Profile tab                                             |
| 4.1.29 | The system shall display a card that has extra information about your current city | The Profile Module satisfies this requirement | Go to Profile tab                                             |
| 4.1.30 | The system shall display a minimap of your city                                    | TheProfile Module satisfies this requirement  | Go to Profile tab                                             |
| 4.1.31 | The system shall allow you to log out from the profile tab                         | The Profile Module satisfies this requirement | Go to Profile tab and use log out on the top right of the tab |

## 11. Glossary

|                                |                                                                                                                                              |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>AIDSAPPV</b>                | Artificial Intelligence and Data Science for Air Pollution Prediction and Visualization                                                      |
| <b>Air Pollution</b>           | 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 |
| <b>API</b>                     | a computer interface that defines interactions between software immediaries                                                                  |
| <b>ArcGIS</b>                  | Esri's all-in-one solution to work with geographic information                                                                               |
| <b>Artificial Intelligence</b> | intelligence demonstrated by machines                                                                                                        |
| <b>Data Science</b>            | an interdisciplinary field that uses scientific methods, processes, algorithms, and systems to extract knowledge from data                   |
| <b>Feature Layer</b>           | a grouping of similar geographic features that are used for visualizing data                                                                 |
| <b>HTTPS</b>                   | application layer protocol that is used for secure communication over a computer network                                                     |
| <b>Machine Learning</b>        | an application of artificial intelligence that provides systems the ability to automatically learn and improve                               |
| <b>ReactJS</b>                 | an open source JavaScript library for building user interfaces                                                                               |
| <b>SDK</b>                     | collection of software development tools in one installable package                                                                          |

## 12. References

React Esri Documentation: <https://github.com/Esri/jsapi-resources>

ArcGIS JavaScript Documentation: <https://developers.arcgis.com/javascript/latest/>

CanvasJS Graphs Documentation: <https://canvasjs.com/>

ReactJS Documentation: <https://reactjs.org/docs/getting-started.html>

ArcGIS services: <https://doc.arcgis.com/en/>

ArcGIS Runtime SDK Reference <https://developers.arcgis.com/android/api-reference/reference/>

Android SDK: <https://developer.android.com/docs>