Global Pollution Interface (GPI)

Written report for Advanced Web Technologies at Napier University. (second coursework)

Vazquez, Adrian 11/30/16 Advanced Web Technologies

Introduction

The objective of the project is to create a web application with python flask, in a learning environment Linux-based server set-up, called Levinux [1]. We must demonstrate a good level of building python flask applications, covering aspects such as routing, URL hierarchy design, static files, requests, templates, redirects, responses, sessions, logging, testing, CSS, JavaScript, multiple users, and data storage. I have also used other technologies such as JSON APIs, and AJAX.

All the source codes have been uploaded to a Git repository [2] where one can also find the developing process or "commits" that I updated during the project and where other developers can see helpful messages about the changes that I made in the codes. Moreover, this repository has a README file which explains how to set up the web application.

This is a web application which collect information from an API [3] called OpenAQ [4]. It collects data from agencies or governments from all over the world about pollution in their countries and cities. At this moment, there are 33 different countries and 4.450 cities with different pollution measurements listed and we can display these data in the web application.

There are different pollution measurements such as:

- PM2.5 [5]
- PM10 [6]
- Ozone (O3) [7]
- Sulfur dioxide (SO2) [8]
- Nitrogen dioxide (NO2) [9]
- Carbon monoxide (CO) [10]
- Black carbon (BC) [11]

The website briefly explains these elements, how they are produced and their impact on the population's health. Not all the cities have these measurements, there are some which just have one, others have most of them, and that depends on the agency or government which provides the data.

The APIs are limited to 1000 request. For that reason, the time span is limited to the last 1000 measurements which roughly cover the last two weeks.

A line chart displays these data where *x* represents the time, and *y* represents the value, depending on the measurement minimum and maximum. For the line chart, I use Morris.js [12], an API which generate the graphic wanted with a JavaScript call.

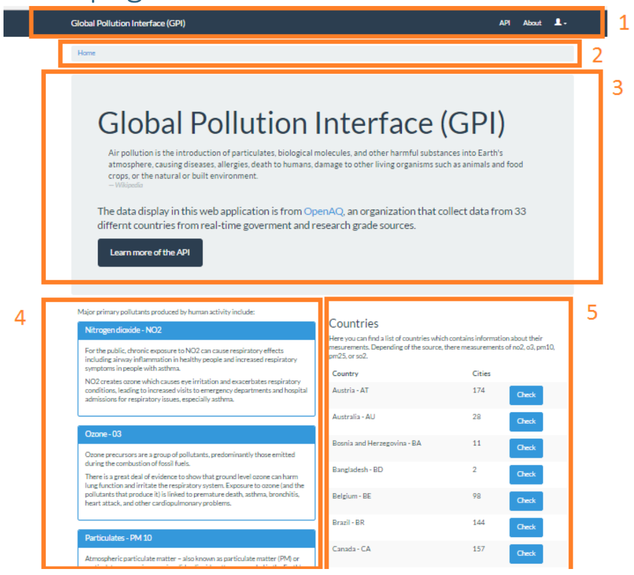
I have implemented a database for users, with which a user can register, log into the platform, and save their favourite locations.

Design

Although the information provided is the most important feature of the website, its design and interaction features are crucial for a positive user experience.

For this reason, I decided to use a Bootstrap framework [13] with which I can easily structure the content. For the colour, fonts and general aspects of the web I have chosen a theme [14], called "Flatly" [15]. I think this theme gives the web a serious aspect, a very clean layout, with very white spaces and consistency of the different elements such as buttons, links, tables throughout the website.

Home page



Global Pollution Interface (GPI)

Air pollution is the introduction of particulates, biological molecules, and other harmful substances into Earth's atmosphere, causing diseases, allergies, death to humans, damage to other living organisms such as animals and food crops, or the natural or built environment.
— Wikipedia

The data display in this web application is from OpenAQ, an organization that collect data from 33 differnt countries from real-time goverment and research grade sources.

Major primary pollutants produced by human activity include:

Nitrogen dioxide - NO2

For the public, chronic exposure to NO2 can cause respiratory effects including airway inflammation in healthy people and increased respiratory symptoms in people with asthma.

NO2 creates ozone which causes eye irritation and exacerbates respiratory conditions, leading to increased visits to emergency departments and hospital admissions for respiratory issues, especially asthma.

Ozone - 03

Ozone precursors are a group of pollutants, predominantly those emitted during the combustion of fossil fuels.

There is a great deal of evidence to show that ground level ozone can harm lung function and irritate the respiratory system. Exposure to ozone (and the pollutants that produce it) is linked to premature death, asthma, bronchitis, heart attack, and other cardiopulmonary problems.

Particulates - PM 10

Atmospheric particulate matter – also known as particulate matter (PM) or

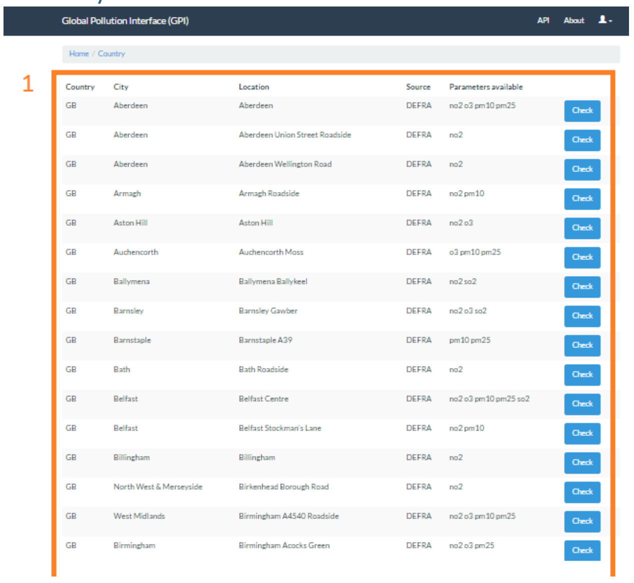
Countries

Here you can find a list of countries which contains information about their mesurements. Depending of the source, there measurements of no2, o3, pm10, pm25, or so2.

Country	Cities	
Austria - AT	174	Check
Australia - AU	28	Check
Bosnia and Herzegovina - BA	11	Check
Bangladesh - BD	2	Check
Belgium - BE	98	Check
Brazil - BR	144	Check
Canada - CA	157	Check

1. The navigation bar is fixed at the top of the window. The most common layout on the internet make the user aware of the different pages of the website.
2. A breadcrumb is a very useful element which informs the user on which page of the site is. It is separate from the navigation bar and the content.
3. This element tries to attract the attention of the user, and will inform him briefly what page is about.
4. A block containing information about the different pollution types, with a blue header that I use also for buttons and links.
5. The table of countries available.

Country

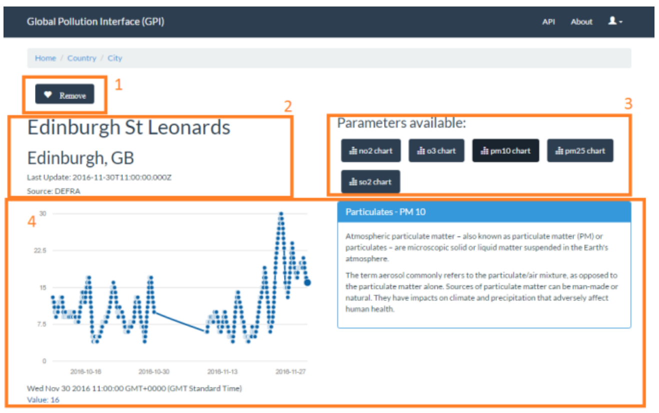


Country	City	Location	Source	Parameters available	
GB	Aberdeen	Aberdeen	DEFRA	no2 o3 pm10 pm25	Check
GB	Aberdeen	Aberdeen Union Street Roadside	DEFRA	no2	Check
GB	Aberdeen	Aberdeen Wellington Road	DEFRA	no2	Check
GB	Armagh	Armagh Roadside	DEFRA	no2 pm10	Check
GB	Aston Hill	Aston Hill	DEFRA	no2 o3	Check
GB	Auchencorth	Auchencorth Moss	DEFRA	o3 pm10 pm25	Check
GB	Ballymena	Ballymena Ballykeel	DEFRA	no2 so2	Check
GB	Barnsley	Barnsley Gawber	DEFRA	no2 o3 so2	Check
GB	Barnstaple	Barnstaple A39	DEFRA	pm10 pm25	Check
GB	Bath	Bath Roadside	DEFRA	no2	Check
GB	Belfast	Belfast Centre	DEFRA	no2 o3 pm10 pm25 so2	Check
GB	Belfast	Belfast Stockman's Lane	DEFRA	no2 pm10	Check
GB	Billingham	Billingham	DEFRA	no2	Check
GB	North West & Merseyside	Birkenhead Borough Road	DEFRA	no2	Check
GB	West Midlands	Birmingham A4540 Roadside	DEFRA	no2 o3 pm10 pm25	Check
GB	Birmingham	Birmingham Acocks Green	DEFRA	no2 o3 pm25	Check

1. This table contains the information related to the country chosen. To maintain the consistency throughout the site, all the tables have the same pattern.

   I could display more information, such as last updates, first readings, or the number of readings available. But it would be difficult for the user to read. Therefore I prioritized the most relevant aspects.

Location



Edinburgh St Leonards

Edinburgh, GB

Last Update: 2016-11-30T11:00:00.000Z

Source: DEFRA

Wed Nov 30 2016 11:00:00 GMT+0000 (GMT Standard Time)

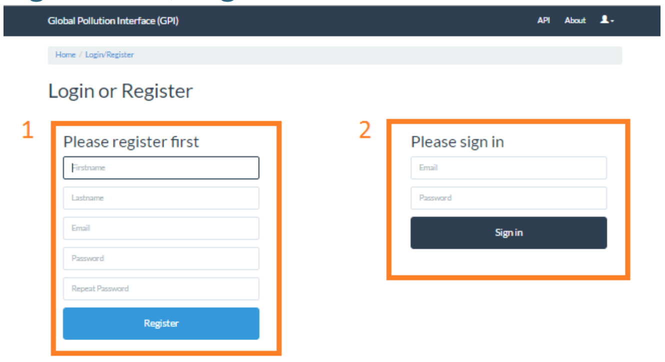
Value: 16

Atmospheric particulate matter – also known as particulate matter (PM) or particulates – are microscopic solid or liquid matter suspended in the Earth's atmosphere.

The term aerosol commonly refers to the particulate/air mixture, as opposed to the particulate matter alone. Sources of particulate matter can be man-made or natural. They have impacts on climate and precipitation that adversely affect human health.

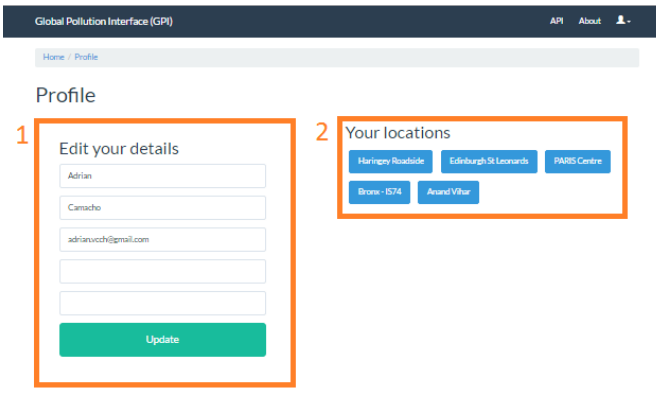
1. This is a button which will save the location for the user. It has a Glyphicon [16], of a heart which means "Favourites". If the heart is coloured, it means that the location was already added but if it is white, it can still be added.
2. The elements displayed in this part are the headers sorted by importance, which contain the location, city, country, last update, and source.
3. The parameters available also contain a Glyphicon which represents a line chart.
4. On the left the line chart has a darker blue and grey lines to determine the values range.

Registration/Login



1. The register and login form are on the same page to reduce the number of pages. On the left side, the user can see the register form which displays the name field required. It has a very bright to button to attract the attention of the visitor.
2. On the right side, it displays the login form. This distribution is because normally users pay more attention what on the top left, and they need to be register before login, therefore the next time the user need to log in will now the login form will be on the right.

Profile



Adrian

Camacho

adrian.vcch@gmail.com

1. The update form is consistent with the other forms on the website but has a different colour button, green, which is very common for updates.
2. The location panel, on the right, displays all the user´s favourites locations, and it has again a bright blue colour to attract the attention of the user.

Web structure

The web structure can be divided in three parts:

- Information pages
- API/Data
- Users

Information pages

/ about: The about page contain information related to this project, the purpose, objectives, link to the git repository and information about me.

/ api: The api page explains about the how I retrieved the information from this API, and informs about that organization.

/ 404: This is a custom error page and it triggers when a page is not found.

/ 401: The is a custom error page and it is display when a user does not have permission to see that page.

API/Data

/ index: The landing page, contains an introduction to the website, the measurements that you can see on the website and a table with the countries, the number of cities available and the button which will send you to the country chosen.

/ country: This page contains a list of cities of the country chosen. It displays the country, the city, the location (a city can have different locations) the agency source of the measurements and the pollution parameters available for that location.

/ city: This page has four different parts:

- At the top, we can see a button where the user can save the location if he is logged in or the question ***"Do you want to add it to your favourites? Register here."*** If he is not logged in.
- On the left one can find information about chose location such as its name, city, country, last update of the measurements and the source.
- Buttons are displayed on the right, depending on the available parameters.
- The fourth part of the page where the user can see a line chart with the values represented as points on the left and a small brief explaining of the pollution particles on the right.

Users

/ login: The login page contains two parts: One for registration, and another for login.

Registration form, anyone can register, the user needs to fill in the form which requires the user´s first name, last name, email, password and repeat the password. There are security measurements to complete the register correctly, for instance, if the user does not type an email or the password does not match, we will see an error message and what caused the problem.

Login form will check if the username is in the database, if this is correct and the password provided is correct too, it will redirect the user to their profile page.

/ profile: The profile page has two parts: On the left, we can see a form to update the user details. These details can be updated, it works like the registration form. The user has to provide his email and a matching password. On the right side, it will display all the locations saved for that user. These locations buttons provide direct links to them.

/ logout: This page will redirect the user to the landing page, it will clear the session which will log the user out.

Enhancements

Although, most of the objectives of web applications are covered, there are a few improvements I would like to add.

I think I should create a better structure for the web, for example: ***/GB/Edinburgh/Edinburgh St Leonards*** instead of ***/country***, and ***/city***.

Also, the favourite features do not work well because they do not change the text between ***"Add"*** and ***"Remove"*** .

I would like to improve the info or error messages, when for instance, the user logs in wrong, or the passwords do not match, because now it is attached to the navigation bar and I think it would be better placed below the breadcrumbs and before the content.

There are two major improvements if I had had the time to research the right solutions I would have chosen a different colour for different types of measures such as, red for CO or yellow for PM2.5 and a scale of minimum/maximum for each one of the measurements, which now it does display just for PM2.5.

Personal evaluation

In my opinion, the objectives of the module have been covered. I have understood very well how to build web applications with python flask, how to use routing, URL hierarchy design, static files, requests, templates, redirects, responses, sessions, logging, testing, CSS, JavaScript, multiple users, and data storage.

Furthermore, I have learned or improved new technologies such as JSON APIs, and AJAX. Researching a good API service that provide the data that I wanted was very difficult, and it was even harder to understand how to gather this information with python [17]. I had to learn how to retrieve this data on JavaScript using AJAX objects to use it with Morrison.js which displays the line chart.

Learning and developing these elements was the most time-consuming aspect of this project.

I believe that I improved my coding abilities, and my time management which is reflected in this project and its report.

Resources and references

A summary of resources used and a list of references

References

1. http://levinux.com/#1
2. https://github.com/thetwentyseven/GPI
3. https://en.wikipedia.org/wiki/Application_programming_interface
4. https://docs.openaq.org/
5. http://laqm.defra.gov.uk/public-health/pm25.html
6. https://www.quora.com/What-is-the-difference-between-PM2-5-and-PM10-with-respect-to-the-atmospheric-pollutants
7. https://diamondenv.wordpress.com/2010/12/10/particulate-pollution-pm10-and-pm2-5/
8. https://www.epa.gov/so2-pollution
9. https://www.environment.gov.au/protection/publications/factsheet-nitrogen-dioxide-no2
10. http://www.nhs.uk/Conditions/Carbon-monoxide-poisoning/Pages/Introduction.aspx
11. http://www.euro.who.int/__data/assets/pdf_file/0004/162535/e96541.pdf
12. http://morrisjs.github.io/morris.js/lines.html
13. https://getbootstrap.com/
14. https://bootswatch.com/
15. https://bootswatch.com/flatly/
16. http://glyphicons.com/
17. http://stackoverflow.com/questions/40663186/create-in-python-a-dictionary-from-json-url

Resources:

Stackoverflow: http://stackoverflow.com/

Teaching materials: http://siwells.github.io/teaching_set09103/

Flask documentation: flask.pocoo.org/

WinSCP: https://winscp.net/eng/index.php

DB Browser for SQLite: http://sqlitebrowser.org/

SQLite3: https://sqlite.org/