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Final Technical Report

## Visualization of Wildland Fire in the United States

**Abstract**

In 2018, the United States experienced one of the most devastating year for wildland fire in recorded history. There were 58083 fires, which burn more than 8.7 million acres area and cost 3.1 billion dollars for suppression in total. Nowadays, the fire season are about 80 days longer than that in 1970, and many of the largest fires in record happened in the past decade. The wildland fire has clearly becoming a serious problem, especially for those area developing near the forest boundary. This project intends to use visualizations to better illustrate the trend and impacts of wildfire in the United States using statistic data between 2010 and 2018. The rest of this report is devided into objectives, requirements, system descriptions, development platforms, proposed visualizations, and experimental analyses.

**Objectives**

The primary objective of this project is to visualize the wildfire statistics data from 2010 to 2018. The demographic factors analyzed in this project include the geographical distribution of the wild fire, the categorized wild fire causes, the number of death and destroyed structures, the affected area of wildfire, the duration of fires, and the cost for suppressing the fire. By analyzing the wildfire statistics from the aforementioned perspective, users can have a better view of how the trend of wildfire changed in the past several years, and more specific, what kind of wildfire is becoming more threatening to our daily life.

**Functional Requirements**

The major function of this project is to retrieve, summarize and show the wildland fire statistics, among the federal and by states, such that users are able to filter out useful information from the mass data. The data should be obtained from the data source and then manipulated and cleaned up, in a way that can be effectively visualized. The users should be able to interact with the system and choose which type of data is displayed. The system should be structured into several sections, each of which should be responsible for one specific topic. When hovering over the graphs, additional information should be displayed to better explain the meaning of the proposed numbers.

**System Architecture and Description**

The original data is queried from the National Fire and Aviation Management Web Applications System (FAMWEB) server via a web API, then downloaded and stored as a raw CSV file. A python script is used to extract useful information from the raw data, grouping the fire events data by date, states and causes, and further reconstruct the data with aggregating functions to transform the data into table-like format. For visualization, the data is segmented into bi-dimensional tables with each table representing a particular perspective. The preprocessed data and tables are stored locally and can be imported by D3 for further visualization.

**Development Platforms**

The front end of this project is implemented using an HTML webpage with bootstrap and CSS. The layout of the webpage is structured with a toolbar, a control panel and a chart area for navigation, filter data and visualization, respectively. Users are able to filter out data by clicking on the checkboxes and sliding bars in the control panel, and a set of JavaScript is responsible to manipulate the displayed data accordingly. The visualization will be created using D3 JavaScript library and Tableau. More details about the visualization will be discussed in the following section.

**Proposed Visualizations**

The animation of this project will be implemented using D3 library. High level summary of wildfire statistics, such as the consistence of causes in each year, is proposed in a pie chart. Clustered bar charts will be used to demonstrate the suppression cost. In addition, the states level statistics such as severe wildfires in each state will be illustrated using a geometric chart, highlighting the locations and the severity of the fires. For more detailed data, bubble charts and bar charts will be used to show the impacted area, the duration, and the damage to the community.

**Experimental Analyses and Conclusions**

The number of fires in each year has a large variance between years, yet the total amount of suppression cost shows a clear increasing trend. In Geometrically, western area, especially the California, has more severe wildfire situation, in regarding to the total number of fires, the impacted area and the damage to the community. For the cause of the fires, different states show significantly different distributions. For instance, Campfire and Lightning are the most common causes of wildfire in AK, while Arson and Miscellaneous are the most common causes in NY. Moreover, in those states that lightning causes more wildfires, the damage to the communities are usually lower than those states with more human caused fires, while the former might have higher acre burned in each year. A possible explanation is that a state with more lightning caused wildfire, it is more likely to have a large area covered by forests. A typical example would be Alaska. On average, Alaska burned about 19% of the total burned area in the United States, while there were 0 death caused by those fire.

In conclusion, there are clear differences in cause and impact of wildfire among different states, and it reveals the fact that the wildfires in the United States have various types or patterns. To better understand the model of wildfires, various of models should be considered for different states are necessary and helpful.