Process Book 2023-IKUN

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Introduction

The COVID-19 epidemic has ended in most parts of the world. In response to the global pandemic, governments worldwide have implemented various policies to curb the spread of the virus and protect people's lives. Policies such as working from home, reducing the flow of people in public places, and decreasing the use of public transportation have been widely adopted globally.

Now that the epidemic has subsided, it has become critical for policymakers and researchers to understand the impact of these policies on public mobility patterns and virus transmission. To shed light on this, we have developed a comprehensive data visualization using the community mobility reports provided by Google and COVID-19 case data from Johns Hopkins University (JHU). Our visualization consists of three different types of charts designed to show the relationship between public mobility and the pandemic from various perspectives. By presenting these two datasets in an intuitive and interactive manner, we aim to provide a better understanding of the global situation, assist in the decision-making process, and contribute to retrospective research efforts on the COVID-19 pandemic.

Dataset

COVID-19 Data Repository by Johns Hopkins University

Link: https://github.com/CSSEGISandData/COVID-19

This dataset, maintained by Johns Hopkins University, aggregates data from multiple sources related to COVID-19. It provides daily updates on the number of confirmed, active, and death cases during the epidemic at the country (and in some cases, state or province) level. The database is of high quality, managed and verified by a team of researchers at Johns Hopkins University. As a widely used resource for policymakers, public health officials, and researchers around the world, it can be directly used for our project without any preprocessing. However, we still performed some basic transformation such as summing the number of cases or calculating the sum within a sliding time window based on the actual needs for visualization.

Google Global Community Mobility Reports

Link: https://www.google.com/covid19/mobility/

This dataset is publicly released by Google to track people's activities during the epidemic in places such as workplaces, pharmacies, stores, public transportation, and residences. It was created to help public health officials and researchers gain a better understanding of how the pandemic and COVID-19-related policies have impacted people's mobility. The database is derived from raw geolocation data owned by Google and has been processed to a high level of usability. The dataset shows how visits and length of stay at different places change compared to a baseline. Changes for each day are compared to a baseline value for that day of the week and is reported as a changing percentage. The baseline is the median value, for the corresponding day of the week, during the 5-week period Jan 3–Feb 6, 2020.

Problem Statement and Design Choice

Our primary difficulty is to find the most appropriate perspective to present and understand our two datasets in this visualization. The data we had on hand included multiple dimensions such as time, country/region, number of COVID-19 active/aggregated cases, and changes in mobility compared to the baseline for six types of sites. To fully explore the information in the data, we decided to design the following three visualizations.

The first visualization is an interactive map that allows users to explore the COVID-19 situation worldwide. Each region is represented by a bubble, and the size of the bubble indicates the active COVID-19 confirmed case number in that region. By observing the sizes of the bubbles on the map, users can visualize the severity of the local pandemic. The map also displays the mobility trends for one of the six types of places in each region, represented by the saturation of the color. The combination of these two elements provides valuable insights into the relationship between mobility patterns and pandemic situations. We once considered whether we should also show the cumulative confirmed cases, but after discussion we decided that only current confirmed cases were most relevant to mobility and that showing cumulative cases would not make much sense and might be more distracting for users. We also wanted to show a mix of mobility trends on the map at the same time, but the display was not satisfactory and slightly duplicated the radar chart function, so we removed it from the map view and had the radar chart take on the function of comparing the mobility of various places at the same time.

Secondly, we utilized a radar chart to compare changes in mobility across the six types of sites in selected countries. This visualization approach enables us to examine the variations in mobility patterns over time for retail and entertainment, grocery and drug stores, parks, transit stations, workplaces, and residential areas. By presenting these changes in radar plots, users can easily compare the relative changes in mobility within a country and between selected countries, gaining a deeper understanding of the impact of policies on public mobility.

Additionally, we introduced a racing bar chart to illustrate the changing rankings of countries' mobility in specific site categories over time. This dynamic visualization provides a fascinating depiction of how the mobility of certain countries fluctuates and ranks in real-time as the pandemic progresses and policies change. By visually tracking the rise and fall of activity levels across countries, viewers can grasp the dynamics of change and identify potential patterns or trends.

Feedback and Improvement

The main feedback we received previously on Milestone 1 was that the exploratory data analysis should have been done better. So, we then performed more processing and analysis on the data, summarizing the Covid-19 case number profile and the data profile of various types of mobility, including average, maximum, and minimum values. These summaries helped us design the three data visualizations.

Starting from our first draft design, we made many adjustments based on the data analysis and our visualization goals. For example, initially, we wanted to show the mobility visualization on the map view as a separate thermal color layer. However, the results turned out to be unsatisfactory, and it was difficult to visualize the relationship between the number of confirmed cases and a certain type of mobility. As a result, we decided to use bubble size to indicate the number of cases and color saturation to represent a selected type of mobility. This approach allowed us to combine data from both databases more effectively and provide more intuitive insights.

Our design for the second radar chart was also modified during implementation. Initially, we created a simple and typical radar chart that met our basic requirements. However, it had several shortcomings, including sharp corners on the lines, lack of aesthetics, and difficulty in distinguishing overlapping areas when displaying multiple countries simultaneously. To address these issues, we researched different implementations of the D3.js radar chart and found a blog article with a design that best suited our needs. We decided to implement our radar chart based on this blog, which successfully resolved the aforementioned problems. Additionally, we discovered that the visual effect of data changes on the radar chart heavily relied on the speed of mouse dragging on the timeline. This caused inconvenience when users wanted to observe the data changes steadily over time. To address this, we added the functionality to play the timeline at a fixed rate, allowing users to observe and compare the changes in mobility across various locations on the radar chart more smoothly.

Tools for Visualization

To create our interactive data visualizations, we used a combination of tools and frameworks. These tools allowed us to implement a variety of chart types, incorporate user-friendly widgets, and provide an immersive experience for exploring the COVID-19 pandemic and its relationship to mobility patterns. The key tools used in our visualization project are as follows:

D3.js

D3.js serves as the main tool of our visualization, providing a powerful framework for creating and manipulating Scalable Vector Graphics (SVG) elements. With D3.js, we are able to generate bubble charts, radar charts, and racing bar charts. Its rich data visualization capabilities, including data binding, transformation, and layout algorithms, allow us to create dynamic and interactive visual representations.

Vue

Vue enables us to modularize components, manage data flow efficiently, and implement responsive behavior. We used Vue and v-select-page to build some helper components such as drop-down multi-selection menus.

HTML and CSS

We used HTML and CSS to construct and design the visual components of our webpage. HTML provided the basis for the layout of the different elements, while CSS allowed us to customize the appearance and design of charts, maps, and user interface elements.

Lectures, Tutorials and Challenge

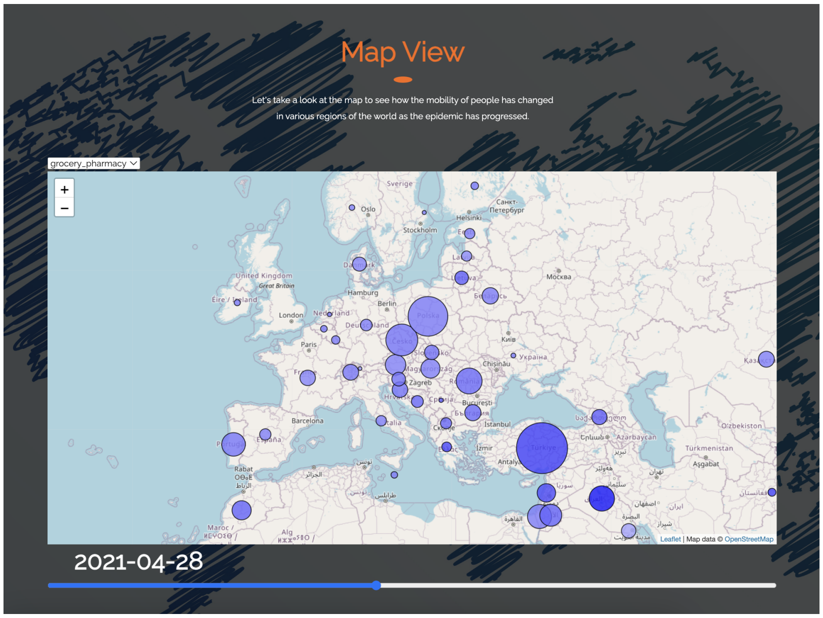
Here is the lecture we used in designing the basic schema and presentation of our visualization.

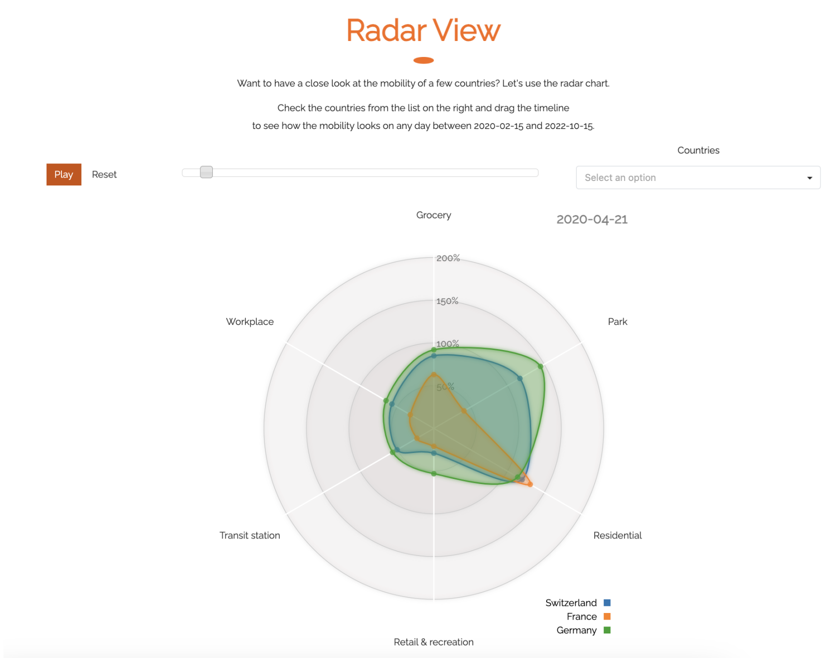
Visualization Work	Related Lectures	Tools
World map of covid-19 cases	Lecture 4.2 8.1 11.1	D3.js
World map of people mobility	Lecture 4.2 8.1 11.1	D3.js
Dynamic ranking	Lecture 11.1	D3.js
Color selection of Page and map	Lecture 6.1	
Web page structure	Lecture 2 3	html, css, js
Data preprocessing	Lecture 4.1	Pamdas, scikit-learn, EDA
Story telling	Lecture 12	

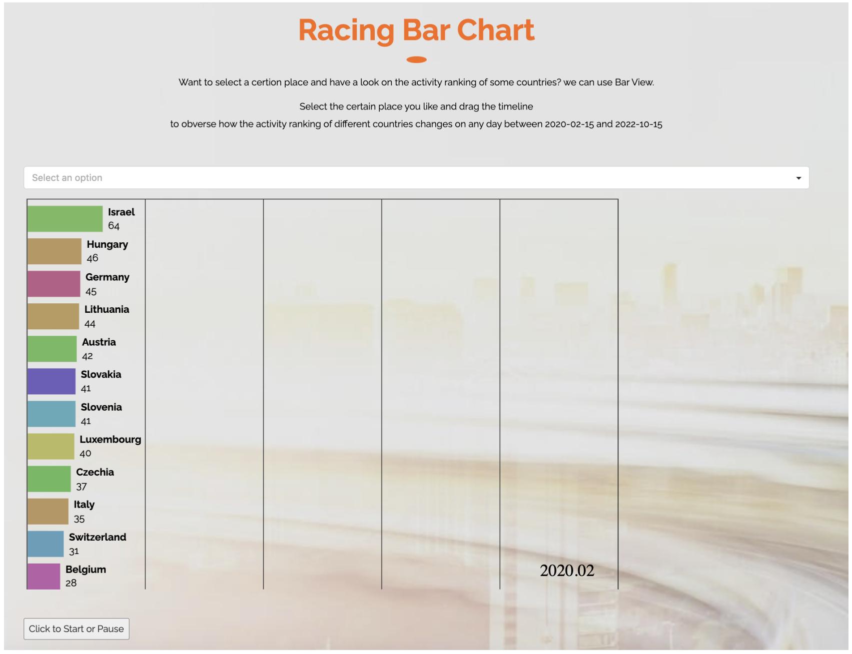
To fulfill our design using D3.js, HTML, JavaScript, and CSS, we studied various online tutorials and website implementations. For the D3.js tutorial, we found that Observable and D3 Graph Gallery offered excellent basic tutorials on implementing the bubble map, time slider, and selection features.

The main challenge we encountered during development was related to JavaScript. Since we developed each section separately, we ended up using different versions of D3.js and initializing variables with the same name. This caused significant conflicts when we merged everything together. Additionally, we faced similar challenges when developing our own sections, as it was difficult to construct complex JavaScript code that accurately reflected our design.

Visualization Demo







Peer Assessment

Zhaobo Wang

- The design and implementation of the map view.
- Process book: Lectures, Tutorial, challenge, Project Structure, Visualization.
- Screencast: Map Chart.

Qiyuan Dong

- The design and implementation of the radar chart.
- The design and implementation of the overall web page layout.
- Process book: Introduction, Dataset, Problem Statement and Design Choice, Feedback and Improvement, Tools for Visualization.
- Screencast: Introduction and Radar Chart.

Yiling Liu

- The design and implementation of the racing bar chart.
- Screencast: Racing Bar Chart.