San Diego Global Knowledge University

Full Stack Development Immersive

Competency Report

120

Air Monitor System

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This document is the final project of 120 in the Full Stack Development Immersive program.

Project Description
This system allows you to keep track of temperature, humidity, ambient pressure, pm2.5 and pm10 measurements in your city or area of interest, through multiple sensors distributed throughout the city of Mexicali, Baja California, México. The system allows any user to visualize the current measurements everytime they visit the site, however, the system's purpose is to aid air pollution researchers by having the ability to access annual, monthly and daily data so they can analyze air quality behavior with those variables (temperature, humidity, ambient pressure, pm2.5 and pm10). In addition, they can see the graphical geolocation of the sensors and the average measurements on them.

Raw data, geolocation and a list of active sensors can be provided to researchers. Measurements can be filtered for a given time frame, providing flexibility in data management.

Finally, the system has an administrator user, responsible of managing (registering) the sensors, update the information collected by the sensors through csv files (stored in the folder data.csv 2020.csv, 2021.csv and 2022.csv) For testing purposes 2020 and 2022 data were randomly generated.

The functionality (what works and what doesn't).
The system complies with the loading of csv files, the CRUD of the sensors, the validation of users (administrator, researcher and anonymous); generates the mapping of the sensors and displays data according to the selected period, displays the data in tabular form also filtered by time periods.

The home screen shows the average measurements of the current date. For temperature, PM2.5 and PM10 it uses a color scheme according to the levels (dangerous or normal).

The graphs section displays information for the year 2021 (the option to change years has not been implemented) and allows data to be filtered such period, either by a specific time or

averaged by day, month or year. The option to zoom in and out by dragging the cursor across the desired area or by using the mouse wheel has been implemented. The functions of the "measurements" app have yet to be migrated to classes.

Some validations, for example if the database is empty the graphs page crashes. This is validated in the sensor map, the main page and the table but not in the graphs. The Change password option is not functional, the email part was not configured

Technologies used
crispy-bootstrap5==0.7   Django==4.1.2   django-admin-rangefilter==0.9.0 django-crispy-forms==1.14.0 django-import-export==2.9.0 folium==0.13.0 Jinja2==3.1.2 numpy==1.23.3 pandas==1.5.0 Python 3.8.10 Javascript Graph.js==3.1

The steps to run the project
The main menu consists of Home, Graphs, Maps, Maps, Tables, Sensors and Login.

Home:
It is the main page and has information about the measurements of the indicators of the current date.

Graphs:
Allows you to view the graphs, with the selection of period, which can be daily, i.e. all the average daily measurements during the year; monthly, the average monthly measurements of the year; and finally annual, the average annual measurements of all the years. Additionally, at the bottom you can select a specific period of dates, the filter button is to expand the selected period and the reset button is to return to the daily measurements of the whole year. A relevant point is that you can also zoom by selecting with the mouse a specific area of the graph, the reset button will restore the original graph.

Maps:
In this section a map is displayed indicating the points where the sensors are located, by clicking on them you can see the average information of each indicator of that sensor. You can select whether the information is annual (indicating the desired year), monthly (indicating year and month) and finally daily (indicating the specific day).

Tables:
This option displays in tabular form the complete information,

without averaging filter, for a period of time. This can be a whole year, a single month or a particular day.

Sensor:
This option has a submenu:

upload information:
Allows to upload the information collected by the sensors, only the administrator user.

List Sensor:
Displays the information of the sensors, only research users and administrators can see them, and only the latter can edit or delete them.

New Sensor: Allows the administrator user to create new sensors.
Login has several options:
Login:
Allows the authorized user to register in the system to log in

Logout:
Allows to end the session

Change password:
Allows you to change the user's password

Singup:
Allows anyone to create an account, however that account does not have any additional access, the administrator will be the one who assigns the privileges of researcher or in his case of administrator

The home page of the project is shown in Figure 1. Temperature, humidity, pressure, PM2.5 and PM10 are displayed as well as a brief description of what PM2.5 and PM10 are.
The color scheme of information boxes are dynamically colored according to the level of threat (or lack thereof) of the variables.

Figure 1 Home Page

The navigation bar shown in Figure 1 illustrates several options that the web application offers.
One such option is the graph section. Figure 2 provides graphical information of the average measurement (seconds and hours will be implemented in another revision) of the variables discussed earlier in the document.
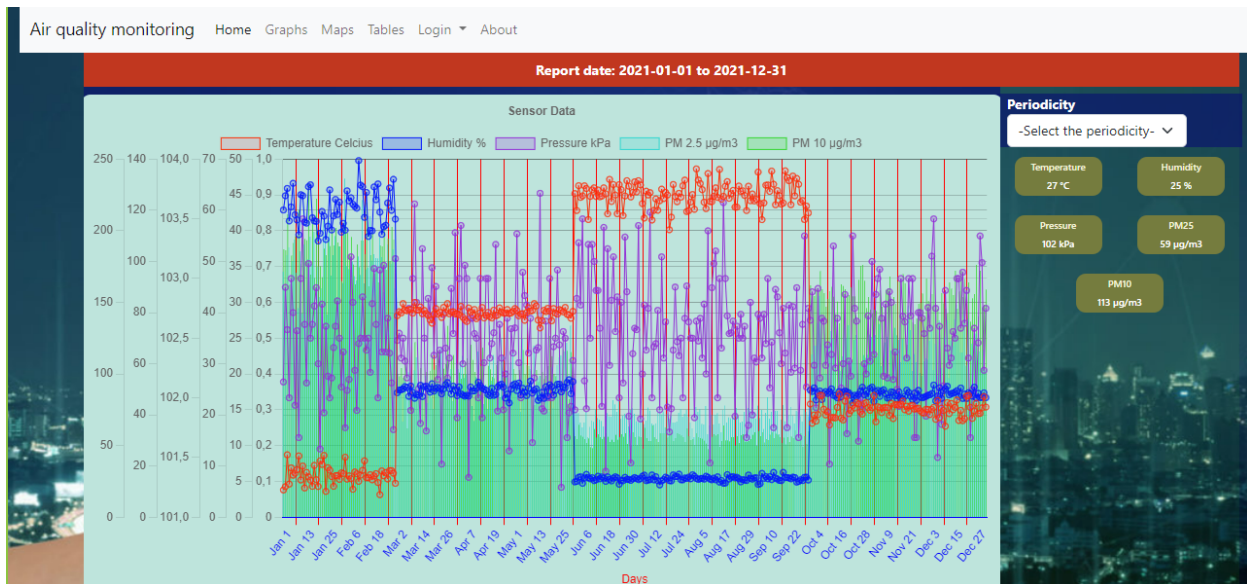
Figure 2 Graphs Section

The graphical section has an option by which the user can activate or deactivate several measured variables. Figure 3 provides such behavior, as the only graphed variables are Temperature and PM10.
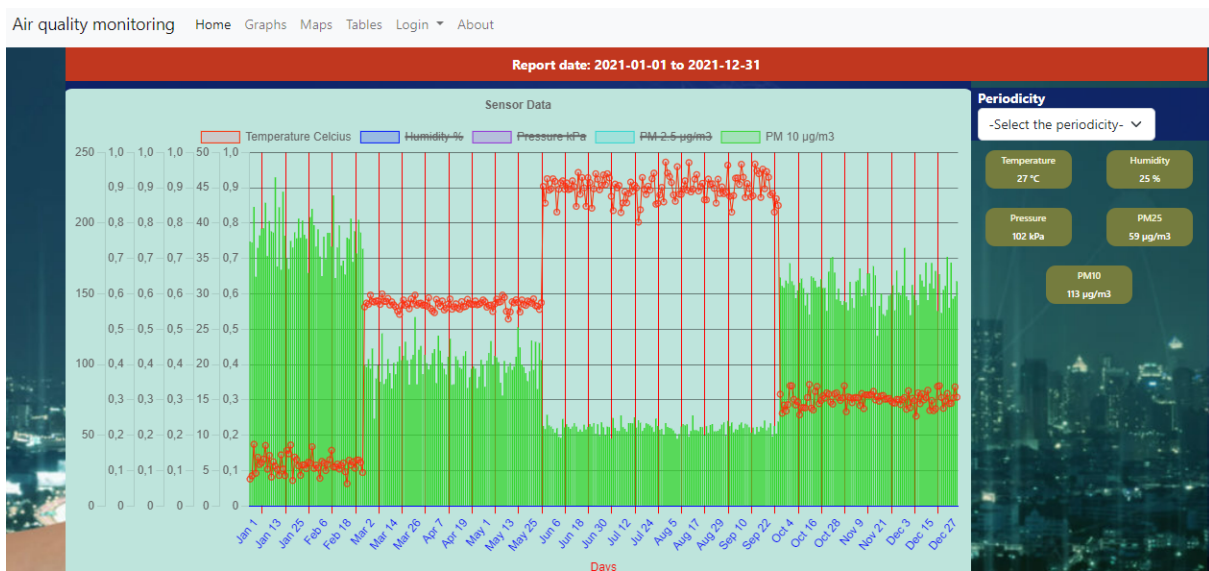
Figure 3 Graph section with only two variables

In the same graphical section, if the user hovers the mouse pointer over the graph area, it will provide a window with the relevant data regarding such point. Figure 4 illustrate such action.
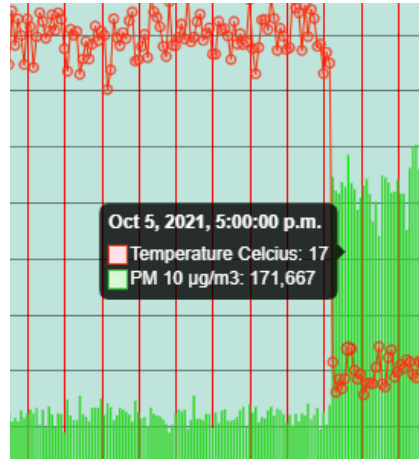
Figure 4 Detailed information of data in the graph

If the user has the mouse pointer within the graphical area, and if the mouse has a wheel, the user can use the wheel to zoom in and out within the graph. The user can also use the left mouse button to zoom into an area by dragging the pointer towards the section. If the user is using a laptop with a touch screen (or smartphone), the option of zooming in and out can be achieved by using two fingers. Although these functions are difficult to present in a document, figure 5 provides the action of zooming in using the mouse wheel.
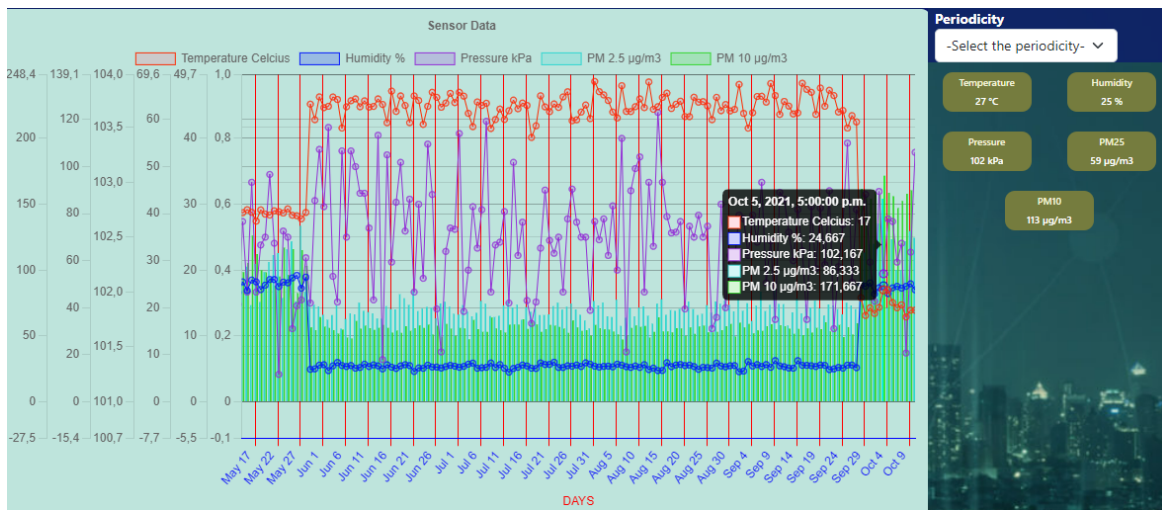
Figure 5 Zooming into the graph using the mouse wheel

The application also has the option of presenting the information by year, month, week and day. Figure 6 shows the monthly average measurements of 2021.
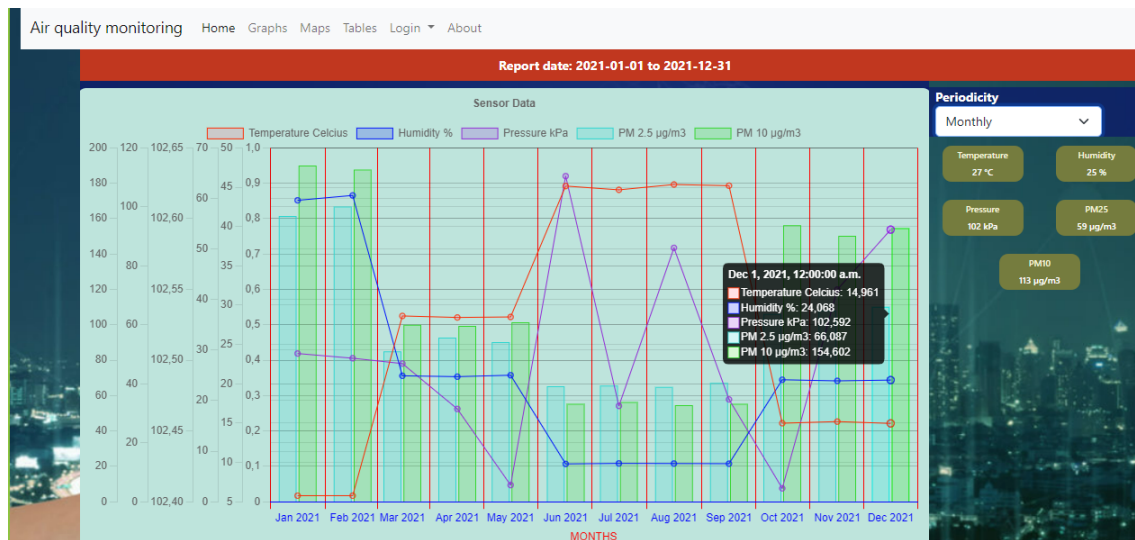
Figure 6 Monthly measurements

The user can use a date filter (initial and final) to focus on a particular time frame. Figure 7 shows the option of such filter and Figure 8 illustrates the result.
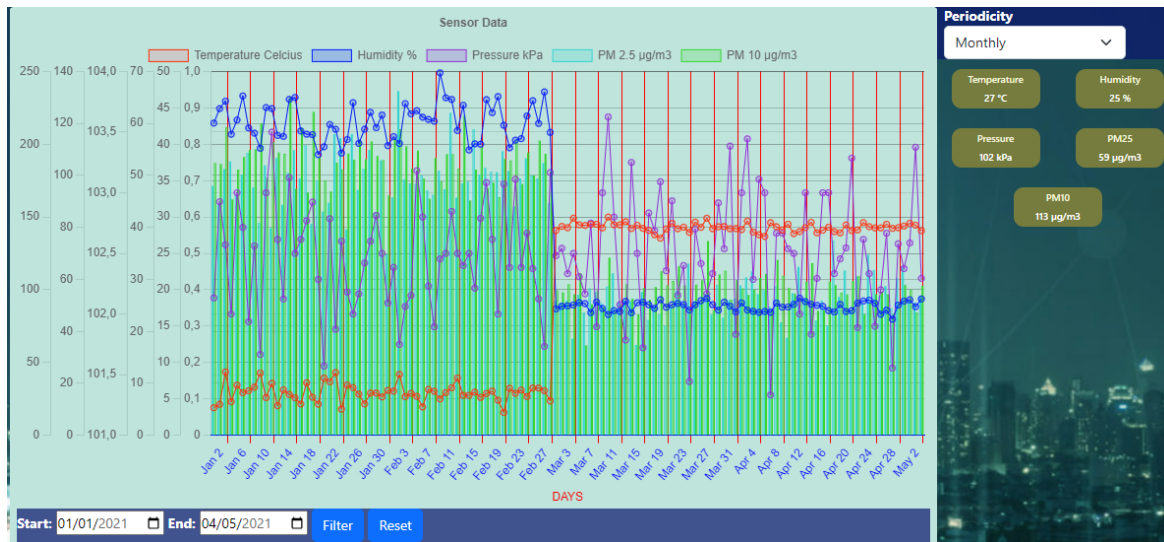

Figure 7 Filter option been used

Figure 8 Filter data shown in graph

Since the application is intended to gather environmental data from several sensors deployed across the city, and such sensors are equipped with a geolocator, an option is implemented within the application to provide such location via a map. The resolution of the onboard GPS is in tenth of a meter, therefore the same resolution is applied to the application. Figure 9 shows the maps page. Data from three sensors is loaded into the application, but those were stationary, hence the lack of trajectory trace.
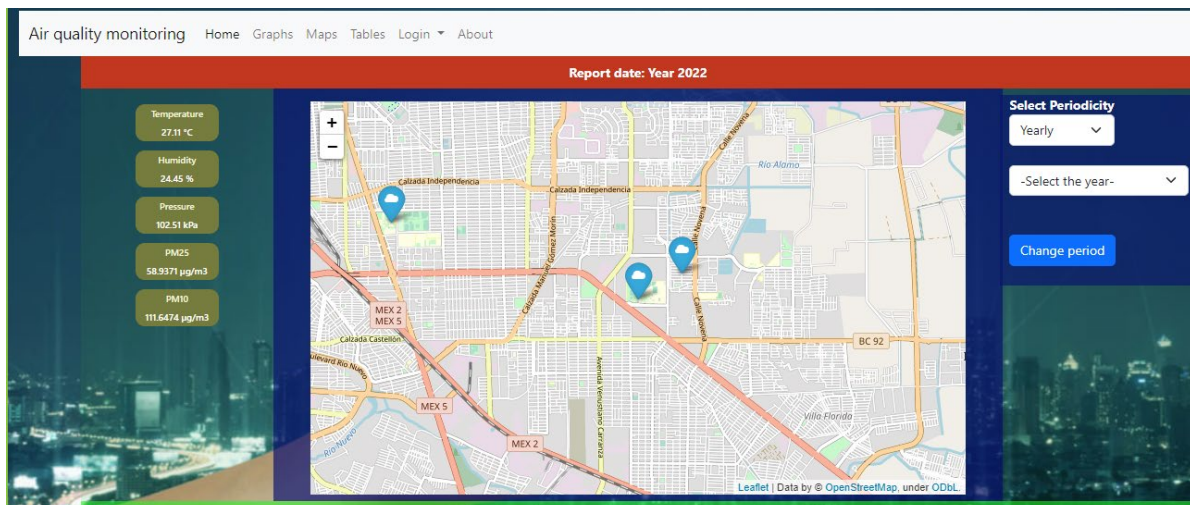
Figure 9 Sensors geolocation in a map

If the user selects a sensor, as shown in figure 10, the application will provide the name (id) of the sensor as well as relevant information regarding its measurements.

Figure 10 Geolocation and sensor data

The graphical information shown in Figures 2 through 8 is depicted in a table format when the user selects the Tables option in the application. Figure 11 provides such information filtered by year. Data can be filtered by month and daily as well.

Figure 11 Yearly data from sensors in a Table format

Since this application is intended to be an information hub for several environmental sensors, the administrator can register individual sensors with specific Ids. Researchers can also register to access historical and live data (when this feature gets implemented). Figure 12 shows the login and signUp page.
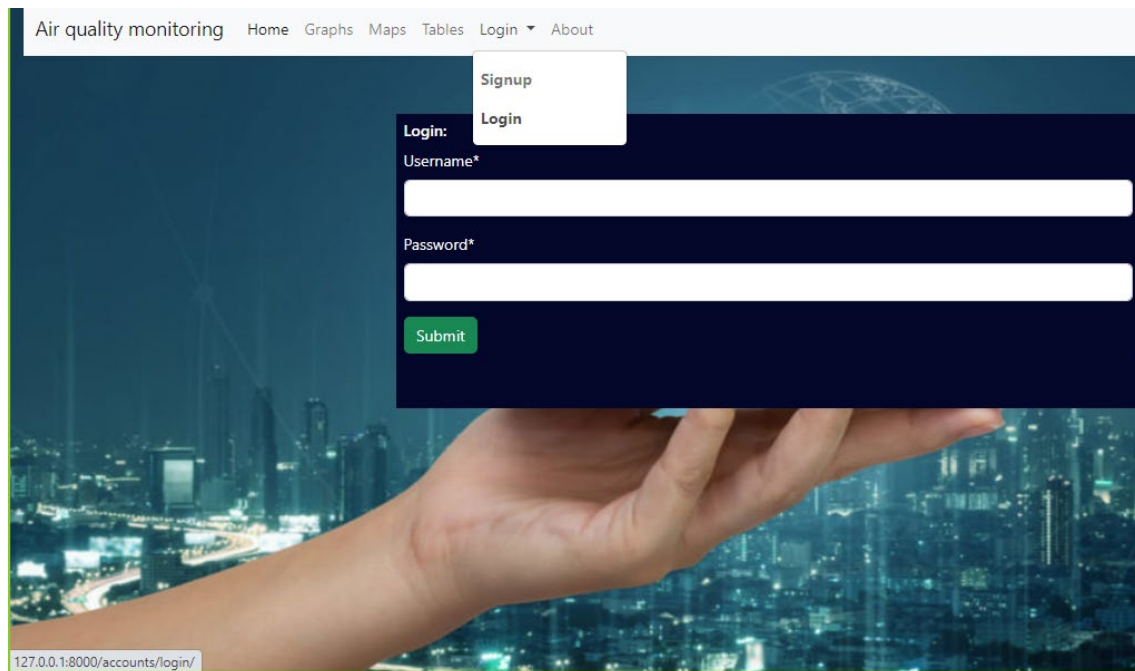
Figure 12 Login and SignUp pages

By login in as an administrator, the navigation bar provides another page reserved only for the administrator called "sensors". Such option can be seen in Figure 13.
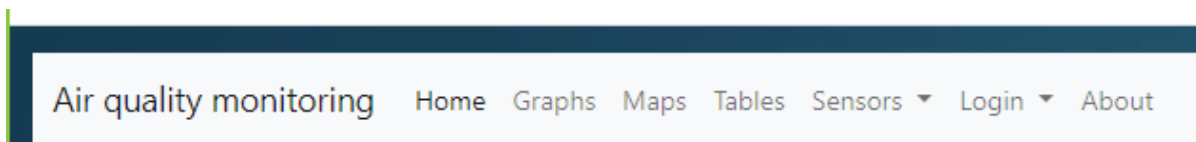
Figure 13 Administrator view (sensors option)

Figure 14 shows the page in which the administrator will register such sensors. This is done in the Sensors page. The tag IdSensor will be provided by the monitor itself or, it can be overwritten by the administrator to best accommodate the database.

Figure 14 Admin page for new sensor registration

Once the sensor is registered, the administrator can see the list of sensors that can be accessed. Figure 15 provides the administrator's page by which the data from the sensors can be shown in the graph and table pages.
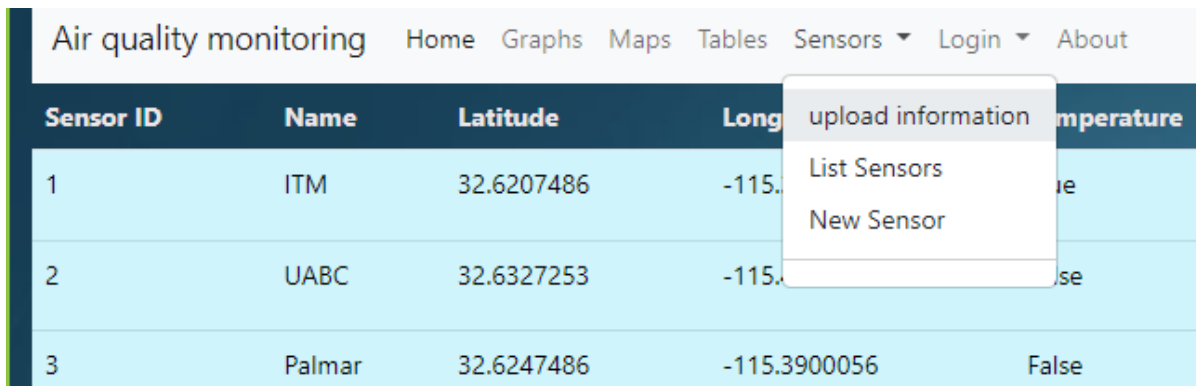

Sensor ID	Name	Latitude	Longitude	Temperature	Humidity	Pression	PM25	PM10	Actions	
1	ITM	32.6207486	-115.3982056	True	True	True	True	True	Edit	Delete
2	UABC	32.6327253	-115.4440380	False	False	False	False	False	Edit	Delete
3	Palmar	32.6247486	-115.3900056	False	False	False	False	False	Edit	Delete
333	22	0.0000000	0.0000000	False	False	False	False	False	Edit	Delete

Figure 15 Admin list sensor page

Finally, the sensors page has an option used by the administrator to load data gathered from the sensors. This option is what currently is been used since the actual deployment of the environmental sensor network has not been launched yet. This also provides an opportunity for other type

of environmental sensors to just upload (via the administrator) their data file and contribute to the overall goal of environmental monitoring. This is shown in Figure 16.

Figure 16 Upload sensor data option

Later revisions will introduce live stream of sensor data.

The project is been kept in github:
https://github.com/Carlos-Castellanos/airmonitor