



Narrative Visualization Project

HOW THE CORONAVIRUS SPREAD AROUND THE WORLD

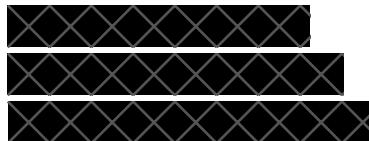


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Introduction

From the last data explore project, the following selected question is what I want to answer at this narrative visualization report:

1. COVID-19 epidemic current situation and history timeline (up to modified date 1 June 2020).
2. The relationship between the spread of the COVID-19 epidemic and its geographic location and flight routes

In this part, due to the time limit, I only focus on the now and past, rather than prediction. Furthermore, for traffic density, flight routes are the best visualization data to show how the people move all over the world.

My intended audience is those who want to know how COVID-19 started and why it spread all over the world. Therefore, it is generally a lightweight popularization visualization. It won't cover too much numbers and tables. Just simple and focus on the fact.

Design

Five design sheets methodology

Five design sheet methodology were used to propose and design expressions. In the first stage, it is sheet1, see the appendix for details. Brainstorming came up with a lot of visualization ideas, but some of them were repetitive and some of them might not be the best. After filtering and summarizing, three main types of diagrams were identified.

- Bubble map

The reason why choose bubble map is that it is obvious enough to show the changes in the data, the use of shades of color is not a sharp contrast to it, nor is it intuitively impressive. It is worth noting that because the epidemic is growing exponentially, if the bubble is plotted based only on a radius of the number of infections, either small and invisible in the early stages, or big enough to fill the entire screen later. So here the square scale is used to draw.

- Area chart

Bubble map can show the change, but it is poor to show the history. The area map was therefore used to plot the time series of the historical number of new infections. In this graph it can clearly see the change in the number of new infections over time, while the area represents the cumulative total.

- Connection map

Connection map or flow map is used to show the flight routes. Connection diagrams can be a good way to show geographic connections and relationships. Connection maps can also reveal spatial patterns by the distribution of connections or the concentration of connections on a map.

Alternative design

Based on the previous visualization choices, a total of three candidates were identified. They each have their own focus. The advantages and disadvantages of each option are discussed. For more details, refer to the appendix.

Alternative one – Dashboard

- Focus
 - Data visualization as a dashboard, providing the full access for all data we have.
 - It provided the real time updated information for the COVID-19, people can visualize and interact with it. Doing some search and filter to see what they are interested.

- Operation
 - control button for animation for time series data;
 - filter different categories cases number;
 - annotation to label important event;
 - all the chart is link to the time-series data, should change while play bottom is pressed;
 - For page limit, only data for top% countries are shown, but if user want to see data visualization, there is search option that can check the data for specific country.
- Discussion
 - PRO:
 - The sheet is shown detailed information for COVID-19.
 - The trend line for small-multiple can clearly show the future trend.
 - line chart and bar chart are easy to read and understand.
 - CON:
 - lack of narrative, there are basically no story telling.
 - no relationship visualization.

Alternative one – Timeline

- Focus
 - timeline, and bind it with website scrolling, which can provide more immersive experience. The final map representation can show at the bottom of website, after scroll down to the end.
 - rank of different countries shows how this rank change during the whole timeline.
- Operation
 - No control bottom, instead page scroll down, the time start counting.
 - timeline process bar shows the percentage from beginning to current date.
 - vertical bar chart represents the ranked data simultaneously.
 - click on map will pop up tooltip to give more information.
- Discussion
 - PRO:
 - immersive experience, clear timeline representation.
 - CON:
 - less link for air flight routes to epidemic data.

Alternative one – Network

- Focus
 - The relationship between cumulative case numbers and air flight routes;
 - The transition between different graph is narrative. It is telling story rather than just switch graphs.
 - Shown relation from geo to abstract net graph.
- Operation
 - Area chart can control the play time.
 - Scatter points in a map can be converted to scatter points in a relational net graph.
 - Tooltip and label to provide more detailed information.
- Discussion
 - PRO:
 - immersive experience, clear timeline representation.
 - good narrative.
 - CON:
 - two graph contains similar information, if it is only for smooth the transition.
 - should provide more information.

Final design – Storytelling

- Focus
 - The narrative of storytelling scroll trigger provide immersive and fluent experience.
 - data is shown with timeline, shown the history of the spread of epidemic.
 - each DOM element represents consistent information, also provide high interactive.
- Operation
 - scroll down control animation for time series data;
 - select and choose time scale to show the related data;
 - time-line act as a whole time period preview;
 - filter different categories cases number;
 - annotation to label important event;
 - force linked diagram shows how the countries connected according to air fight routes.
- Detail
 - the tooltip circle can show the specific detailed information;
 - the time-line preview can change by filter with different data categories.
 - the nodes should consistent within different graph, then the transition can be smoothly converted.
 - the text description can be scroll down, and when the related text move to the central of view, it will trigger the visualization to update.

Modifications due to limited time

- Failure to build the line chart into the tooltip, showing only the name of the current country.
- Force link maps were not implemented, and instead there were separate flow maps and transition animations.

Implementation

Running environment

Recommend use Chrome explore to view my project.

Run script online, because the library is accessed using URL API.

The zip file contains:

- index.html: main html file contains the main page
- data file contains the data used for visualization
- css file contains the CSS file used for index.html
- js file contains the JS script, map_vis_x.js is the file used for d3 plot, roller.js is the file for scroll trigger.

Software and language chosen

I chose to use JavaScript as a presentation tool because it allows for a highly customizable web presentation scheme, allowing for narrative visualizations to be implemented. And the open extensibility allows me to use d3 to chart the appropriate interactivity, data binding.

Library declaration

- D3: D3.js is a JavaScript library for manipulating documents based on data.
- Scroll Magic: Scroll Magic helps you to easily react to the user's current scroll position.
- jQuery: jQuery is a fast, small, and feature-rich JavaScript library.

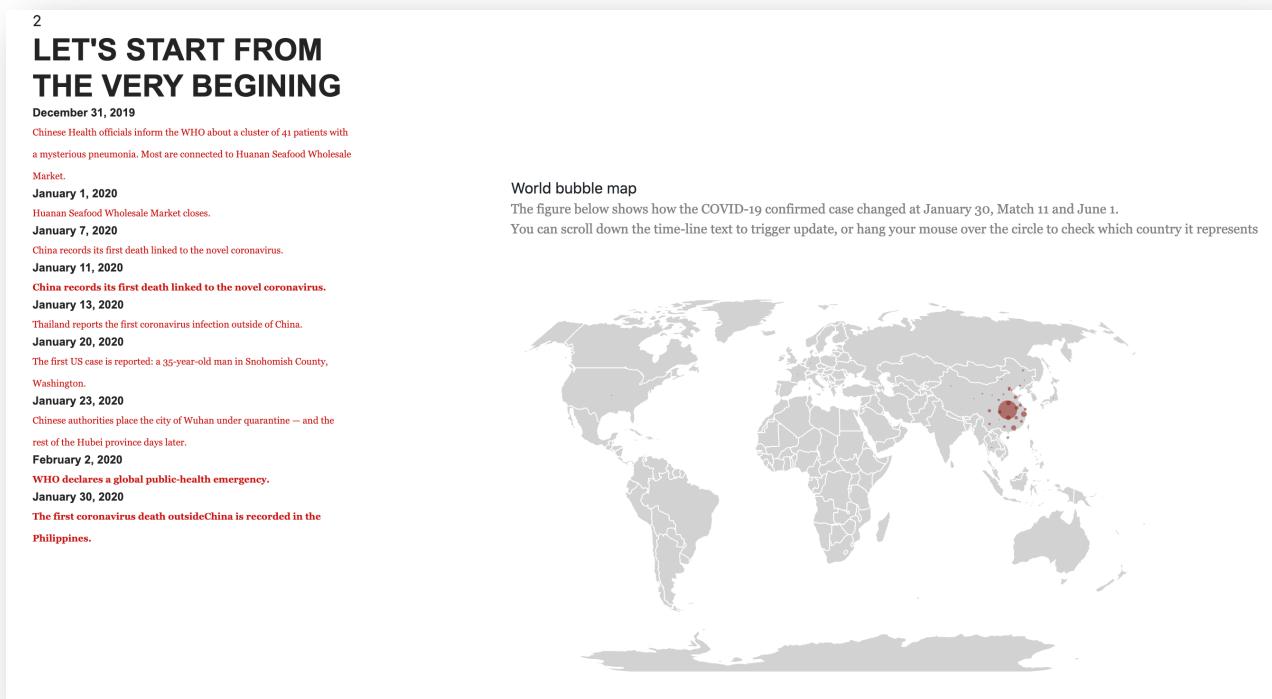
User guide

Scene one: welcome page



On the left, there is a floating down arrow to remind user scroll down to begin. This page is just suitable for viewing in full window, no time to do window size compatibility. So, remember to turn on full screen browsing.

Scene two: bubble map with timeline



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TRUMP'S TWEETS NOT WORKING

March 23, 2020

New York City confirms 21,000 cases, making it the epicenter of the outbreak in the US.

March 26, 2020

Total confirmed cases in the US reach 82,404 — the highest in the world — surpassing China's 81,782 and Italy's 80,589.

March 31, 2020

More than 1/3 of humanity is under some form of lockdown.

April 2, 2020

The world passes 1 million COVID-19 infections.

April 7, 2020

Roughly 95% of all Americans are under lockdown, as 42 states issue stay-at-home orders.

April 10, 2020

The global death toll surpasses 100,000.

May 21

The number of global COVID-19 cases surpasses 5 million.

WHY THIS HAPPENS

Now it's time to stop to look back. everyone in this world affected by the covid-19 more or less. At least I'm study at home and doing this research.

Have a look at how covid-19 spread all over the world.

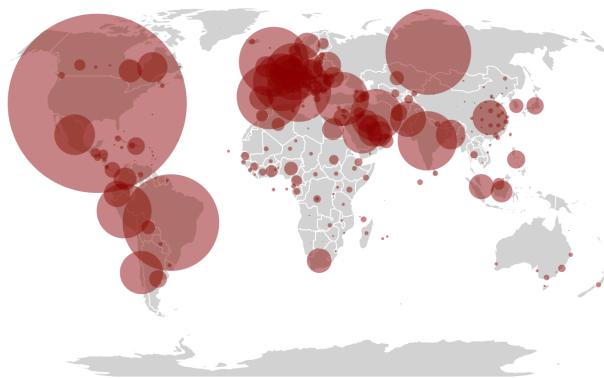
first China, then country nearby, then west to European, then west to

United state. All the way to west. Why it spread from east to east.

World bubble map

The figure below shows how the COVID-19 confirmed case changed at January 30, March 11 and June 1.

You can scroll down the time-line text to trigger update, or hang your mouse over the circle to check which country it represents



On the left the text container shows the timeline of COVID-19, when specific data is in the middle of view, it will trigger the bubble map to update accordingly.

- The reverse is set to be false. Thus, you need to scroll to the top if you want to see the animation again. Only three time period is updated at January 30, Match 11 and June 1.
- Interactive: When the figure is pined on the central of view, hang over the mouse to see the country name.

Scene three: case type bar chart

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HOW ABOUT THE RECOVERED/DEATH

The rank is based on data for June 1, 2020. The United States is now far ahead in terms of infections and deaths, following is Russia, then Italy.

The death toll in Europe is not encouraging either. The UK's abysmal

recovery numbers are linked to its ageing population. Outbreaks in the

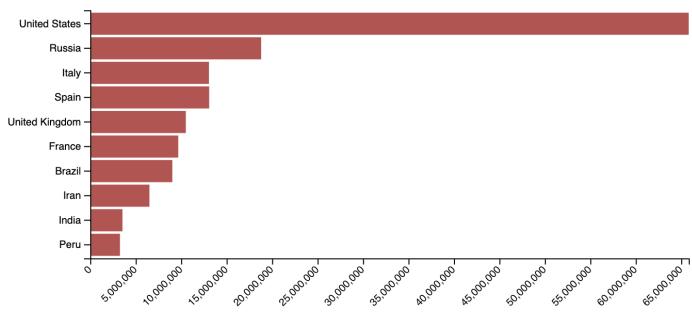
Middle East also began gradually in mid-year.

Top 10 most most-affected countries bar char

The figure below shows how the COVID-19 confirmed/recovered/death case by the end of May

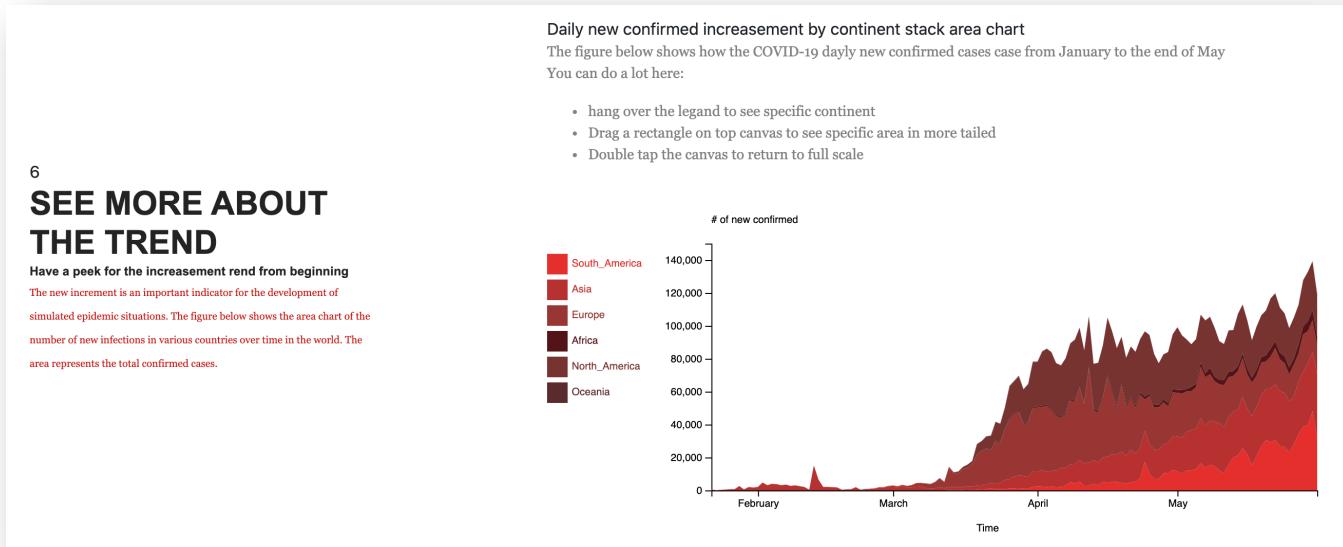
You can click the button to choose which case type you want to see

Confirmed Recovered Death



The bottom on top of bar chart can filter the data to specific data type, only top 10 most affected countries are shown here, data is for June 1,2020.

Scene four: stack area chart

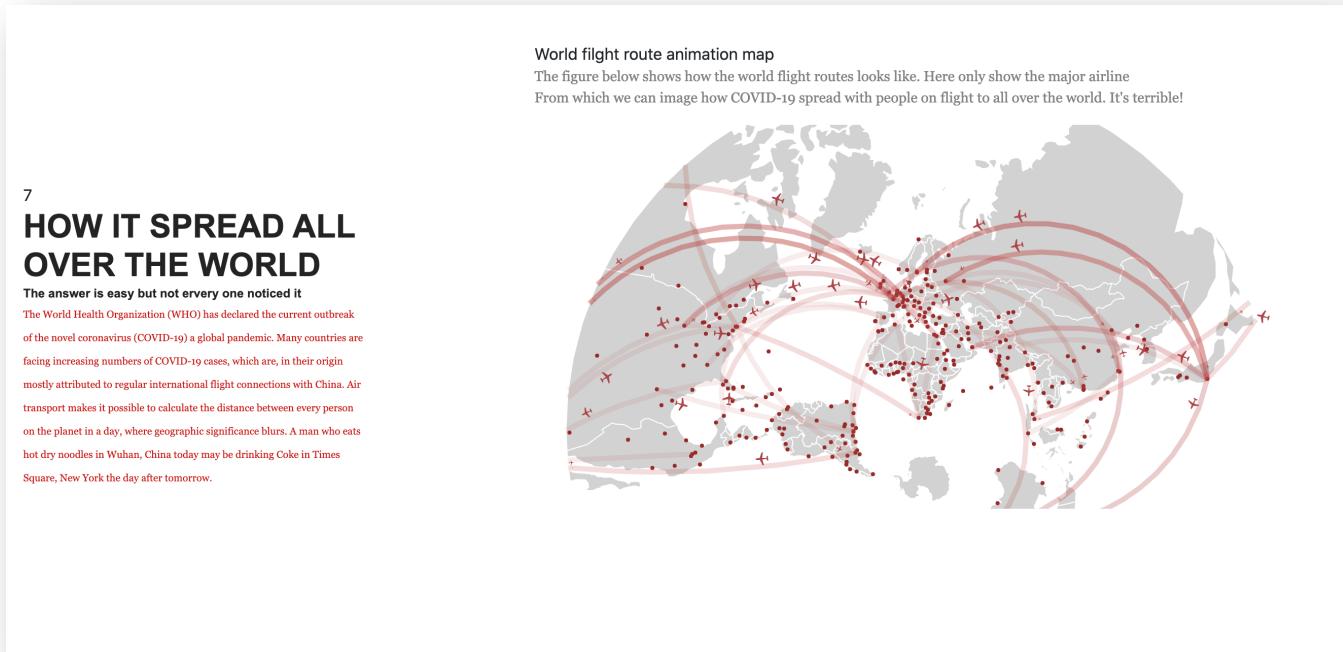


Here I choose continent as category to see how epidemic trend looks like. It's clearly to see the Asia (mostly for China) is started at the early stage, then the whole world fell.

The stack area chart has multiple interactive options:

- Hang over the legend to see specific continent
- Drag a rectangle on top canvas to see specific area in more tailed
- Double tap the canvas to return to full scale

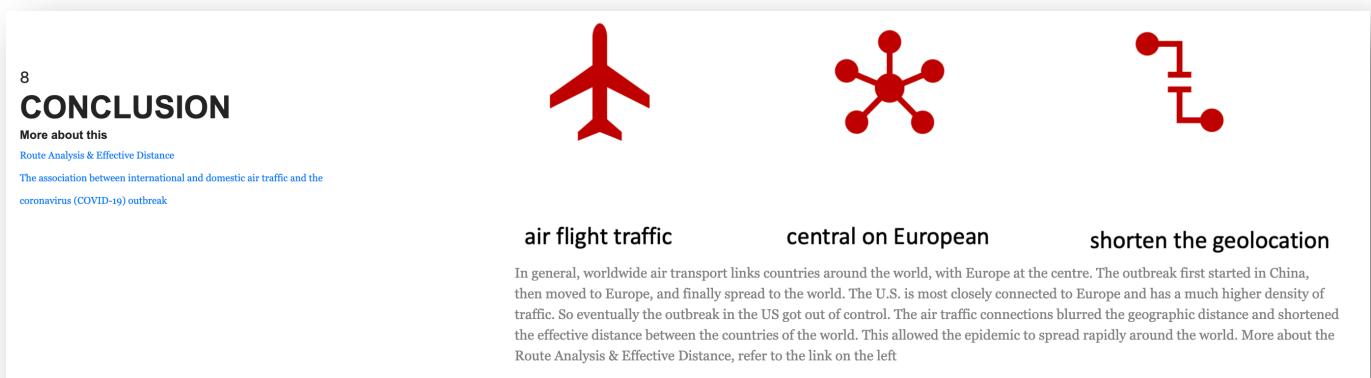
Scene five: connection flight map



The flight animation flow map shows how the world flight routes looks like dynamically. From which we can image how COVID-19 spread with people on flight to all over the world.

- Noticed it is not the real time, flight dataset real time API is expensive.
- Here only show the major airline, and the open flight dataset is for 2012. But it is enough to show the flight trend.
- For map projection, I choose geo-Stereographic to project the world map on central of European, where is the traffic central of our world.

Scene six: Conclusion/discovery



A very brief conclusion about the answer to my question. On the left, click the link to see more about this conclusion.

Conclusion

In general, worldwide air transport links countries around the world, with Europe at the center. The outbreak first started in China, then moved to Europe, and finally spread to the world. The U.S. is most closely connected to Europe and has a much higher density of traffic. So eventually the outbreak in the US got out of control. The air traffic connections blurred the geographic distance and shortened the effective distance between the countries of the world. This allowed the epidemic to spread rapidly around the world. A more in-depth analysis is available here(http://rocs.hu-berlin.de/corona/docs/model/visual_analytics/).

In order to achieve a good narrative and interaction, I added scrollable text next to the figure a third-party perspective to interpret the chart. And in most spaces, I leave it to the user to explore and discover for themselves. Trying not to interrupt the user's wanderings with too many numbers, my target users are not scientists or experts on the subject.

I didn't do a good enough job on how to integrate the air route information with the epidemic information. In the pre-defined scenario, the outbreak information by country and by air is interlinked and can be presented as a force linked connection map. The user can clearly see that the countries are not connected by geographical distance, but by flat air routes. This actually helps us to understand the relationship between the outbreak and the air routes. Because air transport makes it possible to calculate the distance between every person on the planet in a day, where geographic significance blurs. A man who eats hot dry noodles in Wuhan, China today may be drinking Coke in Times Square, New York the day after tomorrow.

Bibliography

- Flight Animation with d3.js. (2020). Retrieved 22 June 2020, from <http://www.tnoda.com/blog/2014-04-02/>
- Holtz, Y. (2020). Basic stacked area chart in d3.js. Retrieved 22 June 2020, from https://www.d3-graph-gallery.com/graph/stackedarea_wideinput.html
- Holtz, Y. (2020). Horizontal barplot in d3.js. Retrieved 22 June 2020, from https://www.d3-graph-gallery.com/graph/barplot_horizontal.html
- McConchie, A. (2020). D3v5 map example. Retrieved 22 June 2020, from <http://bl.ocks.org/almccon/1bcde7452450c153d8a0684085f249fd>

Appendix

Five design sheet 1

1. Ideas

2 Filter

3. Categorize time-series data / tabular data

4. Combine and Refine

5. Question

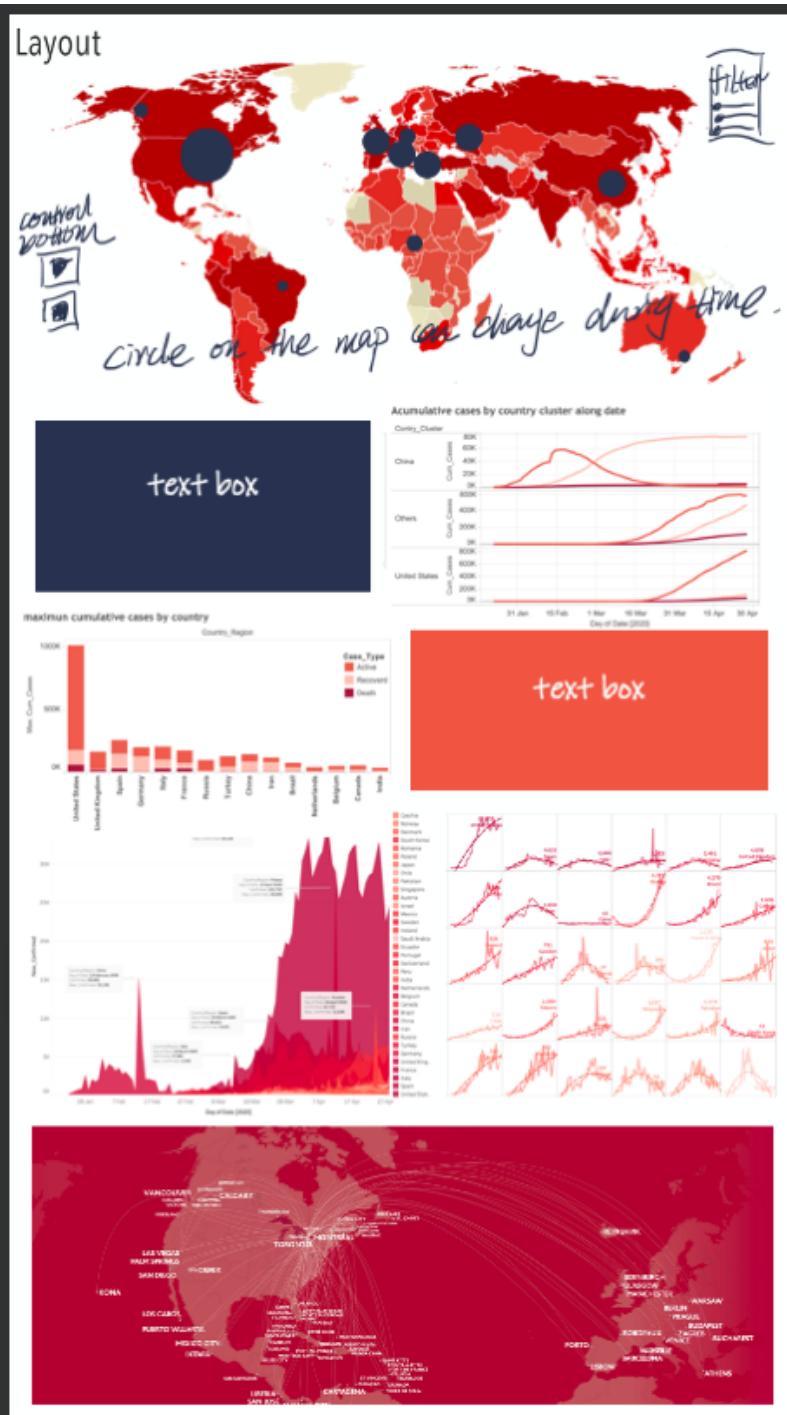
How COVID-19 spread all over the world?

- where and when is started?
- how fast it spread?
- How the epidemic center moved?

Any latent pattern behind the epidemic?

- Air flight routes
- population composition

Five design sheet 2



Focus

- Data visualization as a dashboard, providing the full access for all data we have.
- It provided the real time updated information for the COVID-19, people can visualize and interact with it. Doing some search and filter to see what they are interested.

Title: COVID-19 dashboard
 Author: Songhai Fan
 Date: 1 June
 Sheet: Option one
 Task: COVID-19 data viz

Operations

- control button for animation for time series data;
- filter different categories cases number;
- annotation to label important event;
- all the chart is link to the time-series data, should change while play bottom is pressed;
- For page limit, only data for top% countries are shown, but if user want to see data visualization, there is search option that can check the data for specific country.

Discussion

PRO:

- The sheet is shown detailed information for COVID-19.
- The trend line for small-multiple can clearly show the future trend.
- line chart and bar chart is easy to read and understand.

CON:

- lack of narrative, there are basically no story telling.
- no relationship visualization.

Five design sheet 3

Layout

scroll down timeline

time-line process bar

filter

different category

70%

ed

important event label

At the end of webpage the final (current) state is shown

click each country will show the history

text box

text box

Title: COVID-19 rank timeline
 Author: Songhai Fan
 Date: 1 June
 Sheet: Option two
 Task: COVID-19 data viz

Operations

- No control bottom, instead page scroll down, the time start counting.
- timeline process bar shows the percentage from beginning to current date.
- vertical bar chart represent the ranked data simultaneously.
- click on map will pop up tooltip to give more information.

Discussion

PRO:

- immersive experience, clear timeline representation.
- good narrative.

CON:

- less link for air flight routes or population composition to epidemic data.

Focus

- time-line, and bind it with website scrolling, which can provide more immersive experience. The final map representation can show at the bottom of website, after scroll down to the end.
- rank of different countries, shows how this rank change during the whole timeline.

Layout

Show accumulative cases number worldwide.
History over chart, also as a time line.

move mouse can see change along time-series

transition from map to net graph

tooltip shows detail

text box

text box

Title: COVID-19 net graph
 Author: Songhai Fan
 Date: 1 June
 Sheet: Option three
 Task: COVID-19 data viz

Operations

- Area chart can control the play time.
- Scatter points in a map can be converted to scatter points in a relational net graph.
- Tooltip and label to provide more detailed information.

Discussion

PRO:

- immersive experience, clear timeline representation.
- good narrative.

CON:

- two graph contains similar information, if it is only for smooth the transition, too over.
- should provide more information.

Focus

- The relationship between cumulative case numbers and air flight routes;
- The transition between different graph is narrative. It is telling story rather than just switch graphs.
- Shown relation from geo to abstract net graph.

Five design sheet 5

Layout

scene 1
text
description

scene 2
text
description
time line

area figure show cases number

scene 3
text
description

scene 4
text
description

text box
some responsible feedback quiz; information link;
reference; dataset statement

Title: COVID-19 dashboard

Author: Songhai Fan

Date: 1 June

Sheet: Final design

Task: COVID-19 data viz

Operations

- scroll down control animation for time series data;
- select and choose time scale to show the related data;
- time-line act as a whole time period preview;
- filter different categories cases number;
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- force-linked diagram show how the countries connected according to air fight routes.

Detail

- the tooltip circle can show the specific detailed information;
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