UnivEnv

Visualization of environmental data collected through a network of stations located on the territory

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A.Y. 2018/2019

Contents

1 Introduction

The main topic of this project is to provide a set of visualization tools regarding environmental data collected by a station located in the territory.
The requirement is to design three different information visualization tools, which are the following:

- Individual: app for smartphone/smartwatch
- Public: ambient display
- Technical: application for large tablets or desktop

Each of the representation is linked by a different type of user, for example the desktop application is made for letting back end technical personnel staff to access data at different levels of granularity, instead of the public representation that will provide an approximation of the data collection for letting not technical people understand what they're seeing.

2 Data

The station will collect the following environmental data:

- CO2
- Air Humidity
- Luminosity
- Wind speed and direction
- Location (also height, type of soil, type of surrounding environment)
- Time (hour/season)
- Pressure
- Rain
- Temperature

3 Competitive analisys

3.1 Personal interface

Before we could actualy start the design, a little research on the argument had to be done, about the data representation techniques which could be used with the data we have to visualize and some examples of application which dealed with something similar.

We found some good examples and took some hints.

3.1.1 Air visual

This was a good app to start the competitive analysis, because it was the most complete and the prettiest. We deduced from this app we can organize the general look of the application as a n card view, and there was some historic data management we found vey interesting.

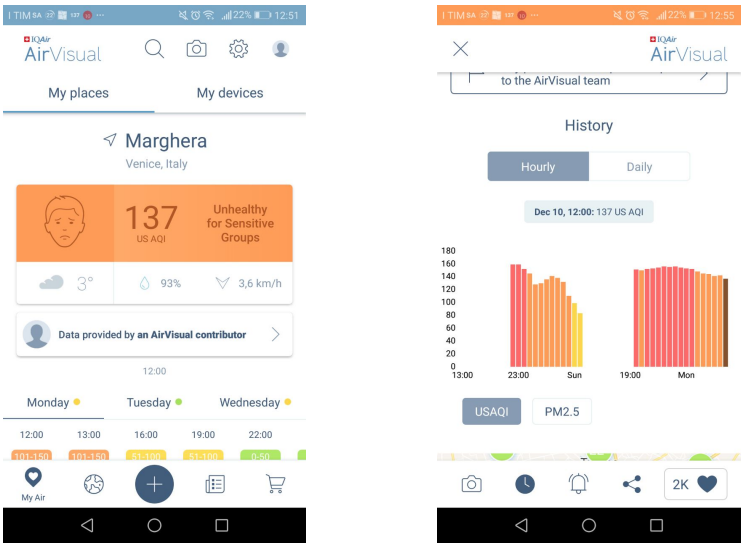

Figure 1: As we can see, the left most img has a 2-card design(My places/My devices), while the right most has a daily/hourly historic data.

3.1.2 Air Quality:Real Time AQI

From this app, we found really interesting the data visualization through histogram diagram and they visualize the data in a certain timespan.

Figure 2: Airquality histograms

3.2 Technical Interface

For the technical we searched for desktop online application and sites which treated the same kind of data(meteorologic, air pollution).

3.2.1 acqin.org

The site displays a large map with colored indicators that indicate the quality of the air in zone where the centers are placed. The use of colours permits a good comparison among the various centers.

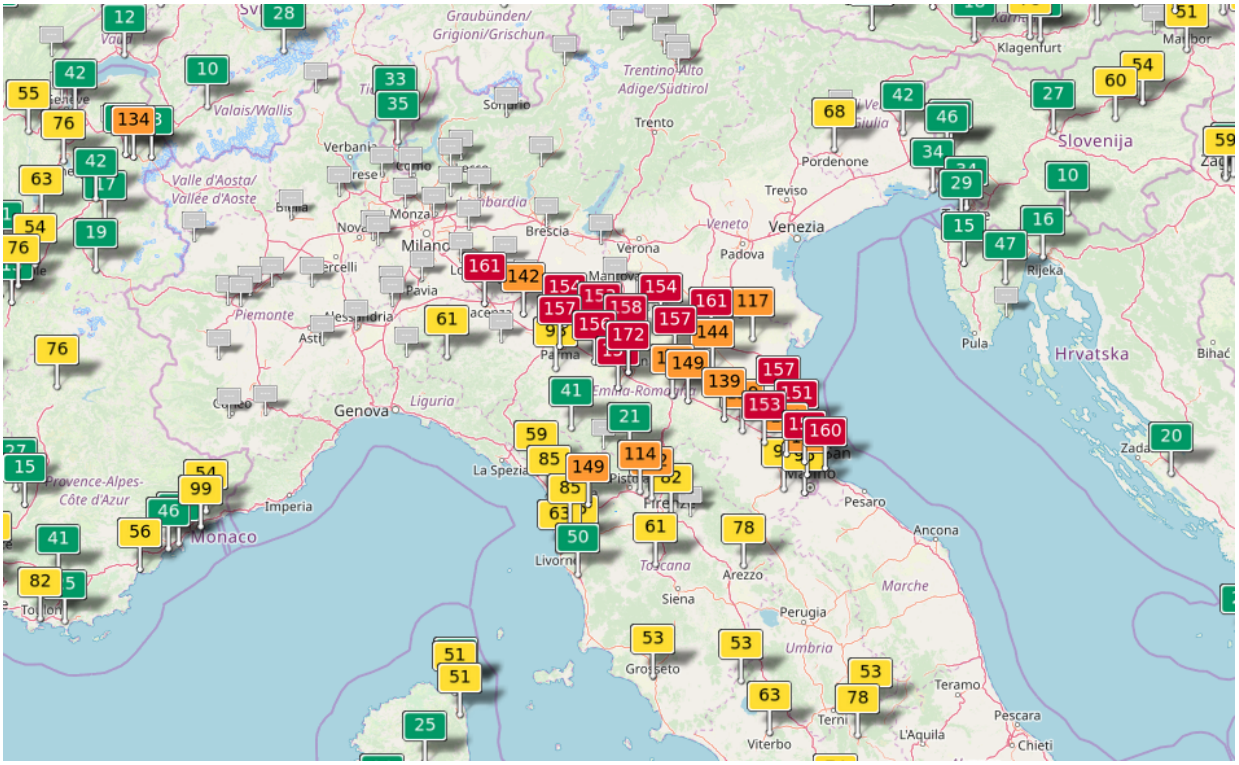

Figure 3: acqin.org Labeled mapchart with the index of air pollution(the more polluted, the more the label is coloured red)

3.2.2 waqi.org

In this second app we have more types of data representation than before. We have a close-up on a specific location with the data relative to it represented in various formats!

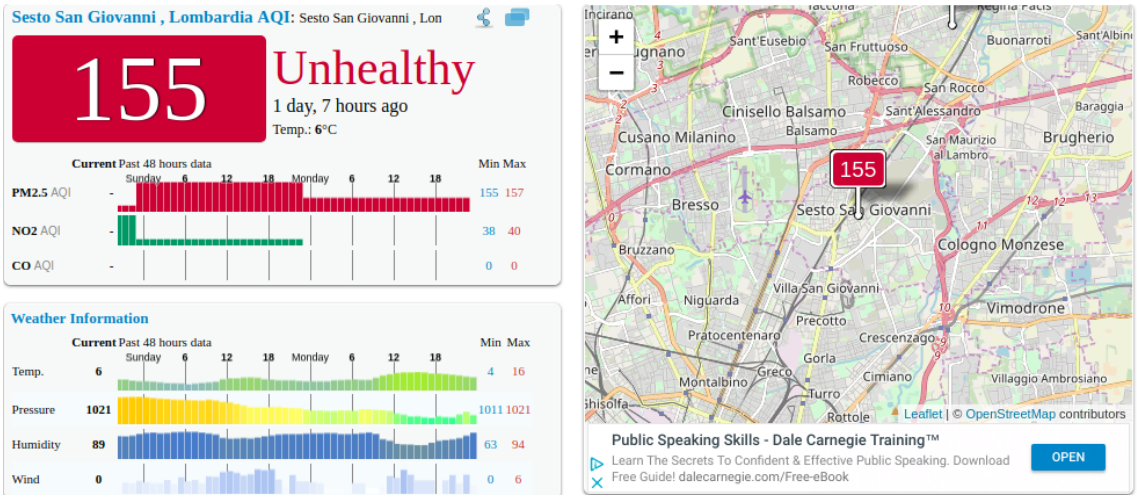

Figure 4: waqi.org in a example postion, which enhance the quality and quantity of data displayed

4 Proposal

The solution provided will present the following representation.

4.1 Individual

4.1.1 Requirements

We define here the requirements for the personal interfaces we decided to implement. The smartphone app we were going to design must fulfill some requisites:

1. Summarize all the information in an easy-to-use tool.
2. Provide readable data about the behavior of a certain variable in time.
3. Allow the most curios users to confront data between the/some stations.

Build such a thing is not an easy task, given that the space is small and so you have to optimize it, to display in the best quality possible those data that the users expect to see. The smartwatch app cannot be as full of details as the smatphone's, given the more restricted space, it will only visualize the last measurements and a daily history.

4.1.2 Reasoning about the dataset

Given the variables the station is measuring and what has to be shown through the interfaces, we have defined a simple hierarchy of the information. We decided to divide them in two groups:

Variables strongly dependent on location, and immutable/less important data

- Weather(and Pressure)
- Hour, season
- Wind direction
- Location features

Important variables, more likely to be studied and with some kind of behaviour

- CO2 ppm
- Wind speed
- Luminosity
- Temperature
- Umidity
- Rain

We started building the interfaces based on this hierarchy, given more details for the most important variables.

4.1.3 Smartphone Proposal

The solution provided has to take into consideration that it has to give an easy representation of complex data. It is divided in two macroparts, a summary of the station first-group data and a view in detail of the most important variables. The station is automatically selected if it's in the proximity of the device, otherwise it will be chosen by the user through a map.

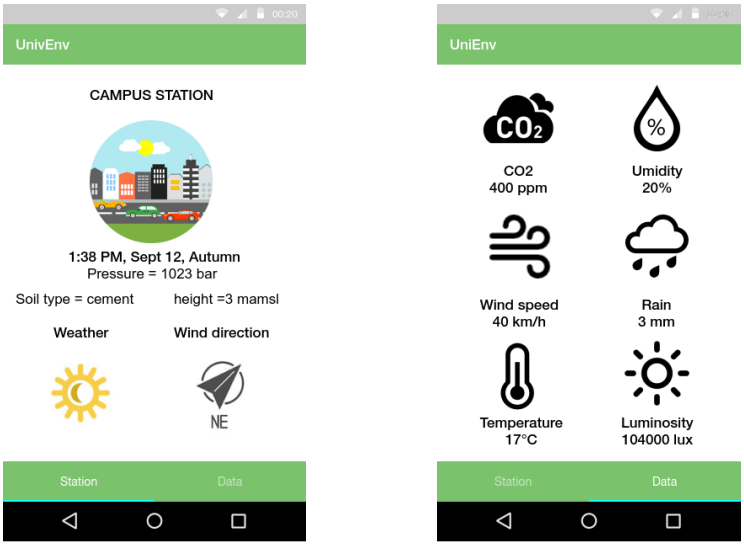

Figure 5: Smartphone activity

4.1.4 User interaction

INVISION LINK: https://invis.io/M5PI3T9Z3JX.

At the opening of the app, three things can happen

1. The user is not in the proximity of a eco station, so a map will be visualized with the nearest ecostation(1-2 km range) and the user will choose what station visualize

2. The user is near a station, presses the notification, the app will open up and the air condition activity of that particular will open up

3. The user is near a station, opens the app in the standard way and a popup will show up(You are near to "Vega ecostation", connect to it?).

When a station is selected, the general display of that station will be visualized, that contains:

- Station name
- Time and season
- Weather around that particular station

- Type of soil and enviroment
- Height in maslm

If the user presses the data button, the icons of the most important variable will show up, with their current lecture already visible.

When an icon is pressed, the activity of that certain variable will popup up, in which the user can see how the last lecture approaches the annual max measure of that particular variable, as well as the behaviour of that variable in time(daily, monthly or annualy).

If the "Comparison" button is pressed, another activity will show up, which presents the comparison of actual lectures of the nearest stations and their behaviour in a week timespan. The user can return to the menu with the left top screen error on the variable-related activity

4.1.5 Graphs used

- **Map Chart**

  This will permit at a user which is not at beacon-range distance to a station to choose a station within a 2 km range max

- **Gauge chart**

  It gives a representation to the max value registered in the season.

- **Histogram chart**

  We use this to show the history of a variable with different time ranges and an easy confrontation of last measure by different stations

- **Line chart**

  It confront the lectures of the different station within a week time span.

4.1.6 Smartwatch

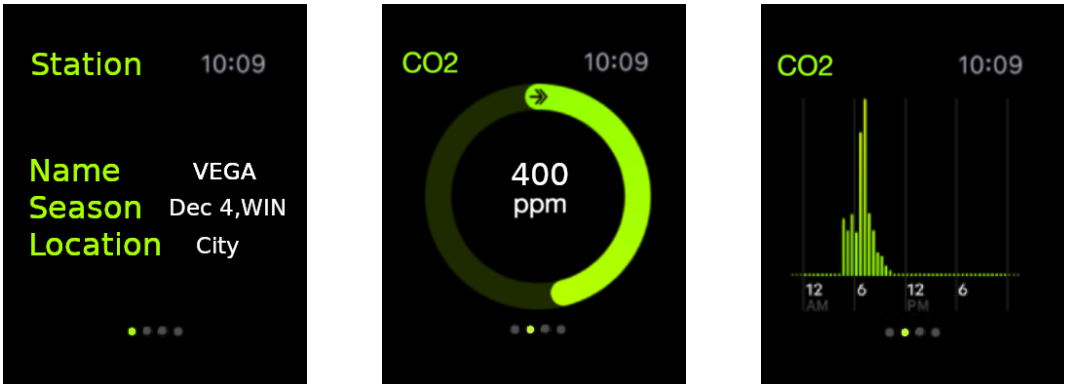

Figure 6: Smartphone activity

INVISION link: https://invis.io/6HPIZVO7FNE. For the smartwatch, which is a simple device, we decided not to provide lots of data or difficult plots that might result not clear to the user. We represent only the most important variables, with a little overview of the location of the station, which is represented with a *Modular Large Complication*.

The navigation of the app will be a *page-based one*, with a total of 7 pages (one for each important variable plus 1 for station overview). The user can swipe through the pages, and in a page representing a variable, a double tap on the radar chart can change the type of data representation the page will visualize.

4.1.7 Graphs used

- **Radial bar chart**

  We use it to visualize the current variable measurement with respect to a daily/montly/annual max value

- **Histogram chart**

  Is a simple plot that can give a quick view to a short history of the variables, in order to extract possible behaviors of a certain variable.

4.2 Public

The public interface has been structured in two parts.

- The first screen (Figure 2), is an image that represent the current state of our environment depending on the variables defined before. If, for example, the level of CO2 is over the average level, we'll add some smog clouds in our representation. Now we define, for each variable, what we are going to add if the level is over the normal level. The temperature is given by a string in the upper-right part.
  - CO2: smog clouds.
  - Air Humidity: fog.
  - Luminosity: bigger sun.
  - Wind speed and direction: wind icon and clouds.
  - Location (also height, type of soil, type of surrounding environment): is described by the image.
  - Time (hour/season): there is a string indicating what time is it. For the season, it's described by the image.
  - Pressure: arrows going down
  - Rain: clouds with rain

  This representation is thought to be as abstract as possible, in order to be accessible to all people (e.i. kids, adults, etc). There'll be a sound output that will tell you what you are clicking, for helping blind people.

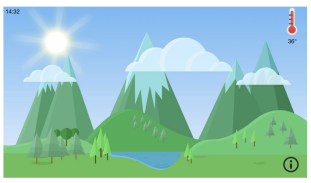

Figure 7: Public interface

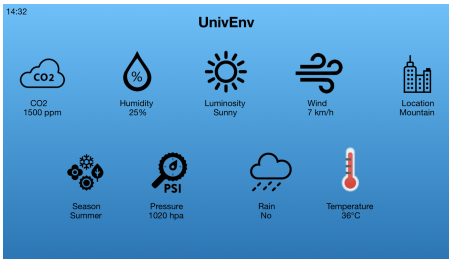

Figure 8: Info of public interface

4.3 Technical

INVISION link: https://invis.io/3WPJB0OEYAP. This type of representation is for people that analyze the row data, so it has been chosen to use representations that maybe are less intuitive to understand but are more accurate.
It has also been introduced the comparison, which allows to select the type of data to compare, and compare it. The system is divided in the following parts:

- Login
- Representation
- Choice of what compare
- Comparison

It has been chosen the following type of representation:

- Radar chart
- Scatter chart
- Bubble Chart
- Line Chart
- Violin Diagram

The technical application will be used by academic and technician to visualize and manipulate data in a more detailed way. The first screen that we are going to see in the technical app is the *login screen* needed to authenticate the users with the permissions to visualize the data. After the authentication we have two ways to display data, we can retrive the data of a singular station or we can compare datas between two stations. If we choose to display the data of a singolar station we will have a radar chart with every parameter registered from a station and, clicking on a specific one, we will be redirected to the various charts regarding that parameter with the possibility to compare it with the same parameter from another station.

4.4 Type of graphs

It has been chosen those type of representation because they represent accurately the raw data. The exceptions are the radar chart, it has been chosen because it sum up all the variables(the values goes from 0 to 10, which represent the quality of that variable); and the Bubble map which represent the situation in that moment on the map.

4.4.1 Radar Chart

The radar graph is a graphic method to represent set of datas consisting of multiple variables, representing them on axis with the same origin.

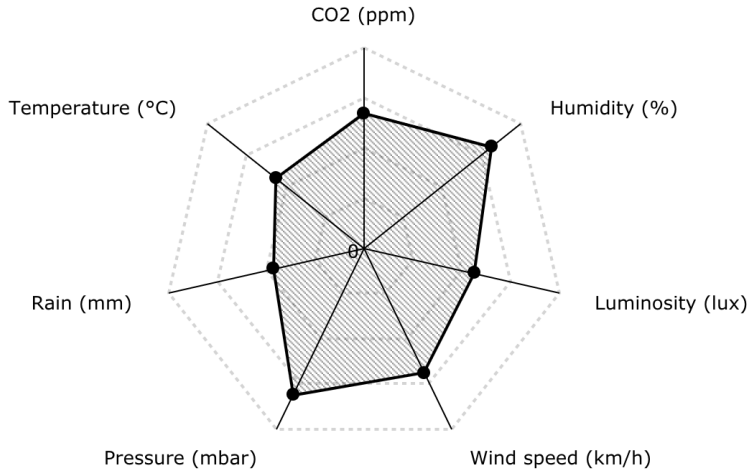

Figure 9: Radar chart

This chart is used in our project to quickly check the optimality of the various parameters of a given building in the moment of the visualization. with this tool we will be able to know which are the worst/best parameters with a glance and use this information to pick the right countermeasures.

4.4.2 Line Chart

The line chart is a chart which displays a series of data points called "markers" connected by straight line segments.

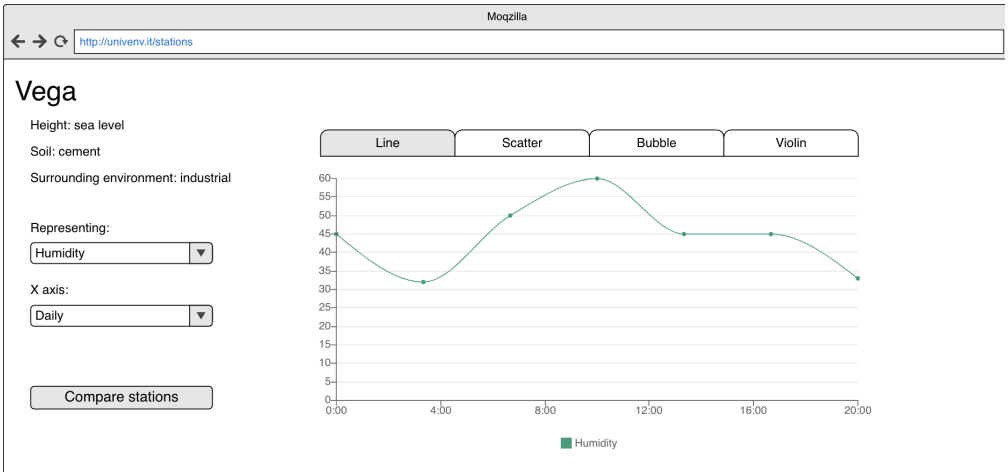

Figure 10: Line Chart

We use this type of representation in our technical interface to display a single data over time, allowing us to appreciate its mutations in a certain period.

4.4.3 Bubble Map

In this chart we have colored circles on a geographic map. The color and dimension of the bubbles are in relation with the data.

Figure 11: Bubble Map

in our representation the red colour of the bubbles indicates bad parameters for the station while the smaller green ones indicate positive parameters.

4.4.4 Scatterplot

Scatterplot shows relation between two variables using Cartesian Coordinates. In each axis is displayed a variable allowing us to find if between those variables there exists a relation

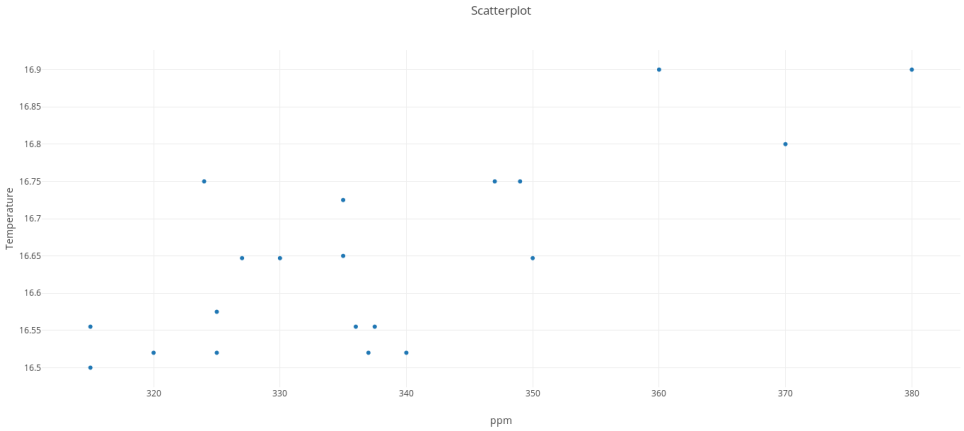

Figure 12: Scatterplot

In our case we can see if we have a relation between the variables we choose (CO2 ppm and temperature).

4.4.5 Violin plot

A violin plot is a method of plotting numeric data. It is similar to a box plot but it is composeb by four layers: The outer shape represents all possible results, with thickness indicating how common. The next layer inside represents the values that occur 95 percent of the time. The next layer (if it exists) inside represents the values that occur 50 percent of the time. The central dot represents the median average value.

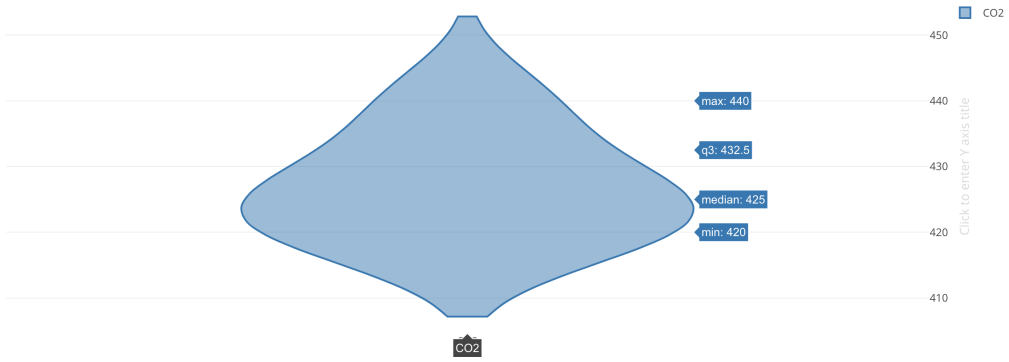

Figure 13: Scatterplot

5 Bibliography

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