
Final Project Report

[Real-time Air Quality Dashboard]



Web Application Programming

Professor: Aich Satyabrata

Major: Mathematics

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Date: 2024.12.11 (Wed)

1. Introduction

- Project Overview

I created a Real-time Air Quality Dashboard to help users easily check air quality data and weather. The dashboard displays real-time information like temperature, humidity, and pollutant levels (PM2.5, PM10, NOx, NH3, etc.). I used HTML, CSS, and JavaScript to design a clean and easy-to-use interface. Additionally, I added charts using Chart.js to make the data more visual and understandable.

My main goal was to create a clear and intuitive UI that allows users to view multiple data points at a glance. While making changes or adding features, the code became more complex, leading to frequent errors. To address this, I prioritized ensuring the overall dashboard worked smoothly.

- GitHub Link: https://github.com/dubuuri/Web_Application.git

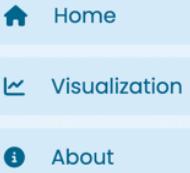
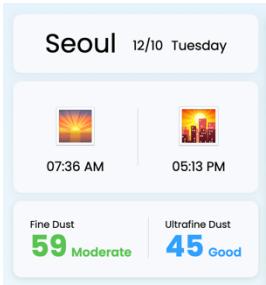
- Demo: https://dubuuri.github.io/Web_Application/Project

- Dashboard Overview

- 1) Home page

The page is divided into three main parts: Sidebar, Main-Content, and Footer.

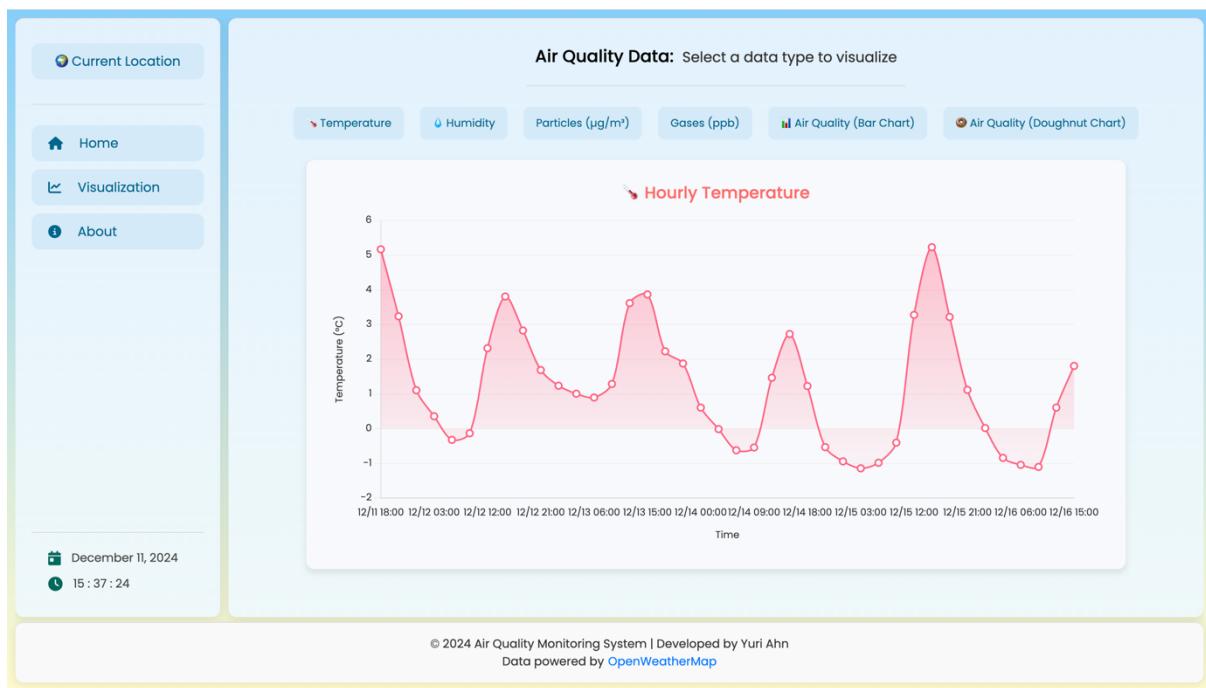
The screenshot shows the 'Welcome to the Air Quality Dashboard' page. On the left is a sidebar with 'Current Location' (dropdown), 'Home', 'Visualization', and 'About'. At the bottom are date/time (December 10, 2024, 21:38:54) and a 'Logout' button. The main content area has a header 'Welcome to the Air Quality Dashboard: Monitor real-time weather'. Below it is a message 'It's a sunny day! Perfect for a walk outside ☀️'. The central part shows 'Seoul 12/10 Tuesday' with icons for sunrise/sunset and a 7-day forecast. It also displays 'Fine Dust 59 Moderate' and 'Ultrafine Dust 45 Good'. To the right are sections for '1.8°C clear sky' (feels like -1.0°C, precipitation 0 mm, wind speed 2.57 m/s, direction 310°, humidity 69%, cloudiness 0%, pressure 1025 hPa) and 'Air Quality Data' (PM2.5 45.09 µg/m³, PM10 58.95 µg/m³, CO 600.82 µg/m³, NO 4.58 ppb, NO₂ 59.63 ppb, O₃ 5.23 ppb, SO₂ 28.61 ppb, NH₃ 3.26 ppb).

Sidebar	 Current Location	Current-Location: Gets the user's current location and displays the weather.																								
	 <ul style="list-style-type: none">  Home  Visualization  About 	Navigation bar: <ul style="list-style-type: none"> - Home: Main dashboard - Visualization: Charts for data - About page: Information about the data sources used in the dashboard 																								
	 <ul style="list-style-type: none">  December 10, 2024  21:38:54 	Date & Time: Feature updated time every second and allow users to see the current time and today's date in real-time.																								
Main Content	 <p>It's a sunny day! Perfect for a walk outside ☀️</p>	Weather Message Container: Displays a message based on the weather conditions in user's location.																								
	 <p>Seoul 12/10 Tuesday</p> <table border="0"> <tr> <td></td> <td></td> </tr> <tr> <td>07:36 AM</td> <td>05:13 PM</td> </tr> <tr> <td>Fine Dust</td> <td>Ultrafine Dust</td> </tr> <tr> <td>59 Moderate</td> <td>45 Good</td> </tr> </table>			07:36 AM	05:13 PM	Fine Dust	Ultrafine Dust	59 Moderate	45 Good	<ul style="list-style-type: none"> - City and Date Information: Displays the name of the current city and the date. - Sunrise and Sunset Information: Visually represents sunrise and sunset times with icons. - Air Quality Summary: Shows fine dust (PM10) and ultrafine dust (PM2.5) levels using colors to indicate the status. 																
																										
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Footer	<p>© 2024 Air Quality Monitoring System Developed by Yuri Ahn Data powered by OpenWeatherMap</p>																	

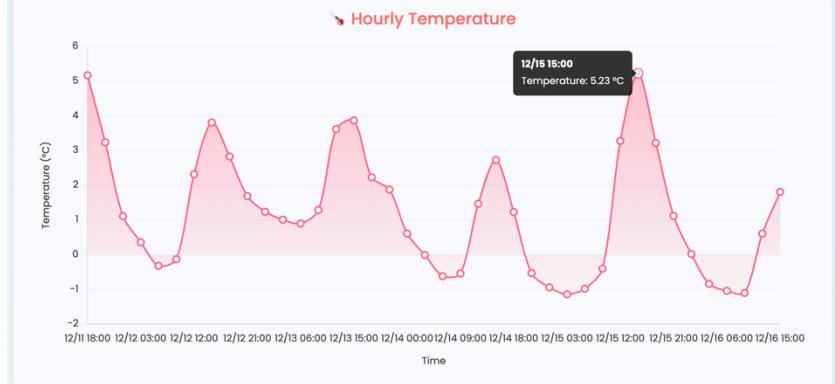
2) Visualization Page

On this page, you can view various charts (line, bar, and donut) visualizing the data.

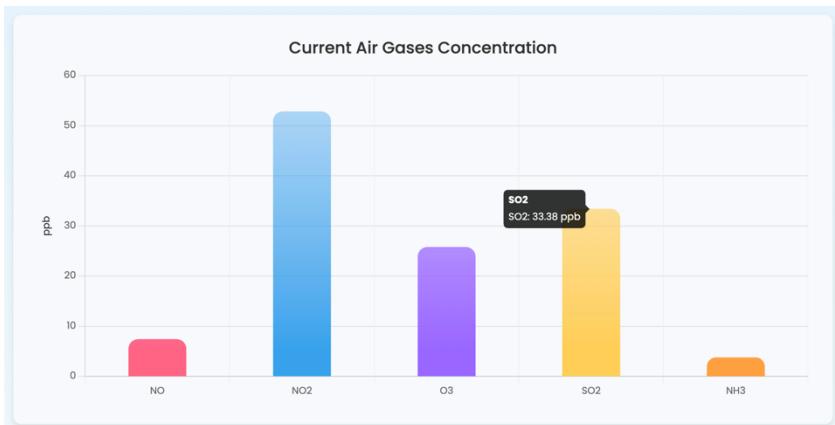


Buttons	<p>Temperature Humidity Particles ($\mu\text{g}/\text{m}^3$) Gases (ppb) Air Quality (Bar Chart) Air Quality (Doughnut Chart)</p> <p>Users can visualize data through charts by selecting the type or data.</p>
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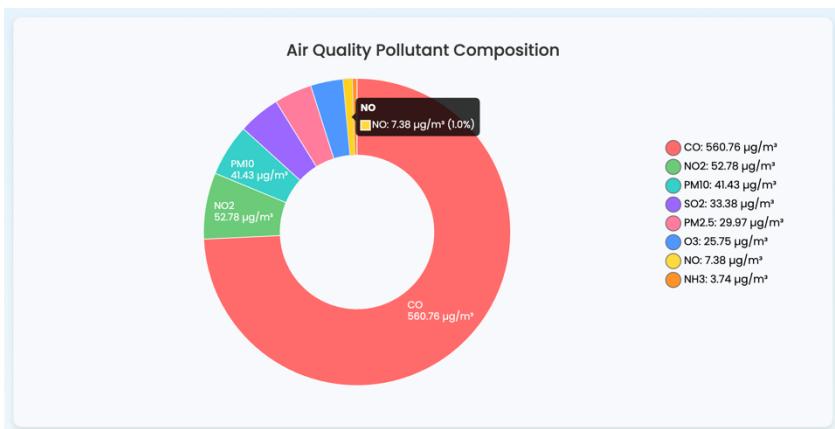
Visualize Charts



Temperature data for the next 5 days is displayed. Hover effects display detailed temperature and time information. This is same for the humidity chart.



Current air quality data is displayed. Since the data includes gas and particle, I made it into two charts. This is same to the other bar charts.



Air quality data is visualized as a donut chart to show the proportions of each element.

3) About Page

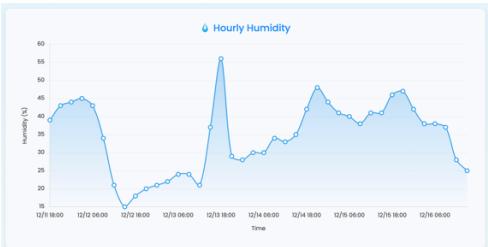
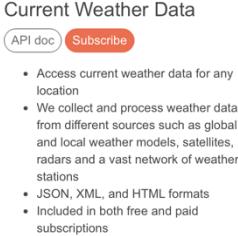
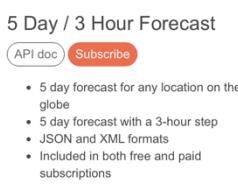
This page includes information about the data sources used in the dashboard.

The screenshot shows the 'About' page of the Air Quality Dashboard. On the left, there's a sidebar with navigation links: 'Current Location', 'Home', 'Visualization', and 'About'. Below the sidebar, the date and time are displayed: 'December 11, 2024' and '15:38:48'. The main content area has a title 'About the Air Quality Dashboard' followed by a brief description: 'This dashboard helps you check air quality and weather in real-time 🌄. It uses data from [OpenWeatherMap](#) to show you information about things like air pollution and weather conditions. The goal is to help you make better decisions for your health and stay aware of the environment around you 🌎.' Below this is a section titled 'Data Descriptions' which lists various pollutants with their chemical formulas and descriptions. At the bottom of the page, there's a copyright notice: '© 2024 Air Quality Monitoring System | Developed by Yuri Ahn' and 'Data powered by [OpenWeatherMap](#)'.

Data Descriptions
<p>CO Carbon Monoxide</p> <p>A colorless, odorless gas from vehicle exhaust and burning fuels that reduces oxygen flow, causing dizziness and headaches.</p>
<p>NO Nitric Oxide</p> <p>A gas produced by engines and industrial processes that can irritate the lungs, especially in people with asthma.</p>
<p>NO₂ Nitrogen Dioxide</p> <p>Formed from vehicle emissions and industrial sources, it aggravates asthma and decreases lung function.</p>
<p>O₃ Ozone</p> <p>A reactive gas formed when sunlight hits pollutants, worsening respiratory conditions like asthma.</p>
<p>SO₂ Sulfur Dioxide</p> <p>Released by burning coal and oil in power plants, it causes coughing, shortness of breath, and eye irritation.</p>
<p>NH₃ Ammonia</p> <p>Emitted from fertilizers and livestock waste, it can irritate the eyes, nose, and throat.</p>
<p>PM2.5 Ultrafine Dust</p> <p>Tiny particles from vehicles and industrial emissions that penetrate deep into lungs, increasing heart disease risk.</p>
<p>PM10 Fine Dust</p> <p>Larger particles from dust, pollen, and construction sites that can cause respiratory issues, especially in sensitive groups.</p>

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2. Software Tools & API used

Chart.js		Used to create responsive charts for visualizing data
Font Awesome		To provides icons to improve the design and make the data visually intuitive
Google Fonts (Poppins)	 <pre>* { margin: 0; padding: 0; box-sizing: border-box; font-family: 'Poppins', sans-serif; }</pre>	I used Poppins for better User Interface
HTML CSS JavaScript		HTML was used to structure the entire content, CSS to style the layout for UI, and JavaScript to add interactivity to the dashboard.
OpenWeatherMap API	 <p>Current Weather Data</p> <p>API doc Subscribe</p> <ul style="list-style-type: none"> Access current weather data for any location We collect and process weather data from different sources such as global and local weather models, satellites, radars and a vast network of weather stations JSON, XML, and HTML formats Included in both free and paid subscriptions 	Current Weather API was used to fetch and display real-time weather data.
	 <p>5 Day / 3 Hour Forecast</p> <p>API doc Subscribe</p> <ul style="list-style-type: none"> 5 day forecast for any location on the globe 5 day forecast with a 3-hour step JSON and XML formats Included in both free and paid subscriptions 	5 Day / 3 Hour Forecast API was used to show temperature and humidity over 5 days.
	 <p>Air Pollution API</p> <p>API doc Subscribe</p> <ul style="list-style-type: none"> Current, forecast and historical air pollution data Forecast for 4 days ahead with 1-hour step Air Pollution API includes both Air Quality Index and indices for CO, NO, NO₂, O₃, SO₂, NH₃, PM_{2.5}, PM₁₀ Included in both free and paid subscriptions 	Air Pollution API was used to display real-time air quality data.

3. Responsiveness

I moved the sidebar to the top and made the entire dashboard scrollable for easier navigation.

The dashboard is designed to be fully responsive, adapting its layout to different screen sizes. It features a top navigation bar with a sidebar icon, a search bar, and a refresh button. Below the navigation is a header section with the URL, time (21:43 or 21:44), signal strength, and battery level. The main content area is scrollable, containing various data visualizations and sections:

- Current Location:** Shows the location as "Current Location".
- Home:** A link to the main dashboard.
- Visualization:** A link to the data visualization section.
- About:** A link to the about section.
- Date and Time:** Displays "December 11, 2024" and "21:43:40".
- Welcome to the Air Quality Dashboard:** A welcome message with the subtext "Monitor real-time weather".
- Weather Forecast:** A message stating "It's a sunny day! Perfect for a walk".
- Air Quality Data:** A table showing real-time concentrations for PM2.5, PM10, CO, NO, NO₂, O₃, SO₂, and NH₃.

Parameter	Value
PM2.5	19.13 µg/m³
PM10	26.75 µg/m³
CO	600.82 µg/m³
NO	2.77 ppb
NO ₂	61.01 ppb
O ₃	8.23 ppb
SO ₂	64.85 ppb
NH ₃	5.57 ppb
- Copyright and Credits:** © 2024 Air Quality Monitoring System | Developed by Yuri Ahn | Data powered by OpenWeatherMap.
- Temperature:** A chart titled "Hourly Temperature" showing temperature fluctuations over time.
- Gases (ppb):** A chart titled "Current Air Gases Concentration" showing concentrations for NO, NO₂, O₃, SO₂, and NH₃ in ppb. A callout highlights SO₂ at 64.85 ppb.
- Bar Chart:** A chart titled "Air Quality (Bar Chart)" showing concentrations for various gases.
- Doughnut Chart:** A chart titled "Air Quality (Doughnut Chart)" showing the composition of air quality.
- Location Request:** A modal asking for permission to use the current location, explaining it's for better location-based services.
- About the Air Quality Dashboard:** A section explaining the purpose of the dashboard and its data source, OpenWeatherMap.
- Weather Summary:** A summary for Gijang, 12/11 Wednesday, showing sunrise/sunset times, dust levels (Fine Dust: 39 Good, Ultrafine Dust: 33 Good), temperature (5.9°C), feels-like (3.9 °C), precipitation (2.37 mm), wind speed (2.57 m/s), and wind direction (20 °).

4. What I did !



- In donut chart, by default, only the data with higher proportions are shown on the chart. When a label on the right is hidden, the corresponding data disappears from the chart, and the remaining data proportions are recalculated and displayed. If the label is made visible again, the data will reappear on the chart.



- Whenever I check fine dust levels on Naver, I found the way the text color changed based on the values looks very intuitive. Inspired by this, I implemented a similar approach by creating separate boxes for the most critical air quality data, PM10 and PM2.5. The values and status change color dynamically based on the measurements.



- When the user clicks the Current-Location button, it fetches weather data based on the user's location. Although I managed to make it work, the biggest challenge was resolving conflicts between this function and another one that triggered on page load using DOM content. Debugging this issue was the hardest part. I also wanted to allow users to select a location and display weather data for that area, but I couldn't implement that feature yet.

5. What I tried ...

1. API

I tried to use different APIs besides the OpenWeather API that I had been using before.

- BreezoMeter

I tried to use the BreezoMeter API to get air quality data, including VOC and CO2 levels.

To use this API, I needed to connect it to Google Maps, which required adding a payment method to my Google account. However, even after trying different cards, I couldn't complete the payment setup, so I wasn't able to use the API.

- RapidAPI

After failing with BreezoMeter, I tried again to find a way to get VOC and CO2 data. Even though there were various API platforms and plenty of weather data options, there were very few APIs for air quality data. Other than OpenWeather, which I was already using, and BreezoMeter, which I couldn't access, I couldn't find a suitable API to retrieve the data.

- KaKao Map API

I added a "Current Location" button to display the weather at the user's current location. However, while testing, I noticed that at school, the current location showed as Busan, but at home, it showed as Gijang, a farther area in Busan. I suspected this was due to an error in OpenWeather's longitude and latitude input. To solve this, I tried using the Kakao Map API to get the user's exact location. However, the Kakao API was too complicated to connect, and I couldn't use it successfully.

2. JS

- Current-Location

; Through the "Current Location" button in the sidebar, I aimed to retrieve the user's location and display the weather for that location. While I successfully fetched the weather data and updated all relevant information, the button only worked properly if pressed a few moments after the page had fully loaded. Sometimes it works well, but sometimes not and I couldn't find the reason why.

6. Conclusion

When I first started this project, I thought I could implement more features for the dashboard. I wanted to allow users to select a location on a map and display the weather and air quality data for that area. However, I realized that writing the code was much more complex than I thought. Even small overlaps in the logic caused immediate errors, making it a very delicate process.

But I feel that my understanding of HTML, CSS, and JavaScript has improved. Now, when I see UI/UX designs in everyday life, I start to notice areas that could be improved. Although there were many challenges and regrets, I'm proud that I persevered and completed the project.