Title: MM802 - Visualization Mini-project
Date: 19/03/2019
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Project Title: World Population

1 Abstract

Many people are fascinated to know about the places in world. Not all the information available has their proper data visualization. In our project we have focused on the world population of each and every country on earth. It is very interesting to know that population in the world is currently (2018-2019) growing at a rate of around 1.07% per year which was 1.09% in 2018, 1.12% in 2017 and 1.14% in 2016. The current average population increase is estimated at 82 million people per year. We categorized and visualized data based on people's age and their gender. User's will be able to know about different countries information through a visualized graphs and charts. This project can benefit in the domain of schools, public awareness, social studies, environment population examining, life expectancy of countries and other key factors of population related traits of the country.

2 Introduction

World population is a web application which deals with showing different statistics of world population around the world among different countries. When searching for new places population user will like the data statistics to be more precise and properly visualized. Our main objective for this assignment is to assist user to find the statistics of world population in a proper visualized manner using different visualization technique like pie chart, bar chart and graph.

The datasets which we are using is from World Population API [5]. This is a free API accessible to everyone. The endpoint api's are countries, wp-rank, life-expectancy, population and mortality distribution. All the datasets are based on real time feedback and it updates regularly according to the real change of data.

There are some related works available on the world population data. In 2019 World Population by country [1] it shows the information on 2019 and 2018 population, growth rate, area and density of population in an area. The countries were also separated according to their continents. But they didn't show any visualized charts or tables to show the data. The population of all countries in 2019 are shown in real time. They also have shown the growth rate and accordingly a prediction of what will be the population in 2030 and 2050. In Current World Population [2] they have shown some historical data and populations from 1955 to 2019, some yearly change in population and percentage, median age, fertility rate, density and urban population percentage. They also have shown data of world population by region and religion.

3 Project status

Our main purpose was to represent world population data in visualized manner using data visualization techniques. We intended to create graphs or charts to show the data statistics in an organized way. By looking at the graphs user can not only analyze the world population but also can analyze population by age, population according to gender and remaining life expectancy of the population.

Roles and Responsibilities	
Rupali Gupta	Dataset gathering React-simple-map plotting Functionality of data visualization
Soumik Das	Dataset gathering Map zooming Designing of data visualization

4 Development environment

We believe that it is crucial to work on the latest technologies and be updated with the new trends, therefore we chose the latest libraries of React Javascript for web development and dynamic REST API for dataset. For more details on the development environment, please refer the below table:

Front-end development **Back-end** **Designing tools :** **Web browser :**	React Javascript Rest API (Application Programming Interface) Html / CSS Google Chrome

5 Development work

5.1 React Js: React JS is a Javascript library , basically used to build user interfaces. It can be either used as a development of single page or mobile application. Some of the libraries are:
- **React Simple Map:** It is a library of react components to make SVG maps. SVG stands for scalable vector graphics which is an XML based vector image format for doing interaction and animation [6].
- **React Chart** :React-chart-js is a library that represent data or information graphically. It provides an accessible way to visualize data, outliers and patterns in data. Some of the data visualization tools includes charts, graphs, map etc. For visualizing massive amount of data, visualization of data is an essential part.

Pie Chart	It is a circular statistical graphic. Generally used to illustrate numerical proportion. It divides the circle in individual slices.

Bar chart	Used to represent categorical data with rectangular bars. The bars can be plotted horizontally or vertically. The heights and lengths are proportional to the values.
Graph	Its an open source application Used to draw mathematical graph in a coordinate system.

5.2 Rest API: Rest stands for representational state transfer. It uses HTTP requests to GET, PUT, POST and DELETE data. It's also referred to as RESTful web service. The purpose of Rest API is to break down the transaction into small modules. Each module addresses a particular part of transaction. For our project we are using "World Population API - API Browser." World Population API - API Browser. Web [5].

5.3 Html/CSS: HTML stands for HyperText Markup Language. It describes the structure of an webpage using markup. Html elements are represented by tags and tag pieces of contents are like "Heading", "Paragraph", "Table" and so on and CSS stands for Cascading Style Sheets. It's very much connected with html and describes how html elements are to be displayed in the screens. It can control the layout of multiple web page at the same time.

6 How to run World Population

In our project we have included multiple features for visualizing our data. Since our main purpose was to visualize data on world population, we divided the parts in several different categories. As the user visits the website, it has the liberty to pick the country and visualize data accordingly. The following are the running of the project.

6.1 Map data visualization: Initially our front page will have the maps of world's countries and user can click on all the countries. User has the freedom to pick any country from the map. User will click to any specific country and the next page according to that will be shown for next user interactions.

Fig 1: Welcome Screen

6.2 Zooming of selected country name: In this criteria, if an user clicks on to a country that country will be zoomed in and will come into focus. The user will be ready to do the next interactions which depends what information does the user need of that specific country.

Fig 2: Zooming on selected country

6.3 Population by year: For this part, user will be able to select country name and as well as year. Then the population of that particular year will be shown. We are visualizing this data using a graph. In the x axis we will be having age increasing incrementally starting from 0 and in the y axis we are having the population. One major contribution of it is, if we hover over the graph then also the population will be shown according to the cursor where it is hovered.
User inputs: Country name, Year
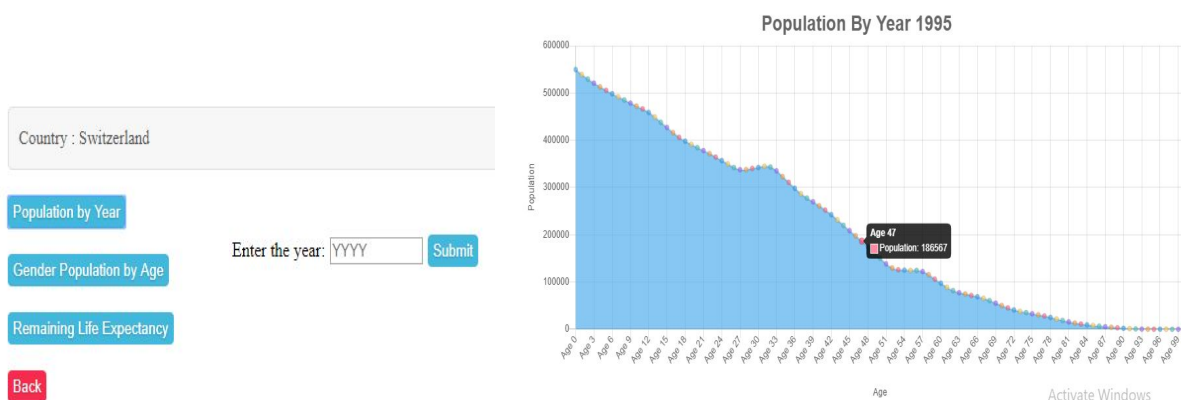
Fig 3: Population by year and Line graph chart

6.4 Gender population by age: When the user selects a country and also year, there will be visualized data on the distribution of population on the basis of gender (male or female). The Data visualization for this category will be for the current year statistics.
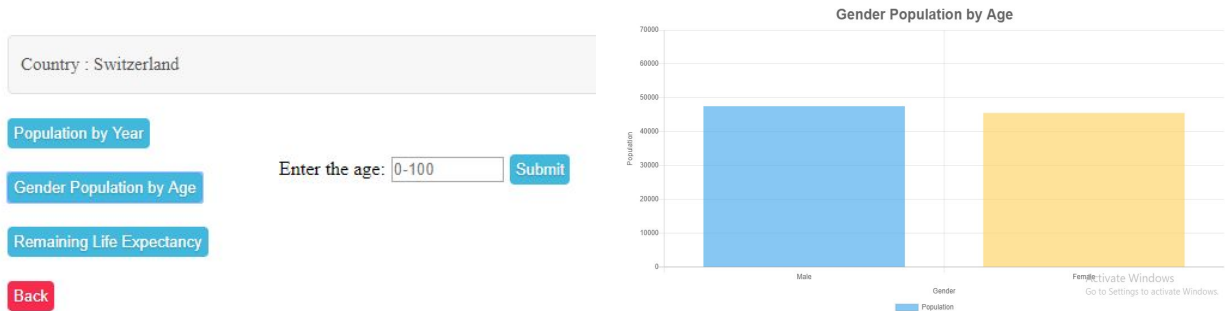
User inputs: Country name, Age

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Fig 4: Gender population by age and Bar graph

6.5 Remaining life expectancy: We are using a pie chart to show the life expectancy of the individual persons.
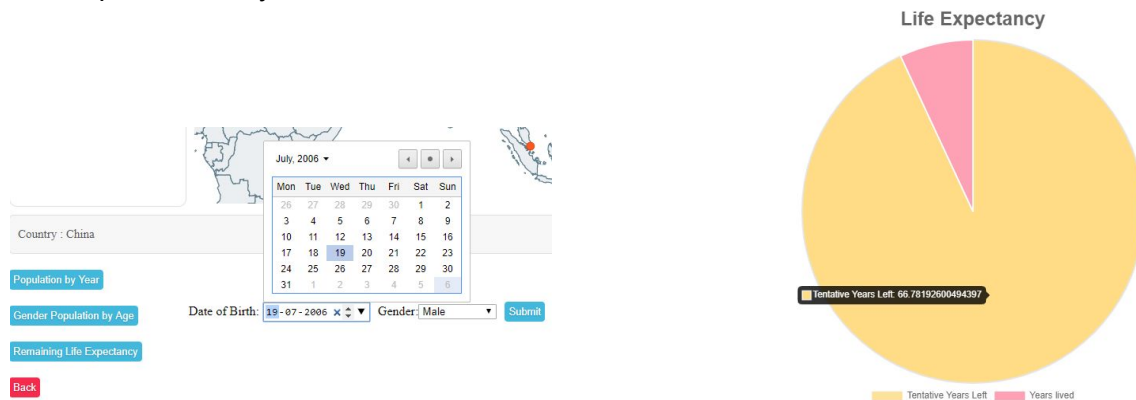User inputs: Country name, Date of Birth, Gender

Fig 5: Remaining life expectancy and Pie chart

6.6 More details when the user hovers over the visualized data: The user has the flexibility to retrieve precise information of each instance from the visualized data by hovering over the graphs, bars and pie chart formed as per the user's specification..
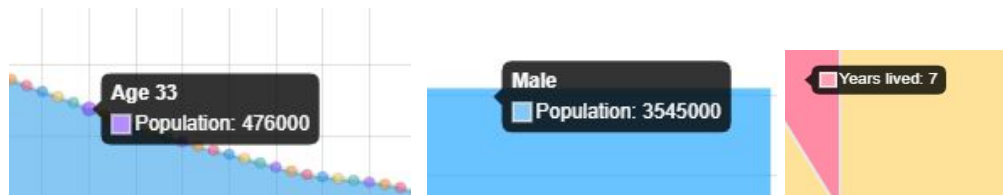

Fig 6: More details on data

6.7 Data calendar to select: This is an inbuilt function of input html tag which allows the user to enter the data in date format. We have used this data visualization technique for allowing the user to enter date of birth for remaining life expectancy.
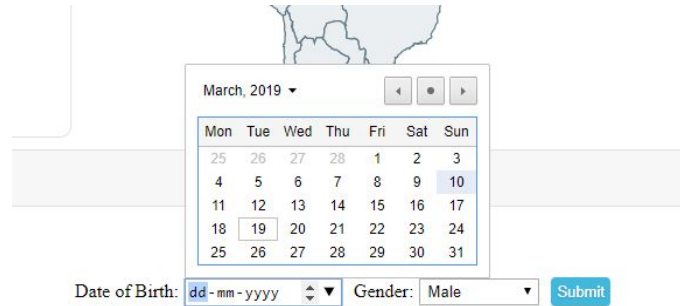
Fig 7: Calendar selection for date

6.8 Checks on the user input information:
- While entering the year user have to take input either year greater than 1950 or less 2050. If user takes the wrong input then there will be a pop up message showing that "Value must be greater or equal to 1950" or "Value must be less or equal 2050"
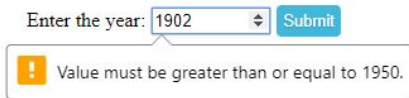

Fig 8: Data check for year

- For the second feature we have included that, if an user takes the wrong input of age like age greater than 100 or less than 0, then a pop up window will come showing that the "value must be less than or equal to 100" or "value must be greater than 0"
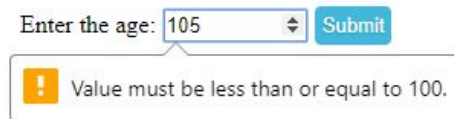

Fig 9: Data check for age

- User can not keep any field empty. He must select or enter any content. While selecting the gender if user doesn't select either male or female then it can not be submitted either, which means no data will be shown.
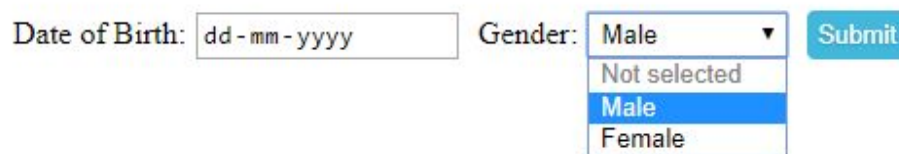

Fig 10:Data check DOB and gender selection

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8 Limitations

For our project we are currently limited to three charts which are Pie chart, Bar chart and line graph. In order to keep the application data visualization focused, we did not add interpretation details and random facts about the country. However, we can add these factors in future while developing an application on it.

9 Concluding remarks

We have successfully deployed the application having details of world population statistics. We were able to visualize the countries in world map format. As per the user's input, we are visualizing the world population data on the basis of Population by year, gender population by age and remaining life expectancies. We were able to accomplish all of the above mentioned tasks.

We have learned about different javascript libraries, how to import the dataset and visualize them. We also learned front-end and back-end development using server side or client side programming language like React JS. For designing we implemented using html, css. We gained hands-on experience in React JS and Rest API for website development. For data visualization we have obtained different data visualization techniques like pie chart, bar chart and graphs.

10 Future Work and Extensions

The future work can be a better data interpretation details for user. Including classroom module in the project to make it a fully function application which can be used by institute for educational purposes.

In the future we can extend our data visualization to other key information of world like crime rates according to country, total expenses for tourism, Employment and education rate in a country. We can include some further details like birth rate, share market information, profit a company makes, current news of the country.

References

[1] 2019 World Population By Country http://worldpopulationreview.com/
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[5] "World Population API - API Browser." *World Population API - API Browser.* Web. <http://api.population.io/>.
[6] SVG "Scalar Vector Graphics" https://www.w3schools.com/graphics/svg_intro.asp