Development of a visualization tool

Forest Fire Analyser

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Abstract

Forest fires are a major environmental issue, creating economic and ecological damage while endangering human lives. As so, occurrence estimation is a powerful tool in preparing for such events. In order to facilitate this necessity, Forest Fire Analyser was developed. This is a tool that allows analysts to evaluate the development of forest fires through time and compare it to the panorama of other regions to restrict the causes behind these phenomena.

Motivation and objectives

The growing environmental crisis indicates a necessity in the industry of tools that allow, simple and thorough, analysis of the efficiency of measures applied in fighting it. The endeavour of this project is founded on the desire of making such technology available to a broader audience, lacking when it comes to theme of data processing.

Users and the Questions

When studying the evolution of forest fires through time one might come up with questions such as:

- What was the most affected year over the last twenty years? And what happened that year?
- Which were the most affected zones? And what justifies these differences?
- Were there improvements in the frequency on fires? Where?

Normally, the people asking these questions would be analysts, environmentalists, or government officials. Some scenarios in which these users can utilize the Forest Fires Analyser tool are: government staff working on Forest Fire Prevention Programs; non-profitable organisations for environment preservation planning campaigns in defence of the Amazon Rain Forest; or even meteorologists studying the impact of dry seasons in semi-arid regions of Brazil in the last few years.

With that in mind, the application was developed to be as simple as it was aiming for a fast and intuitive learning process, leaving more sophisticated functionalities for the more curious user.

Dataset

The dataset chosen was taken from Brazil's Ministry of the Environment, more specifically the data of the number of Forest Fires per state, per month, from 1998 to 2017. This dataset contains five features: Year, State, Month, Number of Forest Fires, and Period (an aggregation of Month and Year). [1]

Visualization Solution

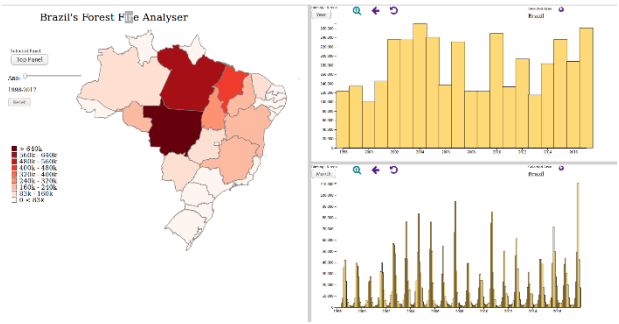

Figure 1: App overview

Overview

The solution developed comprises of a mixture of map and bar charts, fully customizable by the user.

The idea behind the designed layout is that the user can attain a generalized view of the problem at hand by inspecting the map and then progress to a more thorough analysis by transitioning into the bar charts.

Map

The map allows an evaluation of the most affected area at a single glance. Filters may be applied to the time lapse shown to evaluate the problem in a particular year.

Bar charts

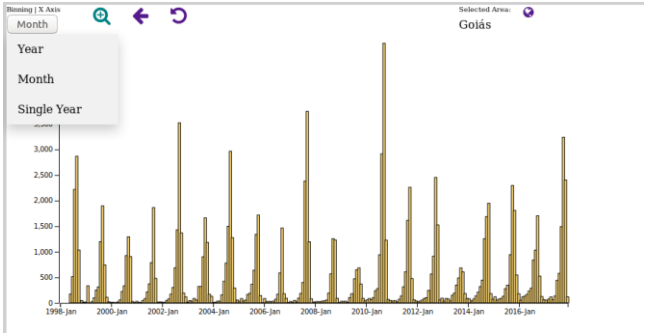

Figure 2: Bar chart

The tool's right panel enables a sophisticated analysis of the forest fire panorama in a particular state, or the whole country. Both chart sections of this panel are analogous, and their content can be modified directly by the user.

The functionalities of this section include the filtering of data in the chosen state by:

- Year throughout the whole period of the dataset;
- Month throughout the whole period of the dataset;
- Month throughout a single year determined by the user with a slider.

A time evaluation of higher detail may also be achieved by using the zoom functionality triggered by a zoom button and implemented by means of brushing.

Given the diverse set of options, the use of this tool is prone to mistakes. Because of that, individual rollback in each bar chart was deemed necessary, and is accessible through an intuitive button, or within the speed of a double click on the desired graph.

Cross-Visualization and User Interaction

As described in this section's introduction, the idea is to get a general evaluation with the map and transition to a more detailed evaluation in the bar charts.

As so, after deciding which state to inspect, the user may do so by simply selecting said state. This action will show the filtered data on the selected graph, which may be chosen in a dropdown menu, next to the map, or by clicking the desired chart.

The user might also find the need to go back to a general analysis with the map after discovering an abnormal time lapse in the bar charts. Such goal can be achieved by triggering the brushing functionality with the arrow button. The user can then select said time lapse with a brush and it will be plotted on the map.

Implementation challenges

The app was fully implemented in JavaScript using the d3 library [3]. A major obstacle in the implementation was the lack of vision at the beginning of the project as to the complexity the app would achieve in its final form. This led to the choice of less time-consuming code writing, which culminated in very time-consuming processes when adding functionalities nearing the end of the project (e.g., the implementation of a rollback button). Also, working with a choropleth map [4] was something the authors had never done before and necessitated further research.

Evaluation and changes in the prototype

The tool was inpected in terms of design and functionalities on three occasions. Two of them derived from the feedback of field experts, which implied the need of a functionality that allowed the user to go back to the map for further analysis, and the need of tooltips, as well as a more intuitive interface. The final feedback came from the tool's use by volunteers. This was used to measure the degree of "intuitiveness" provided by the current interface, which showed satisfactory results.

Conclusion and Future Work

The final product incorporates all the functionalities aspired in the beginning of the project. Nonetheless, further detail would be needed in order to provide a complete answer to the questions previously formulated. The bar charts should allow the analysis of a broader area of the map, and not just of a single state. Mathematical data such as, mean, standard deviation, variance and a measure of the evolution's derivative should be available on user's demand and the possibility of coupling the current visualization with data of other datasets of different matters (e.g., money investment in fire prevention per state) should be added.

References

[1] "Sistema Nacional de Informações Florestais - SNIF - Incêndios Florestais - Focos de Calor - estados - 1998-2017.csv," *Portal Brasileiro de Dados Abertos*, 11-Jun-2018. [Online]. Available: http://dados.gov.br/dataset/sistema-nacional-de-informacoes-florestais-snif/resource/949310f1-05bc-4f56-a63f-aef67aac6164. [Accessed: 19-Dec-2019].

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[3] M. Bostock, "Data-Driven Documents," *D3.js*. [Online]. Available: https://d3js.org/. [Accessed: 19-Dec-2019].

[4] D3, "Choropleth," *Observable*, 06-Nov-2019. [Online]. Available: https://observablehq.com/@d3/choropleth. [Accessed: 19-Dec-2019].