Effect of Pandemic on the Airline Industry

Chia Chi Dai, Prajakta Khandve, Sanya Singh, and Simran Makandar

University of Southern California, Los Angeles, CA, USA

Abstract. In section 2 we present related visualization work, in section 3 we present the data set used, in section 4 we explain how we designed and the process we used to build the system, in section 5 we showcase the main aspects of the website we have built and finally conclude with section 6

Keywords: Covid · Airlines · Visualization

1 Introduction

As we are living through pandemic and with much of the world closed for business, it may be months before airlines could operate flights as they did before. Multiple airlines have already gone bankrupt and are out of business, we have Avianca, Virgin Australia Trans States Airlines and a few more. Our viz shows the changes in the number of flights, when the drop actually happened (April, May and June) and also user can visualize the steady recovery of travel.

- **Motivation**: From 2015 to 2019 the industry saw a boost with an average of 30 billion US dollars profit which soon went into a loss of 85 billion US dollars. We have built the visualizations to highlight the level of pandemic impact to flights for regular passenger to make travel decisions.
- **Scope of visualization**: The audience of our visualization are passengers who wish to travel abroad via flight and are unsure about the current status of airlines. These visualizations will give them enough insights about the impact of COVID in their own region, and at airports around the world.
- **Contributions/Brief Description:** Our dashboards are original in a way that we have, Region-wise comparison of all 6 regions/continents (Asia, Africa, Europe, North America, South America, Oceanic) between covid19 cases, and whether it is safe/easy to travel to either of these regions. We have a comparative analysis of rising covid19 cases against the change in number of flights flying across regions(multi line graphs under region-wise section), countries(d3 map under Map section) and airports(mapboxgl under Airports-mapboxgl). We capture the most affected airlines under the Airports section thus giving us an economic downfall. Further, it showcases the most active airports by their sizes, ie. whether large, medium, small or heliports. More importantly, it captures the top 10 busiest airports during the pandemic allowing travellers to choose the right airlines and airport for the travel.

2   Related Work

- **@SirBenedick on GitHub:** [1] A page demonstrating the aviation traffic difference from January to May between 2020 and 2019 with Cartograms and Line charts.
- **flightradar24.com**   [2] analyzed the drop in March and showed it with spatial visualization. This has directly affected the number of airplanes in the sky.
- The aviation industry's unprecedented free fall from the coronavirus pandemic already has forced some airlines into bankruptcy, and others are on the brink. **Washington Post** [3] reported the drop with links on Choropleth Map and highlighted it with the policy change among countries.
- Our project focuses on changes in the international flight services due to COVID and depicting their steady recovery. We have provided wider view of the effect of pandemic with global map, and also combined it with the drop in number of flights.

3   Data

Data is a crucial part of any visualization. Considering the goal of our visualization we needed to show covid and impact of covid on airline industry side by side. There was no availability of such a data-set which provides details of both corresponding to each other. We had to create our own data-set as per requirements for every graph. Starting with selection of **OpenSky Crowd sourced** [4] along with the **covid CSSEGISandData from GitHub** [5] we had found our two major data-sets for working with,

- **Data set - OpenSky Crowd Sourced Data**
  This data set is specially drafted to illustrate the changes in airlines across the globe during the pandemic. This data contains 10 attributes in total. They are as follows,
  callsign: the identifier of the flight displayed on ATC screens (usually the first three letters are reserved for an airline: AFR for Air France, DLH for Lufthansa, etc.)
  number: the commercial number of the flight, when available (the matching with the callsign comes from public open API)
  icao24: the transponder unique identification number; registration: the aircraft tail number (when available);
  typecode: the aircraft model type (when available);
  origin: a four letter code for the origin airport of the flight (when available);
  destination: a four letter code for the destination airport of the flight (when available);
  firstseen: the UTC timestamp of the first message received by the OpenSky Network;
  lastseen: the UTC timestamp of the last message received by the OpenSky

Network; day: the UTC day of the last message received by the OpenSky Network.

– **Data-set - CSSE covid 19 time series**
Further we needed latest covid data as per every country hence we picked time series covid19 confirmed global data set from the CSSE covid 19 time series on GitHub.

– **Pre-processing of data sets** - The data-sets were pre-processed considering reduction of file size, summarized data, use of minimum storage space and merging two different pieces of datasets. Using Node.js for scripting we needed to pre-process the data as follows:
Removed *number, registration, altitude1, altitude2, firstseen, lastseen* data columns from files for every month, Summarized the covid data for every day to months from January 2020 to September 2020. Addition for origin country, destination country, origin region and destination region corresponding every record in the OpenSky Crowd sourced data. For Airports-MapBox we needed to get coordinates of all airports and their corresponding destination coordinates to where airplanes have travelled.

4 Approach

Our approach was to show the pre-covid and covid effect on airline industry. Design is as follows:

– **Home Page** - It has routes to our graphs (Region-Wise, Map, Airport, Airport-MapBox)
– **Region-Wise** - We have multiple graphs on this page which focus on the effect of covid on airline at a very high level at every continent, these continents are Asia, Africa, Europe, North America, South America, and Oceanic.
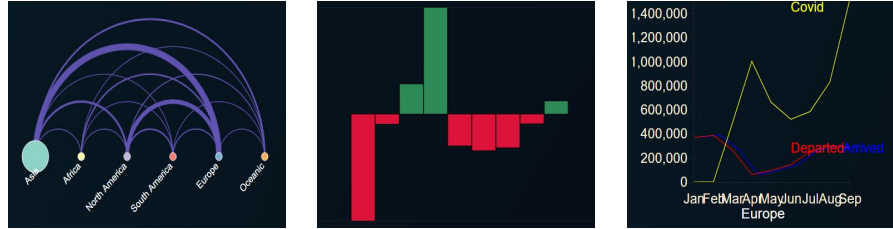

Fig. 1. Arc Graph, Bar and Line Charts

1. **Multi-line graphs** - For every continent it compares the covid cases and the number of flights arrived and departed for months starting from January, February, March, April, May, June, July, August and September. These are responsive in nature in a sense they would adjust to the screen size.

2. **Arc Diagram** - This new layout of d3 graph, helps users get a summary of the connections between all regions. The links joining 2 continents has a different width for every connection and it indicates the number of flights that flew between the two continents. The radius of circle for every continent represents the number of covid cases for the region. We have a selection for month above the arc diagram thus allowing users to get this summary for the required timeline.

3. **Bar Charts** - The bar charts are two KPI indicators thus indicating whether it is easy to travel to a region and the second indicating whether it is safe to travel to a region. Easy to travel is a measure of the difference between the number of flights activity between two months. If there is an increase in the number of flights then it is easier to travel indicating a green signal else a red signal indicating it might have a decrease in flights making it difficult to travel to the region. Similarly, safe to travel captures the change in number of covid cases for a region and indicates green if the cases have decreased and a red if the cases have increased.

4. **Transition Graph (Bar graph)** - It let us check the number of covid cases per continent.

- **Map** - A d3 map showing all the flights from one country to another with the confirmed cases of COVID cases per month. We can easily see the drop of international flights global-wise from April and steadily recovering until now.

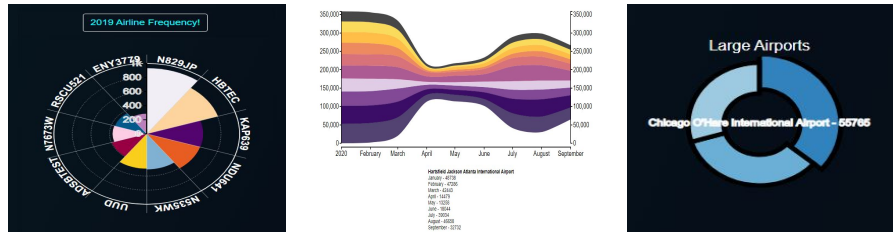- **Airports** - An in-depth analysis of the effect on covid9 on airports.

Fig. 2. Radial Graph, Stream graph and Donut Chart

1. **Radial bar graphs** - Comparing the frequency of top 10 airlines that most got affected (having the most percentage decrease from 2019 to 2020)

2. **Donuts** - Divided the airports according to their types and for each type, I have shown the top 3 airports that are having the most number of flights (incoming and outgoing) - i.e. most active during the covid drop (during April, May, and June)

3. **Stream graph** - It shows the flow of how flight frequency changes from Jan 2020 to Sep 2020 for the airports that are having the most number of flights throughout.

– **Airport-MapBox** - The mapboxgl world map takes input an airport and a month thus indicating the outgoing airport activity for all the available airports for the given month. This provides an insight at the airport level.

5   System

– The technologies we used are **D3.js, React-Bootstrap, HTML, CSS, JavaScript, NodeJs** for the scripting in order to process the data files.
– Our website's home page is a beautiful video about the covid giving users an idea of what exactly we are looking at. We have varied level of information at every tab - Region Wise page which includes a summary at the continent level of how airlines have been affected at the highest level of the hierarchy. Further we have the Map which goes a level down in the hierarchy and displays all countries in different shades darker representing the most number of covid cases and lighter representing the least number of covid cases further the links connecting the countries represent the number of flights that flew between those two countries. Further the Airport has the summary of how airports are performing during the pandemic, while airport-mapbox gives us an idea of how many airplanes are flying from a certain airport.

6   Conclusion

Our dashboard let's us to come to a conclusion that for Asia and Europe the number of covid cases are still growing and hence the flights have decreased and are now steady. For NA, SA, Africa and Oceanic the covid cases are dropping. The flights in the month of April were at all time low in the entire world. Chicago O'Hare and Dallas Fort Worth International Airport has been the busiest airports of all times. We have also captured the airlines that most got affected and shown the transition in their frequency when compared to 2019.

7   Contributions

– Chia-Chi Dai - worked on world map and react deployment
– Prajakta Khandve - data cleaning and region-wise analysis dashboard
– Sanya Singh - worked on analysis of airports and airlines dashboard
– Simran Makandar - worked on visual presenting

References

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