Data Visualization : Milestone 2

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1 Goals

Given the complexity and abundance of climate change data, our objective is to create accessible visualizations that clarify key aspects for both the general public and scientists. Our primary aims are to illustrate:

- The underlying causes of climate change.
- The observed effects of climate change over recent years.
- The actions taken by countries to address this issue.

Our focus is on presenting historical data without venturing into predictive analysis. By providing clear visual representations, our goal is to empower users to form their own conclusions regarding societal efforts to combat this pressing global challenge.

2 Design mockup

The idea behind our website is for the user to first arrive at a website showing a global map, with colors indicating a key feature such as change in temperature compared to 1970. There will be a slider to choose the year of which the data is displayed, along with a drop-down menu to choose a different feature. The slider will only show dates for which enough data is available for the given metric. This page look as shown in Figure 1.

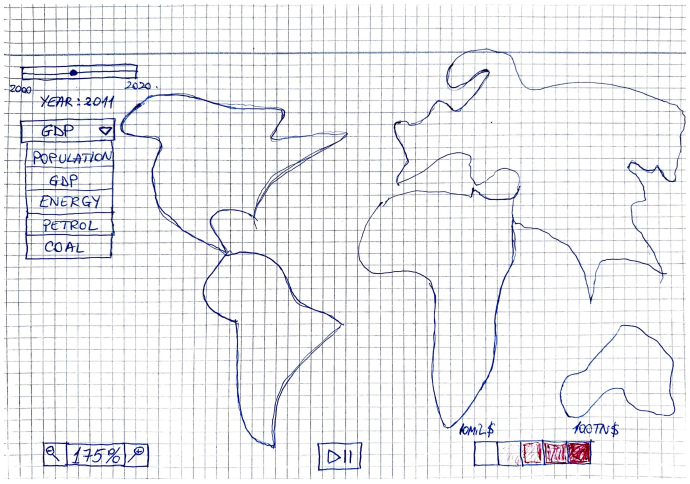

Fig. 1: The initial page shown to users

From the initial page, a user is able to click on an individual country, to get more specific details on that country. This will be presented in terms of a big pop-up window, that blurs or otherwise hides the background of the map as shown in Figure 2. The contents of the pop-up window are shown in Figure 3. It will display a map of the country that was clicked, with more specific data if this is available. For example, it will contain data of each the weather stations in the country. Below the map there will be a range slider to select the range of years of data that will be presented. There will also be a play button to animate the change in data over the selected years. On the right-hand side of the window, there will be a variety of plots covering our data for this specific country, such as its change in population over the years, the GDP over time, etc. This will also not only be limited to line plots but can include other forms such as bar charts, bubble plots, Sankey diagrams, etc.

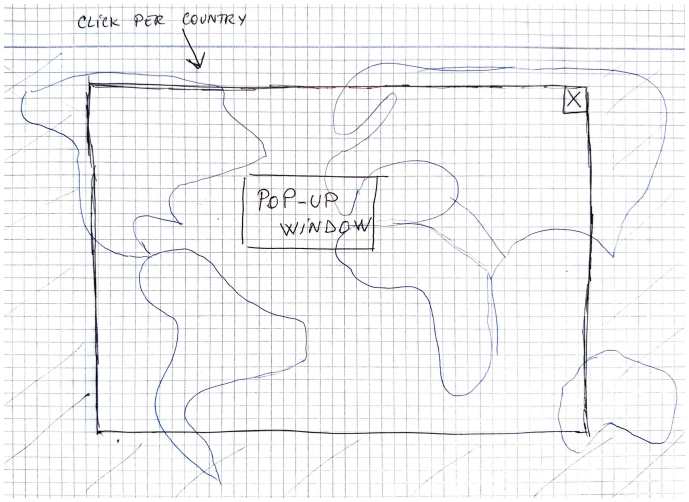

Fig. 2: The pop-up showing when viewing an individual country

3 To-do's

To achieve the goal, creating a visualization as described above, we need to take a lot of steps. To create the initial page, we need to implement the following building blocks:

- Main map
- Play button
- Metric selection menu
- Legend

Then, for the pop-up window we need to implement more parts:

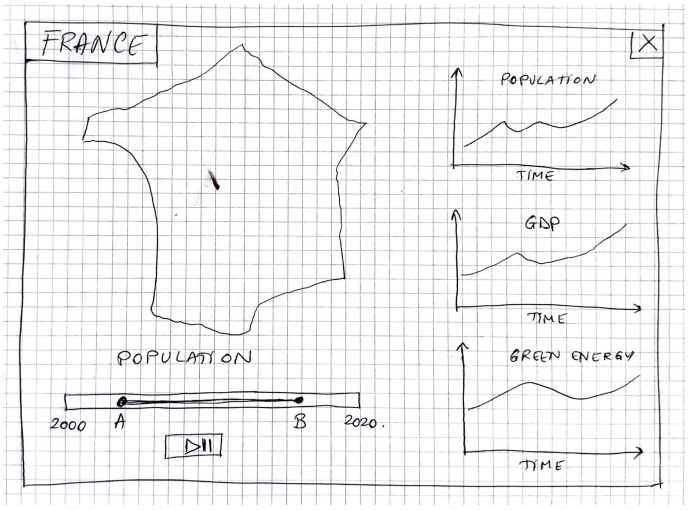

Fig. 3: The contents of the pop-up window for an individual country

- Pop-up window itself
- Individual countries
- Range selector for years
- Animation of data over years
- Charts

On top of our core visualization, there will be a few quality-of-life changes we should add to make the whole experience more user-friendly:

- Convert numbers to readable format
- Zooming functionality
- Edge limiting

Numbers in our dataset come as very large values, sometimes in the trillions. We should convert these numbers to human-readable formats (27,956,998,000,000 → 27.96tn). Secondly, it is possible to zoom and drag windows of maps around. However, it should not be possible for users to zoom in indefinitely or move the map out of the visible screen. There should be some zoom boundaries and dragging limitations in place.

For this milestone, we wanted to have the basic version of the website to include the pop-up window showing each country map with basic plotting. However, due to time restrictions and code errors we decided to leave this part totally for the to-do's part. In addition, as mentioned in first milestone report, this pop-up window will include a case study feature for the USA as we have more data available for this country. This feature will include additional plot choices and animations.

4 Tools and Lectures Used

4.1 Tools

To effectively create and manage the visualizations for our project, we have utilized a comprehensive suite of technologies and tools suited for interactive data visualization and web development. The tools employed are integral to achieving dynamic, interactive, and visually appealing representations of complex climate data.

- **D3.js:** A crucial tool for creating dynamic, interactive data visualizations. It is used across various components of our project to bind complex climate data to the DOM and enable data-driven transformations within web-based visual interfaces.
- **TopoJSON:** An extension of GeoJSON that encodes topology, it is utilized in conjunction with D3.js to render scalable and efficient geographic maps, crucial for our global and detailed country-specific visualizations.
- **CSS and HTML:** These foundational web technologies are used for styling and structuring the web page, ensuring functional and aesthetically pleasing visualizations.
- **JavaScript and jQuery:** Employed for DOM manipulations and handling asynchronous tasks, these tools enhance user experience through smooth interactions and transitions, especially in dynamic components like pop-up windows for country-specific data.
- **SVG:** Scalable Vector Graphics technology is utilized to create responsive and high-quality visual components essential for detailed map visualizations and other graphical elements.
- **HTML5:** Used for building interactive forms, sliders, and buttons, enabling users to control visualization parameters such as year and data metric selection.
- **Bootstrap:** This framework aids in creating responsive and intuitive user interface components, enhancing accessibility and usability.

4.2 Lectures

Throughout this course, we have explored foundational concepts and advanced topics in data visualization, which have directly influenced the design and implementation of our project. Key lectures have covered subjects such as JavaScript, D3.js, effective map creation, graphs, interactions, colors and do's and don'ts. These sessions have provided both the theoretical underpinnings and practical techniques necessary for developing our interactive visualizations. The knowledge gained from these lectures will be instrumental in ensuring that our visualizations are not only informative but also engaging and user-friendly.

5 Extra work

This chapter is marked as "extra". Depending on the complexity of the to do list, we may think to implement also this features.

5.1 Toggle to switch to another global world

For example, you want to see an order of countries depending on a metric. A tree map is very helpful. We were thinking about having a toggle above to switch from "World "view to "Tree map" view -Fig.4. In the Tree map view, you can define your own formulas, described in the next subsection.

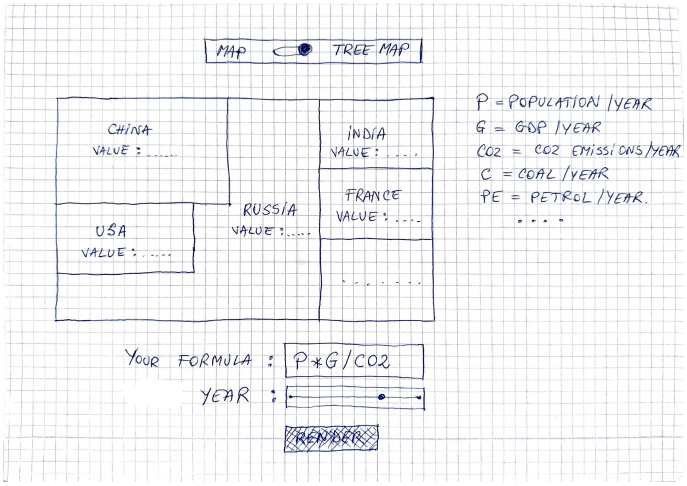

Fig. 4: Extra work: View using Tree Map

5.2 Define your formula

As mentioned in our previous report, our target audience consists of the general public and scientists alike. It could be very useful

to have special features in place for our advanced users. They may want to calculate GDP/Population or GDP/CO_2 emissions or even more complex formulas such as Population * GDP / CO_2. Our tool can help people who want to define their own metric and see the distribution in the world on that metric.

In this way, they have a powerful tool which makes climate change investigation easier.

We have predefined variables, as you can see in Fig.4 where we predefined the values, for example: P variable = Population in that selected year, G variable = GDP in that selected year, etc. These abbreviations may change in the final product.