Human Computer Interaction and Information Visualization

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Project Documentation

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1. Analysis, Representation and Presentation

1.1. Theme definition

The goal of the given assignment is to provide three different tools for the visualization of environmental data, with a particular stress on general weather and air pollution values, collected through a network of stations located on the territory of Venice and its surroundings and/or using a series of satellites. A future upgrade of the tools is to enlarge the area of interest covered by the application.

The tools are:

1. An information visualization tool designed like an application for smartphone/smartwatch, that will allow the user to access the environmental data of the single station placed near to the user (current data and historical data) and to offer some kind of comparison with the other stations;
2. An information visualization tool for the end users, designed as an ambient display to be delivered in a public space;
3. An information visualization tool designed like an application for large tablets or desktop/laptop computers, that will allow back-end technical staff to access the data with different levels of granularity in order to:
    a. Monitoring the status of air pollution;
    b. Identifying patterns and possible relations between CO_2 and the other environmental variables monitored by the system.

1.2. Competitive Analysis

As a first step of our analysis we tried to retrieve some scientific papers about this topic, but without finding any relevant result. Then we tried to find some real tools which treat these arguments. Even though we haven't found any solution that deals with all the variables we have to take into account, we discovered some applications that represent the data with interesting approaches.

1.2.1. Smartphone/Smartwatch Applications

Within the App Store or the Play Store there is a huge availability of air monitoring applications for general public. Below we present some screenshots of the most interesting representation we have found.

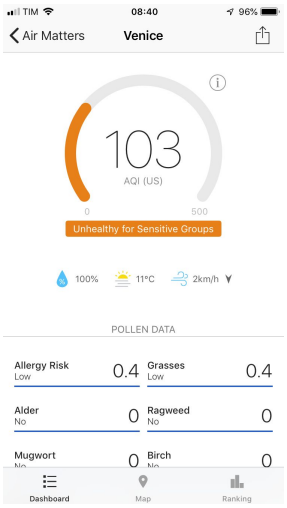

Figure 1 - Overview of the weather and air pollution

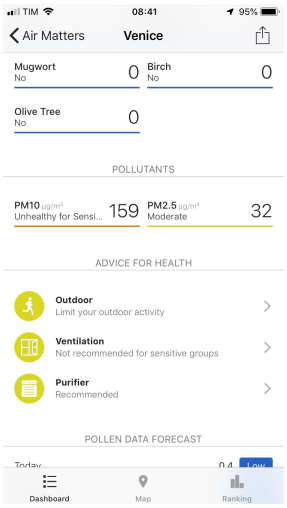

Figure 2 - Air pollution info and advices

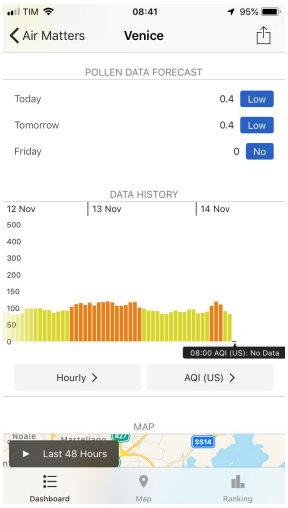

Figure 3 - Data history and forecast

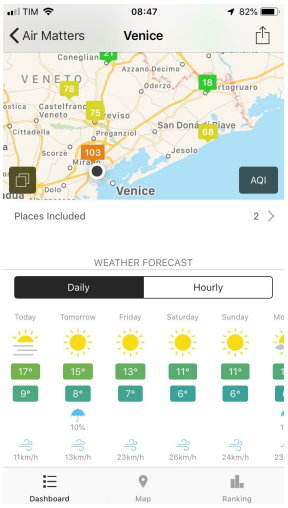

Figure 4 - Map with different stations/clusters and weather forecast

From the '**Air Matters**' application we have taken a lot of inspirations. From 'Figure 1' we've found interesting the use of the colors to show the quality of the air (AQI: Air Quality Index) related to a particular station and the presence of other useful informations like the current humidity, temperature, wind speed and pollens, that continues in 'Figure 2', with air pollutants and some advices. In 'Figure 3' we can see the forecast for the pollens and an historical representation, thanks to a simple bar graph, about various variables, visible one at a time, selectable through a pop-up modal. We think that, for us, this type of representation is not so good since we want/need to show more than one variables at a time. Finally, visible in the 'Figure 4', the app offers an interactive map showing all the available stations (selectable), using a clustering system, and the future forecast weather info (Min/max temperature, wind speed, ...) adopting the iconic and the 'color-based' representations.

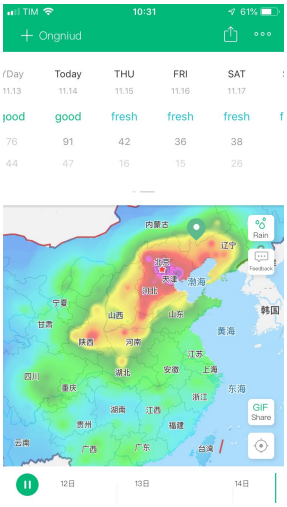

Figure 5 - Geographical air pollution map

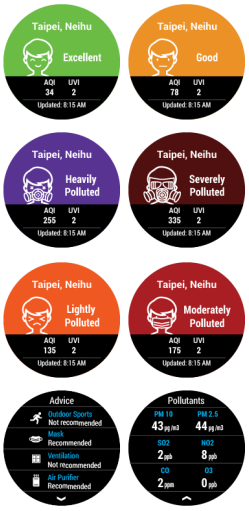

Figure 6 - Air quality smartwatch app

From the '**ColorfulClouds Weather**' application (Figure 5) we've found very interesting the idea of using a 'live' colored pollution map for an easy and fast overview of the current air situation, even though this will not be a perfect solution for us since we have more than one quantitative variable to represent, but with some adjustment it could be very effective.
Lastly, in the 'Figure 6', we can see some smartwatch '**Garmin Air**' app screenshots, in which we can appreciate a good tradeoff between the small screen dimension of the device and the good amount of info that we want to show to the end-users.

1.2.2. Desktop Applications

As in the case of Smartphone apps, we have found some non-technical solutions, dedicated to a general public, while we did not succeed in finding back-end technical tools for professional purposes. Below, there are some of the solutions from which we take some hints used even to developed the other tools, however, we will develop a more sophisticated technical interface, since our target is a technical public.

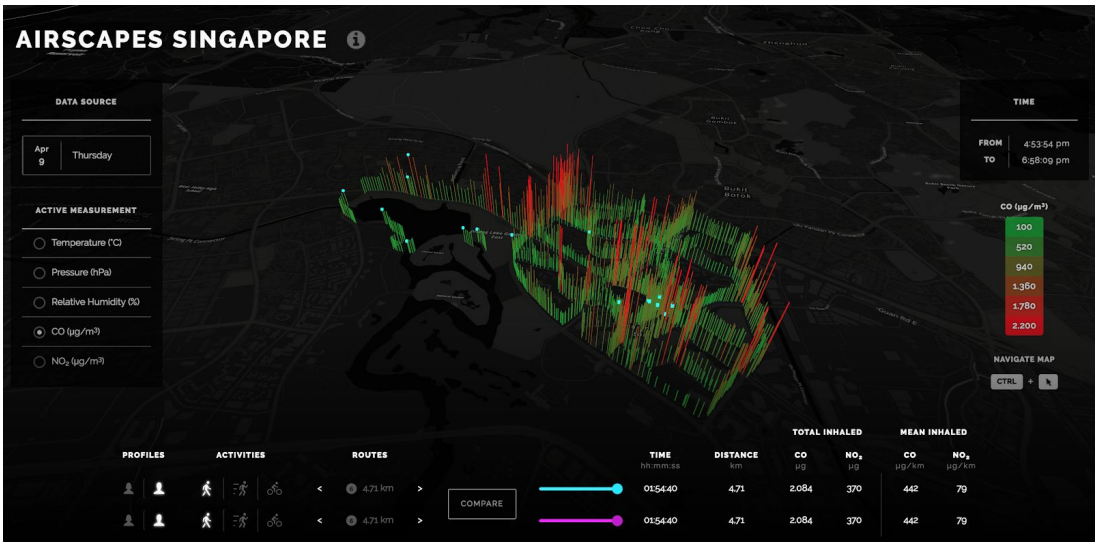

Figure 7 - Interactive 3D maps that provides personalized air pollution exposure metrics

The **Airscapes Singapore** website (Figure 7) uses a very interesting and particular representation, it takes the crowd-sourced environmental data from a network of sensors and it augmented they to provide a personalized air pollution exposure metrics. In this way, the people are able to see, in a different style, how their urban experiences (walking, jogging, cycling) may impact their exposure in real-time.

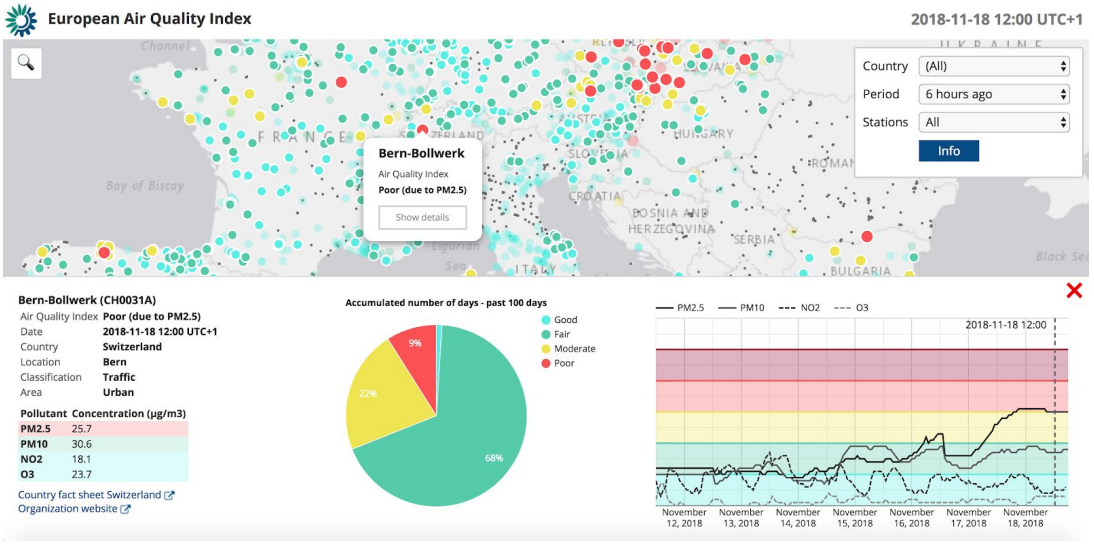

Figure 8 - Some live charts data

In the ‘Figure 8’, the **European Air Quality Index** website uses a solution to the problem of showing how variables change during time. This representation becomes useful for our goal too, even though in our case we will have more line charts and instead of comparing only different variables we will compare also the same variable among multiple stations.

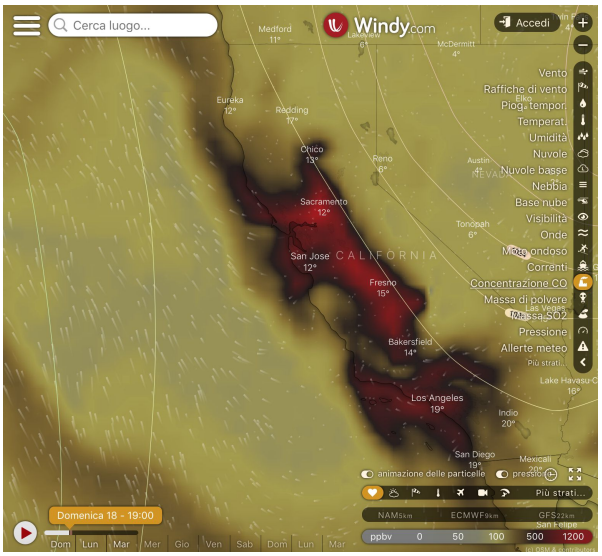

Figure 9 - Air quality distribution

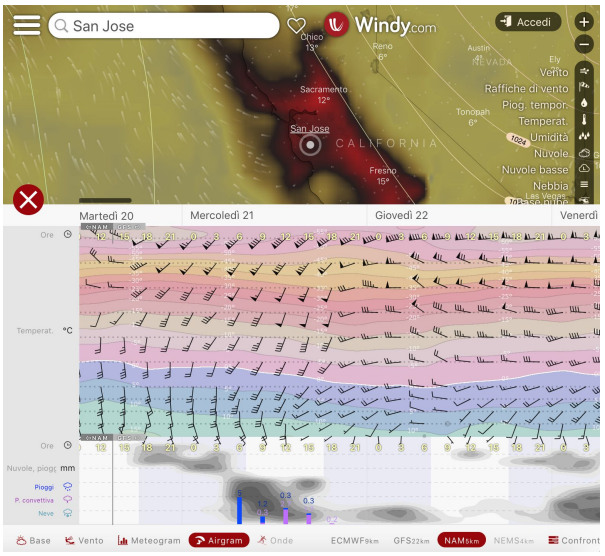

Figure 10 - Air quality info (single station)

Lastly, in the **Windy** website (Figure 9), we can appreciate a very effective representation of the air quality, because it’s easy to understand and it’s immediate to see the differences between different areas thanks to the use of a ‘color-based’ map representation. In particular it uses a live map in which the user can choose, and so visualize, informations from a wide selection of parameters (CO_2, live wind flow, humidity, …) in order to compare them with each other.
While when you choose a specific station you will get some charts (Figure 10) in which you can see a more detailed data history and other useful informations.

1.3. Dataset and requirements definition

All of the three tools will deal with the same data, collected through a series of station, except for the desktop one that integrates and expand those informations using the data retrieved by a series of satellites, so in this case we will have a fully mapped representation without blank spots. The variables that will be collected by the sensors and that we will take into consideration can be divided into two categories: dynamic variables that changes in time and static variables that remains always the same within a single station.

Dynamic variables

- CO_2 (ppm)
- Air Humidity (percentage %)
- Luminosity (klx)
- Wind speed and direction (Km/h)
- Time (hour/season)
- Pressure (hPa)
- Rain (mm)
- Temperature (°C)

Static variables

- Location (latitude and longitude)

Location features

- Height (meters above sea level)
- Type of soil (Terrain, Asphalted, Sandy/Rocky/Boggy Ground)
- Type of surrounding environment:
    - **Urban areas**: This type of areas are characterized for having more than 15000 residents. Each of the agglomeration consists of a core urban area, which is the divided into an inner and outer urban area. Surrounding the core urban area is a peri-urban area.

        1. Inner urban area: A compact and densely built area with continuous development;
        2. Outer urban area: A dense urban area extending from the boundary of the inner urban area to the outer edge of the continuous built area;
        3. Peri-urban area: A part of the intermediate zone between urban and rural, which is directly linked to an urban area.

    - **Rural areas**: Different rural types are delineated for the areas that have not been identified as urban. The boundary between urban and rural areas is not unambiguous and for that reason the classification framework has been designed to be flexible.

        1. Rural areas close to urban areas: Areas with a rural character that are functionally connected and close to urban areas;
        2. Rural heartland areas: Rural areas with intensive land use;
        3. Sparsely populated rural areas: Most of the land areas are forested.

All data are related to a single station and we assume that each station collects data on an hourly basis.
There are two different type of target users for our tools:

- General users with non technical knowledge, that will use primarily the smartphone/smartwatch app and the ambient display to consult the data;
- Back-end staff with technical knowledge, that will mainly use the desktop application, and sometimes the smartphone app too.

In selecting the representations used in the three tools we take into consideration the type of user for the different tools and their knowledge.

1.3.1. Requirements for smartphone application

With respect to the smartphone/smartwatch application, the end user has the possibility to look at one station at a time, starting from the station closer to his current position. The user can also explore the area around him, looking in detail at the surrounding stations and compared them.

The smartwatch and smartphone app will use the same design in order to keep the consistency between different type of devices (to not provide exclusive content for only certain devices). For this reason in this file we will describe only the smartphone application.

A possible future update is to implement a ‘sport’ section which provides for the users who do outdoor physical activities (i.e. running) the best possible route in order to breathe the least amount of toxins in the air as possible (like in describe in the Figure 7).

1.3.2. Requirements for desktop application

The desktop application, that is reserved only to the staff, will be designed in order to explore in details the whole system. Data can be analysed with different levels of granularity:

- Single area/zone;
- Multiple areas/zones
- Whole system.

The user can search and analyse a specific area/zone, compare two or more (up to 5), or be aware of the state of the whole system.
For what concerns time, the user have the possibility to visualise data related to a single moment or to an interval of time, and in both cases the time period can be easily chosen while using the application.
In this way the analysis can be developed both in terms of space and in terms of time.

1.3.3. Requirements for the ambient display

We will provide two different type of ambient display.
The first one will be a series of ‘totems’ placed around the city that offer the possibility to the end user to rapidly and easily understand the air status based on the closest station and to

achieve that it will be design such that from the street sides it will show the key information in a meaningful way that even the users that aren't very close to the tool, like from inside the car, they will be able to understand the current situation, meanwhile in the sidewalk side there will be an interactive touchscreen display that allows the user to access and analyze the data.

The second one will be an interactive table that it will be placed nearby people's high density places such that squares, shopping centers ecc… and it will offers a certain level of interaction to filter and analyze the data.

1.4. Representation definition

In this section we will explore all the representations that will be used in the three tools.
Some representations will make a comparison among variables with different measure units. In these cases the values of the variables will be normalized with respect to a reasonable interval that will obviously be different for each variable. In this way we can represent the idea of high or low value for all the variables, while the real value of the variable can be seen as a number on the side. In this way we are able to provide both relationship informations and exact informations.

1.4.1. Smartphone

With respect to the smartphone app we will use the following representations:

- **General situation when opening the app**:
    - **Map** (Figure 11,12)**:** We will visualize a map centered in the user position, that will show the closest station and the surrounding ones, if available, though a clustering color-based system representation that give a first glance idea of how high is the AQI (Air Quality Index) value in that particular station. In this activity it's also available a brief overview of the current situation and informations regarding the surrounding area (min-max temperature, humidity %, wind speed/direction and visibility, ...).
      The navigating through the different stations can be done by deselecting the current one and pick a new one.
      The user need to press the up-arrow to load the current station details.
    - **Stations comparison** (Figure 13): To compare multiple stations the user has to select all the stations involved into the analysis and also choose one variable to compare them then she/he needs to press the up-arrow to load the current station details.

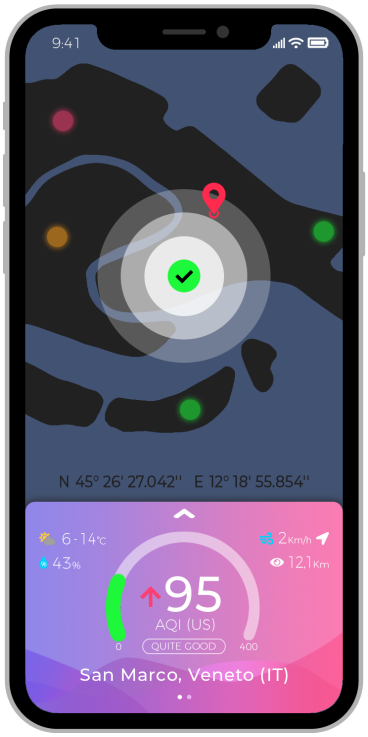

Figure 11 - Main activity (single station)

Figure 12 - Main activity (more information)

Figure 13 - Main activity (multiple station comparison)

- **Station details**: Once the user has chosen to view the station details the app will load a new activity in which at the top it'll show a general overview plus, through a right swipe, it'll be available other information regarding the physical station (height, type of soil, type of surrounding environment, … - Figure 14/15).
  Meanwhile on the rest of the screen it will be available a custom interface section, 'Live Status', displaying the current value and a small graph (24h-based) regarding only the variables chosen by the user. In this way the app allows to create an unique experience based on the user's preferences and provides some useful shortcut to access to the data history of the specific variables by just tapping the corresponding card.
  If the user want to inspect the data history of a specific variable, even not available in the 'Live Status' section, it can be done by selecting one in the 'Data History' section (Figure 16).

Figure 14 - Station details (first tab)

Figure 15 - Station details (second tab)

Figure 16 - Station details (data history comparison)

- **Stations comparisons:** Once the user has chosen to see the data history of a particular variable, the app will load a new activity which provides an immediate values meaning (minimum, mean, maximum) and a star-plot representation based on the current filters applied (Figure 17).
  The filters available, that affects the graph representation and the other cards, are arranged in this form:
  - **Level of zoom (granularity)**: It filters the data accordly with one of the following time range:
    - D (1 Day): The graph shows a 24 hours representation in which each dot represents 2 hours;
    - W (1 Week): The graph shows a 7 days representation in which each dot represents 1 day;
    - M (1 Month): The graph shows an entire month representation in which each dot represents 3 days;
    - 3M (3 Month): The graph shows a 3 months representation in which each dot represents 1 week;
    - Y (1 Year): The graph shows a one year representation in which each dot represents 1 month;
    - ALL (all the data): The graph shows all the data available in which the granularity of a single dot is chosen accordly with the range's size.

- **Ending to**: It filters the data accordly with the ending date picked (e.g. [Level of zoom: W; Ending to: 30 NOV 2018] = the graph shows one week representation, which starts from 24 NOV 2018 and ends to 30 NOV 2018).

If the user has chosen to compare multiple stations the app will show (Figure 18), on the same graph, all the plots, but it will colored only one station at a time, meanwhile the other will be greyed. To change the visible station the user has to tap on the name of a particular station.

We have chosen to include only this type of graph because it has a good trade-off between the small screen size available and the good amount of data that we want to plot, but without sacrificing the possibility to analyze the behaviour of the variables through the time.

Figure 17 - Data history activity of a single station

Figure 18 - Data history activity of multiple stations

- **Iconic representation**: They have been used to give an overview of the qualitative variables of the station such as weather (Figure 19) and wind direction (Figure 20).

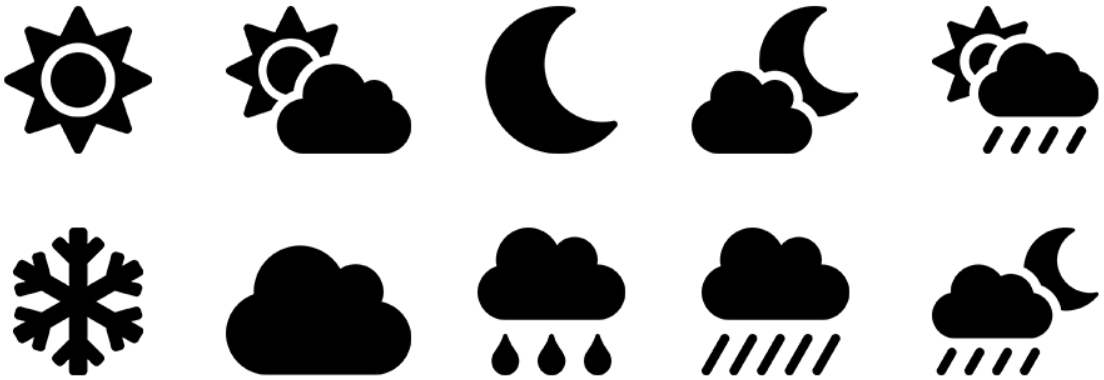

Figure 19 - Icons weather conditions

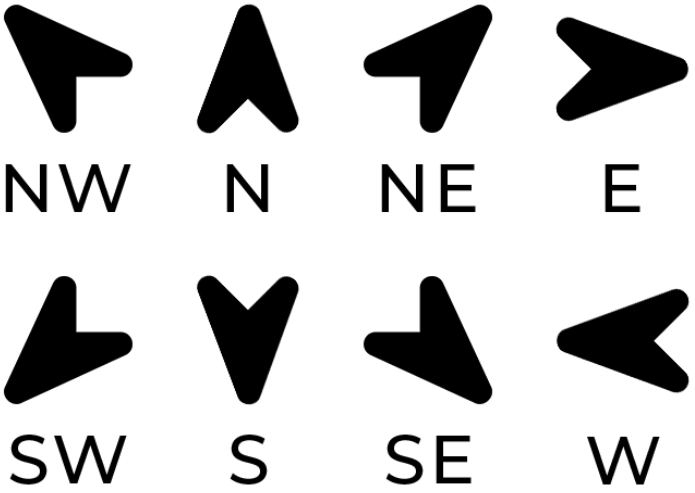

Figure 20 - Icons wind directions

1.4.2. Desktop

With respect to the Desktop application we will use the following representations.

- **General situation when the user visit the website (Figure 21)**:
  - **Map**: It will present the whole system colored, thanks to the data collected by a series of satellites, according to the actual values of the selected variable plus it will display the current user location and the current AQI.
    The web app also allows the user to see the trend of the selected variable through a 'live' short video that represents the data values in a tight period of time (i.e. how the pollution moves around the globe thanks to the wind).
  - **Candlestick graph**: This graph is related to the selected variable (map section). The system also offers to the user to filter the data by the period of time (from/to inputs), which affects also the other graphs.
    The granularity is provided through a series of fixed level of zooms, like in the smartphone app (explained in the previous section), which describes how much time is represented by a single candlestick.
    The system will also give the possibility to show, on top of the candlestick graph, a simple line plot triggerable by a input switch.
    This type of representation is commonly used to spot some trends/patterns.
  - **Bean plot**: This graph is related to the selected variable (map section). This representation is very useful because it shows the actual data distribution filtered by the period of time (from/to inputs).
  - **Scatter plot**: One of the variable involved in this graph is related to the selected variable (map section), the other one will be selectable through a drop-down menu, which contains the remaining ones.
    The system also offers to the user to filter the data by the period of time (from/to inputs), which affects also the other graphs.
    This kind of representation should help understanding if there is any correlation, and of what kind, among variables.
  - **ThemeRiver graph**: It will represent all the six quantitative variables that are not static within the single station. Using this representation it will be possible to explore the behavior of the current station in different moments and to understand if and how these variable are correlated.
  - **Other widgets/tools**: The system offer a series of useful tool to understand more deeply what is happening around the selected area. For this reason the web app provides the last news related to the air/weather condition, the future forecasts and the current value of all the variables using, in this last case, a color based system to give an instant feedback to the user.

- **Single area detail (Figure 21)**: The representation techniques used for inspecting a single area/zone, described before, is used independently on the type of element requested/selected.

Figure 21 - Desktop web app (Single zone/area)

- **Comparison among multiple areas (Figure 22):** The user can select up to 5 zones/areas.

    - **Multiple bean plots**: These graphs are related to the selected variable (map section). This representation is very useful because it shows the actual data distribution, filtered by the period of time (from/to inputs), for each zone (each one is represented by a capital letter), so in this way the system offers to the user an easy and instant feedback of the filtered data.
    - **Scatter plot**: One of the variable involved in this graph is related to the selected variable (map section), the other one will be selectable through a drop-down menu, which contains the remaining ones.
      The system also offers to the user to filter the data by the period of time (from/to inputs), which affects also the other graphs.
      This kind of representation should help understanding if there is any

correlation or similarities, and of what kind, among variables and areas, which are represented by a capital letter.

- **Parallel coordinates plot**: It will show the whole set of variables for all the stations identified each one by colors. This representation is very useful because it allows to explore and discover relationships among variables.
- **Other widgets/tools**: The system offer a series of useful tool to understand more deeply what is happening around one of the selected areas (one at a time). For this reason the web app provides the last news related to the air/weather condition, the future forecasts and the current value of all the variables using, in this last case, a color based system to give an instant feedback to the user.
  To view the information of one of the other zones involved in the comparison, the user can archive that by simply click to the 'tooltip-flag' (on the map) of the desired zone.

Image 22 - Desktop web app (Multiple zones/areas)

1.4.3. Ambient Display

With respect to the ambient display tool we will use the following representations.

Totem: This type of tool will shows only the data relative to the closest station, only one, so there isn't a comparison mode between multiple station.

- **General situation (street side - Figure 23)**: these three sides will show the information using a series of outdoor display in which each screen will show one single variable at a time and for a certain period and after that it will change to another variable.
    - **Line graph**: It will show the values related to the current variable of the last 24 hours. To make it easy to understand, even from a good distance, it will feature a color based system (Green, Orange, Red).
    - **Other information**: Each display will also show the current value, the trend (arrow) and a simple feedback (Good, Moderate, Danger) of the variable involved.

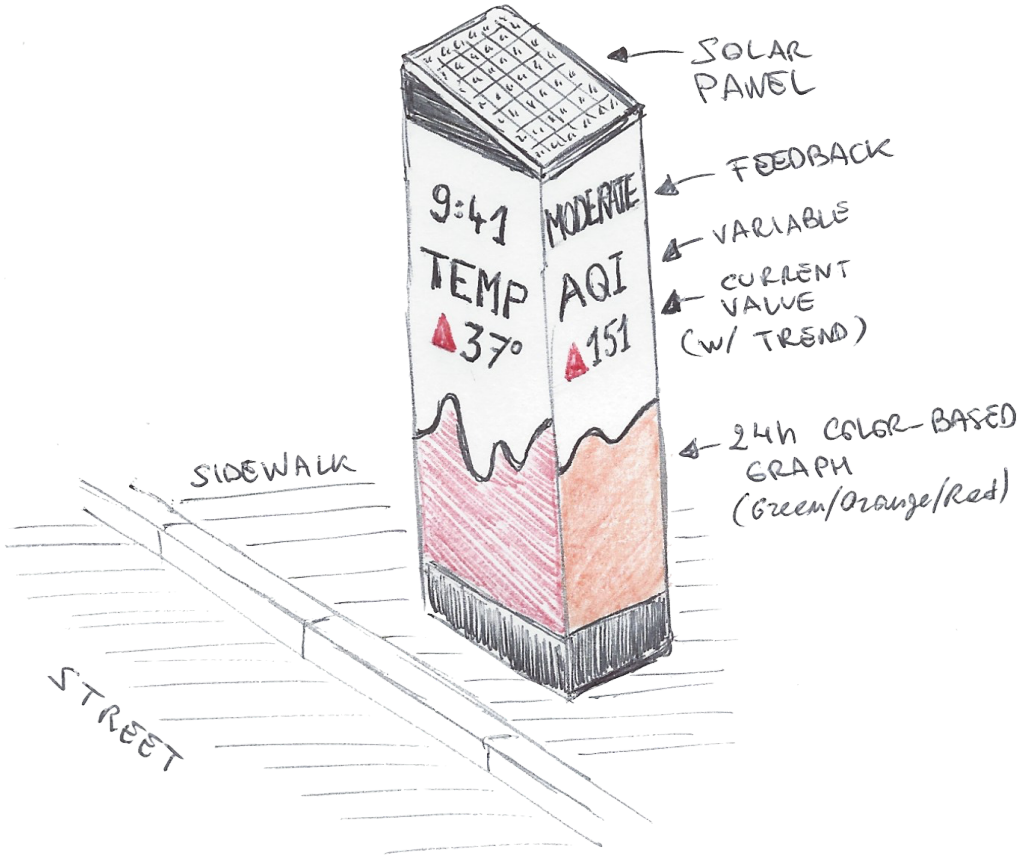

Image 23 - Totem (street side view)

- **General situation (sidewalk view - Figure 24)**: This side will show the information using an outdoor touchscreen display in which the user can interact to analyze the data.
    - **Star-plot**: We have chosen to include only this type of graph because it has a good trade-off between the ease of reading/understand and the good amount of data that we want to plot, but without sacrificing the possibility to analyze the behaviour of the variables through the time and other filters (same design like in the smartphone app).

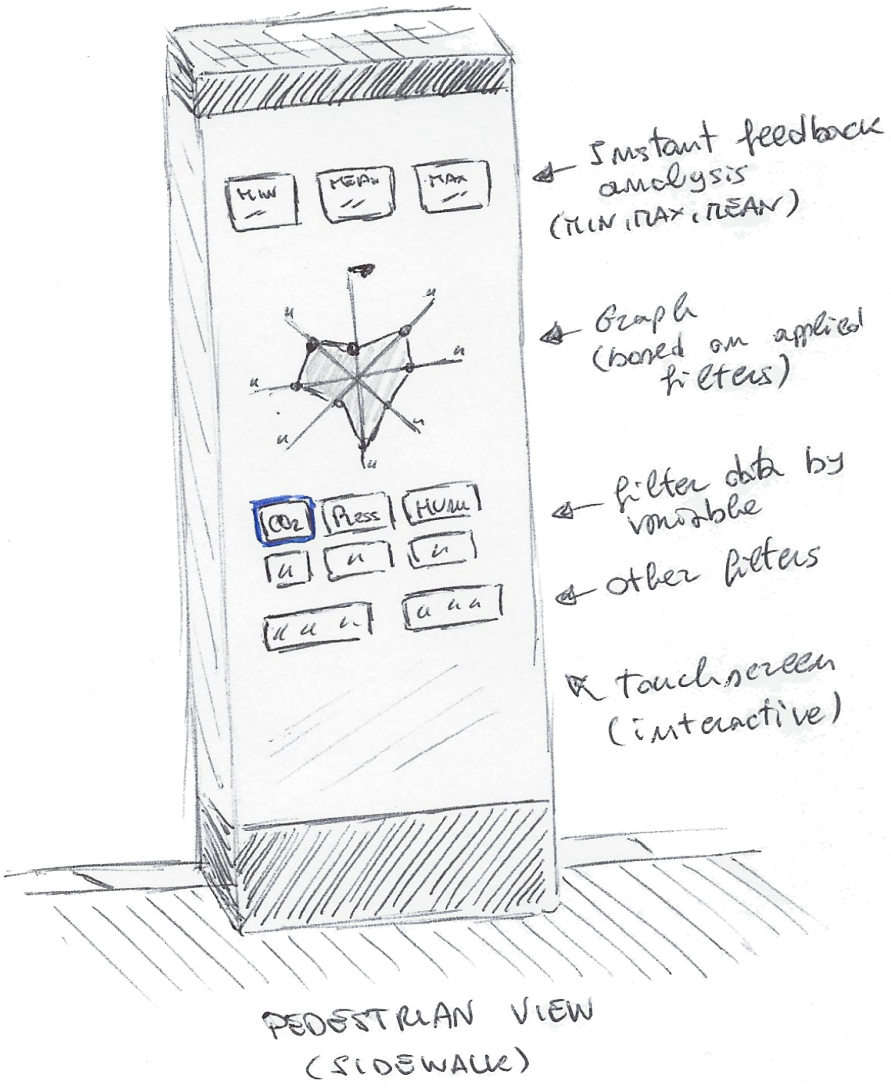

Image 24 - Totem (sidewalk view)

Interactive table (Image 25): This type of tool allows the user to interact using a series of physical buttons and inputs range to filter and/or analyze the data that affect a 3D representation done by a series of motorized sticks (color-based). It's basically a 3D bar plot.

- **General situation**:
    - **Motorized sticks**: These sticks will adjust their height according to the filters applied: variable, range of distance (aggregated data starting from the nearest station), range of time.
      They will also change their color in accordance with the current value of the selected variable (Green, Orange, Red).

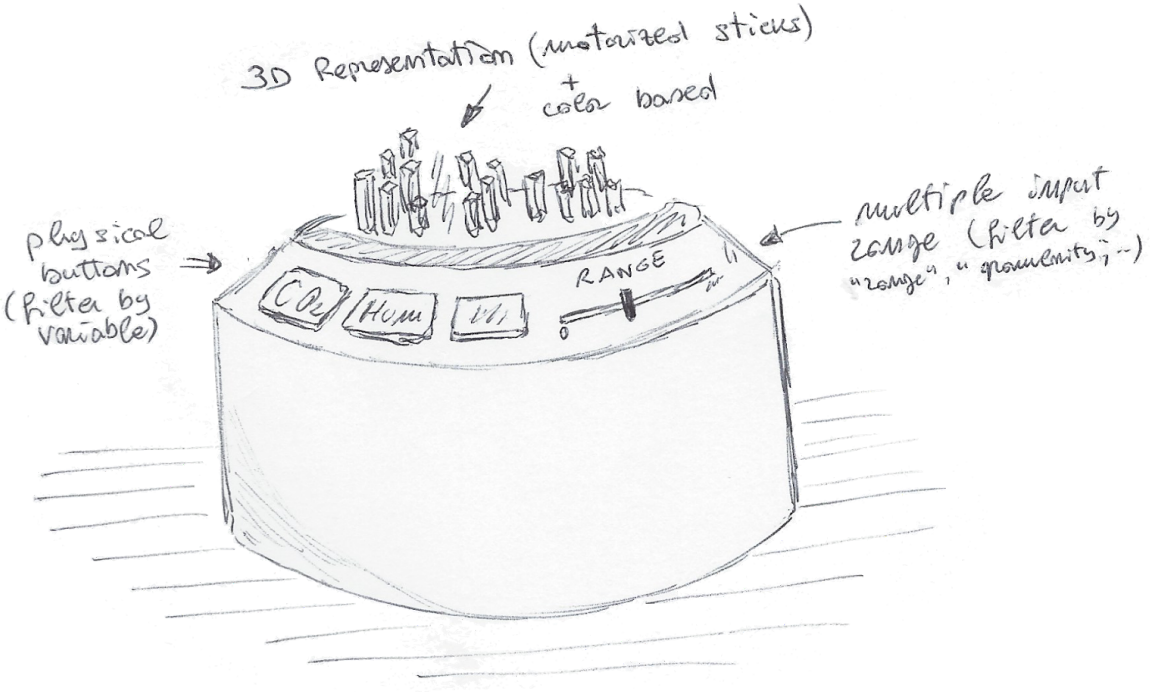

Image 25 - Interactive table

1.5. Presentation definition

In this section we will describe the presentation for the smartphone and desktop tools. Since the device on which they will be used and the target users are very different the presentations used are different from one tool to the other. Here below we will discuss in details the two different layout design.

1.5.1. Smartphone/Smartwatch

In the smartphone application the data are presented with three different kind of visualization:

- A general view;
- A detailed view;
- A comparison view.

The **general view** offer a color-based map to give to the user an overview of the situation around the current position. This type of view is loaded first, then the user can scroll-up to load the **detailed view** in which can find a more exhaustive description.
To access to the **comparison view** the user, from a detailed view, needs to tap on the 'compare with others' link.
The navigation through all the views is managed by and upper comeback menu or a up/down swipe (arrow).
In the general view there's also a bottom menu, in which the user can choose to render different variables into the map.

1.5.2. Desktop

The desktop tool has been designed for the staff. This means that the user will have the possibility to explore more deeply all the data of the system that the tool analyses.
We distinguish three different kind of visualization:

- A general/detailed view;
- A comparison view.

The **general/detailed view** will consists of a fully color-based map in which if the user zoom-in enough it will be loaded a more detailed view similar to the one in the 'Figure 7'.
This view will uses the same types of representations like in the smartphone app (Iconic and Star plot) plus the theme river and scatter plot that will allows to compare multiple variables in a single chart in order to identify some possible patterns/relations between each others. Moreover it's available a bean plot and a candlestick graph which is helps to spot more easily some type of patterns.
Finally, the **comparison view** will be done thanks to the use of the Bean, Scatter and Parallel coordinates plots. This view will be loaded, on the same page, if the user has selected from the map section more than one area.

2. Interaction

In this section we will describe how the user can interact with the tools that we have proposed before.
Furthermore we consider both explicit and implicit interaction.

2.1. Interaction Definition

2.1.1. Smartphone/Smartwatch

In the following lines we talk about the interaction between user and smartphone/smartwatch application.
We supposed that the device can be geolocalized and we implicit assumed that the user can scroll up and down the screen.

Explicit Interaction. Interactions that user makes in order to change the status of the application and retrieve the information. Interactions can be done in some specific part of the application.

Overview screen. When the application start, the first view is an overview of the area where the user is geolocalized (it can be seen in figure 11), and the application show the data of the station closer to the user.
From this view the user can:

- **See the information:** Since the user is geolocalized and the closer station is selected, the user can see all the data that the station can offer to the user (see previous chapter)(Figure 11,12).
- **Drag the map:** The user can drag the map and see the other station. Also the user can zoom-in and zoom-out (pinch-to-zoom) on the map in order to see major or minor number of stations. If we zoom-out the map then the stations are grouped.
- **Swipe up the information box:** The user has an overview of the station's data. If he/she swipe up the box fixed at the bottom then he/she can have a more detailed information for that station. (Figures 14,15,16)
- **Select multiple stations:** Initially the station closer to the user is selected in order to display the data referring to that station. The user can select another station just tapping on that if he/she want to compare their data. (Figure 14)

Detailed screen. When the user decide to visualize the data on a particular station, there are some interaction that the user can perform:

- **Swipe right/left the infobox:** In the infobox at the top of the activity, the user can swipe left or right in order to display various information about the station (Height meters above sea level, type of soil, type of surrounding environment, ecc...)
- **Customize the data area:** The user can add or remove some widget from the station's data recap, deciding to view what he/she prefers (e.g. He/She prefer to visualize CO_2 emission rather than Humidity). Obviously the unselected data are available at the bottom of the page and still valuable for being consulted.

- **Select a single data:** If the user want to have a more detailed information then he/she tap on a desired widget in order to views the graphs for that variable.

Comparison screen. This is the part relative to the interaction in the comparison view of the application. In this part of the application the user can:

- **Modify the granularity of data:** At the bottom of activity the user can modify the 'level of zoom' of data and the range of date (ex. Data from 30 nov. until today).
- **Come back:** If the user wants to go back to the previous activity, he/she simply swipes left or tap the 'back' button in the top left of the page if she/he is in the comparison page of a single station, while if she/he need to come back from a multiple comparison view she/he can achieve that through a swipe-down (arrow) to the upper magenta box.

Implicit Interactions: The implicit interactions are those interaction that the user does without interact with the application.

- **Critical level of data:** When a variable increase over the maximum threshold, the user receive a notification.
- **Daily basis notification:** Every morning the user receive a message from the app in which there will be information about the actual AQI based on his actual position.

For the **smartwatch** application we replied the same information as in the smartphone application, so, there are the same interaction that the user could do in the smartphone app.

2.1.2. Desktop

In this section we describe how user can interact with the desktop application. Obviously is more complex and for specialist use only. Both explicit and implicit interaction can be done in a single view or a comparison view in the application (Figure 18,19).

Explicit Interactions: The user can perform various direct interaction.

- **Select variable**: The user can select the variable involved in the various graph using the top menu positioned on the 'map' section.
- **Modify the granularity of data:** The user can filter the data of the candlestick plot accordly with one of the following time range:
    - 1h (1 Hour): One single candlestick stands for 1 hour;
    - 6h (6 Hour): One single candlestick stands for 6 hours;
    - D (1 Day): One single candlestick stands for 24 hours;
    - W (1 Week): One single candlestick stands for 7 days;
    - M (1 Month): One single candlestick stands for an entire month;
    - 3M (3 Month): One single candlestick stands for 3 months;
    - Y (1 Year): One single candlestick stands for one year;
- **Select multiple areas:** The user can select two or more stations (up to 5), in order to compare data relative to the zones involved. To add one station the user needs to spess to the map, while to remove one she/he needs to press to the 'x' available on the relative 'tooltip-flag' on the map.

- **Change area:** The user can change the area (single comparison) involved by clicking to the ‘x’ available on the ‘tooltip-flag’ on the map and after that clicking to a new location.
- **Search a place**: The user can search a specific place through an input fields available on the map.
- **Change from/to date**: It filters the data accordly with the range of date picked (e.g. [From to: 06 DEC 2018 to 08 DEC 2018] = the graph shows two days representation, which starts from 06 DEC 2018 and ends to 08 DEC 2018).
- **Go to ‘favourite stations’ page (Image 26)**: The user can load a different view that will shows an instant feedback, thanks to the minimal but meaningful information, of all of its favourite stations. From this page the user can add more locations to its favourite ones or if she/he click to one specific card-area the system will load the comparison view of that exact location.
  The user can also change the alert settings related to the specific area (i.e. She/He can set an alert related to the CO_2 status in which she/he can specify the threshold value, where if the actual value exceed that the system will send a notification alert) by clicking the the ‘edit’ icon available on each card.

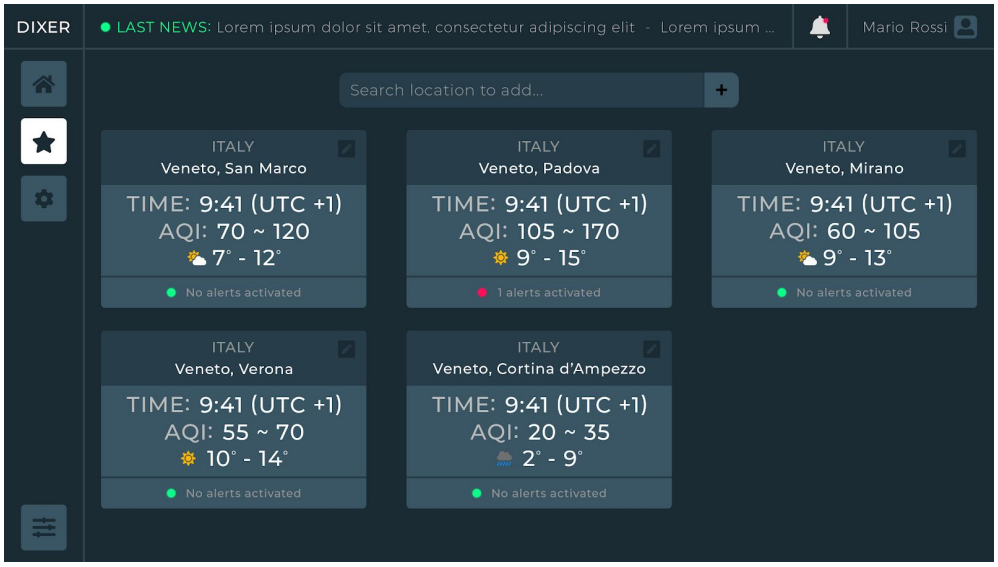

Image 26 - ‘Favourite’ section (Desktop webapp)

- **Go to ‘Settings’ pages**: The user can load a different view where from that can change its personal preferences and/or customize its pages layout (remove/add graph, specific position, ...).

Implicit Actions: The desktop application gives to the user an overview of the data taken from a selected station.
Moreover when a favourite station exceed a certain level of criticality, the application send a notification to the user.

2.1.3. Ambient Display

In the last part of this chapter we talk about the ambient displays that we have designed.

The ‘totem’ ambient display it has been designed to be placed in some specific point of the city in order to give the possibility to the users, sidewalk side, to analyze with the data taken from the closer station.

Explicit Actions. These actions are what the user can explicit do when he/she interact with the ambient display.

Comparison screen: This is the part relative to the interaction in the comparison view (the only one available) of the tool. In this part of the application the user can:

- **Modify the granularity of data:** At the bottom of screen the user can modify the ‘level of zoom’ of data and the range of date (ex. Data from 30 nov. until today), then the system will adjust its graph and other info-box to the new settings/filters.

Implicit Action. This is an action that happen without a explicit interaction from the user.
There is only one action that the ambient display does without the user’s input.

- **Give the essential information:** The user can see the essential information of the environmental behaviour, as we shown before (Figure 23)

The ‘interactive table’ ambient display it has been designed to be placed in some specific point of the city in order to give the possibility to the users to interact, with more setting compared to the ‘totem’, in order to analyze with the data taken starting from the closer station (and depending to the ‘range’ distance input the data displayed will be aggregated with the other information of the near stations).

Comparison screen: This is the part relative to the interaction with the tool. The user can:

- **Modify the granularity of data:** The user can filter the data selecting one variable at a time by pressing the corresponding physical button and/or filter the information by ‘range’, distance from the actual position (like a radius), and/or based on the time (through range input), then the system will adjust its 3D-graph to the new settings/filters.

Implicit Action. This is an action that happen without a explicit interaction from the user.
This type of ambient display doesn’t have this type of interaction.

3. Storyboard

3.1. Smartphone

[Invision Link]

3.2. Desktop

[Invision Link]