Project Title: Interactive Visualization for Recommending Monthly Overseas Travel Destinations Based on Personal Ideal Weather

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Abstract:

An interactive visualization that maps monthly weather information (climate conditions) of countries around the world on a global map. It marks countries with ideal weather conditions for outdoor activities during that month with red flags. This will provide travelers with a data-driven guide on where to travel each month.

Introduction:

Sometimes, we feel the urge to drop everything and take a spontaneous trip. If you're considering traveling abroad, you might wonder where to go and which places have good weather. This project aims to create an interactive visualization to help with that decision. For people living in places with distinct seasons like Indiana, there's a desire to visit cooler places during hot and humid seasons and warmer places during cold seasons. Therefore, the goal is to create an interactive visualization that analyzes which places around the world have the ideal weather conditions for outdoor activities each month, recommending the best travel destinations for that time.It would be very beneficial if travelers could find destinations with climate conditions that suit them, based on objective average climate data for each month.

Since the goal is to recommend countries based on a person's ideal weather, I researched existing studies and visualizations that recommend travel destinations based on weather or help users find ideal climate conditions like temperature or humidity.

Several papers recommend travel destinations or routes based on weather or other factors as follows. Setiawan, E. B. et al. (2023) [1] present an Android-based application that provides travel route recommendations by visualizing optimal routes and the probability of rainfall along the way on a map. This makes the application more engaging by integrating weather predictions directly into the route visualization. However, while it includes an interesting visualization, it primarily focuses on route recommendations rather than recommending destinations, which differs from the focus of this project.

In contrast, Yoon, J. et al. (2023) [2] propose a machine learning-based recommendation system that focuses on providing accurate, customized tours by considering real-time external factors and tourist types. Rather than focusing on visualization, this system emphasizes precise recommendations using machine learning techniques, which again makes it different from the visual-oriented goal of this project.

Although these papers primarily focus on route recommendations or differ from this project's objectives, they still highlight the value of recommending travel destinations.

Zhang, L. et al. (2023) [3] developed a recommendation algorithm based on GCN for tourist evacuation route planning and designed a visualization system for scenic spot administration. In their visualization, they pin recommended travel spots on a map, similar to what is intended in this project. Pinning destinations on a map helps users easily see where to focus, which is beneficial.

Interactive visualizations that help find desired ideal temperatures or humidity levels include the following. First, myPerfectWeather (https://myperfectweather.com/) [4] is an interactive map that helps you find locations in the United States that closely match your preferred temperatures, precipitation levels, and/or amount of snowfall. While it uses various types of data, it only shows trends over time and lacks the function to combine different temperature information. Goldilocks Zone Finder (https://lukechampine.com/goldilocks/) [5] is an interactive map that helps you find locations in the United States with your perfect year-round temperatures. It's advantageous because you can check averages, min/max, and view by month, but it only considers temperature, which is a drawback. Both visualizations share the common disadvantage of being limited to the United States.

A visualization using climate data for the entire world is still lacking. Reference [6], although it doesn't use climate data, visualizes the arrivals of non-resident tourists/visitors, departures, and tourism expenditure in various countries using data from the World Tourism Organization. It uses a global map, which aligns with the interest in worldwide visualization. This shows that global-scale visualizations can effectively provide useful insights for users

As a result of reviewing various existing visualizations and research, it is clear that the task I am attempting does not currently exist, making it a fresh approach. I believe this project has high potential for practical and interesting use in the future.

Objectives:

The main objective of this project is to develop an interactive visualization that recommends monthly overseas travel destinations based on personal ideal weather preferences.

Specific goals include:

- Allow users to select a month on a world map. Upon selecting a month, red flags will indicate the recommended travel destinations for that time.
- Enable users to hover over each country to view detailed climate conditions for that month.
- Provide default recommendations based on common ideal weather conditions.
- Allow users to input their preferred weather parameters (e.g., temperature range, humidity), adjusting the recommendations accordingly.

Datasets:

Various datasets were considered for this project. HadCRUT4 (https://www.metoffice.gov.uk/hadobs/hadcrut4/) [7] provides global historical surface temperature data, and NASA's climate data portal (https://data.giss.nasa.gov/) [8] offers various global climate-related datasets. However, the WMO Climate Normals data from the National Centers for Environmental Information (NCEI) (https://www.ncei.noaa.gov/products/wmo-climate-normals) [9] was chosen because it is the most practical and convenient to use. The NCEI data is comprehensive, provides various kinds of up-to-date climate normals all at once, and is available in an easily accessible CSV format, making it suitable for this project .

The NCEI's WMO Climate Normals is a tabular CSV dataset providing climate normals information for countries worldwide. It includes the following 8 columns (data types):

- Precipitation
- Number of Days with Precipitation ≥ 1 mm
- Mean Daily Maximum Temperature
- Mean Daily Minimum Temperature
- Mean Daily Mean Temperature
- Mean Sea Level Pressure
- Mean Vapor Pressure
- Total Number of Hours of Sunshine

The NCEI dataset is advantageous due to its global coverage, detailed climate normals, and ease of use with Python libraries for data analysis and visualization.

Additionally, the Tourism and Transport data from UNdata (https://data.un.org/Default.aspx) [10] (which is used in the reference [6]) was also considered for potential inclusion. This dataset provides columns like tourist/visitor arrivals and tourism expenditure for each country, which could enhance the travel recommendations. However, integrating this data requires careful consideration, so it will be incorporated if feasible after initial development with climate conditions.

Visualization Methods:

The project will be developed using Python, leveraging libraries such as *Pandas* for data manipulation, *Matplotlib*,*Seaborn*, and *Altair* for basic plotting, and *Plotly* or *Bokeh* for interactive visualizations. Since the project aims for an interactive and user-friendly interface, tools like *Plotly* (which integrates well with Python) are suitable.

Reference [6] utilized Tableau as a visualization tool. There is a Python package called TabPy that allows Tableau to integrate with Python scripts. Considering this, using TabPy might be beneficial for advanced visualization features if needed. Exploring TabPy could provide the interactive capabilities of Tableau while allowing for Python-based data processing.

The visualization will involve:

- Mapping global data onto an interactive world map.
- Using heatmaps to represent climate condition distributions.
- Implementing interactive elements that allow users to select months, input preferred weather parameters and ranges, and hover over countries to see detailed data.
- Utilizing red flags or markers to highlight recommended travel destinations based on user preferences.

Also, data processing will involve cleaning the dataset, handling missing values, and normalizing data as necessary. The data will be structured to facilitate efficient querying and visualization based on user inputs.

Conclusion:

By integrating detailed global climate data with interactive visualization techniques, this project aims to provide travelers with personalized recommendations for travel destinations that match their ideal weather conditions each month. The use of the NCEI dataset ensures comprehensive and reliable data, while Python's versatile libraries enable the development of an engaging user interface.

References:

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