**CSCI 552**

**Data Visualization**

**Project Report**

**World Earthquake Visualization**

Submitted by

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**Abstract**

The aim of this project is to visualize earthquake information based on real earthquake dataset. Data driven document (D3) framework and geo-visualization technique has been used to visualize data on the world map. The visualization of the dataset helps to quickly identify the location, date and magnitude of the earthquakes. To make the visualization user friendly, filter options have been used.

**1.Introduction**

Data visualization is a way of describing data by using a visual context and it helps to make information more understandable. There are many different tools and techniques present to visualize huge amount of data. Here, for our project a powerful visualization framework Data-Driven Documents, D3.js, has been used as a platform for creating visualization. It is a JavaScript library for manipulating documents based on data [1]. We have collected real earthquake data and visualize that dataset using D3.js. The dataset is available in National Earthquake Information Center (NEIC). The NEIC is a part of the United States Geological Survey (USGS), and it determines rapidly the location and size of all happening earthquakes all over the world [2]. Our data set contains 23412 rows of earthquake data since the year 1965 to 2016 with the magnitude level of 5.5 or greater. Each data instance contains date, time, latitude, longitude, magnitude, depth, time, source, status etc [3]. For visualizing each point date, latitude, longitude and magnitude have been used from the dataset. Our objective of this project is to visualize date and magnitude of earthquakes in different location using filter options.

This paper will discuss about our project technique description, interface design and results, results interpretation, insight gained and conclusion.

**2.Technique Description**

Geovisualization method was needed to use in the project. Geo graphic visualization refers a group of tools and techniques which support to analysis geo graphical data. It uses an interactive visualization technique to visualize continent, country on a world map [4]. D3 is a powerful library for representing geographical information using SVG, HTML5 and CSS and we used version 4 d3.js for the project. It provides some tools for geo graphic data representation from which we have used Geo Path and Projection. For generating geo path, we used d3. geoPath() function it does a mathematical transform between geographic coordinates and plane coordinates. Besides, Projection helps to transform spherical polygonal geometry to planar polygonal geometry. In this project d3. geoOrthographic() projection has been used. It is an azimuthal projection suitable for displaying a single hemisphere. TopoJSON script and world/110m.json are used for generating the base globe containing countries and land [5]. D3 can load data from different types of file format, but most commonly used file format is comma separated values (CSV). Our dataset “database.csv” is in csv file format. We used Latitude and Longitude for viewing our earthquake points as small circles on the globe. Then we collected information from the magnitude and Date attributes and used d3.tip() function to view those information on specific location point. The circle diameter depends on the magnitude range. But here our dataset contains magnitude value in a range of 5.5 to 8.2 as well as the magnitude scales of 5.5 to 6 are most common. Therefore, we have kind of similar size circles on the globe. There are some locations where multiple earthquake happened over time, so in those cases circles are overlapped. We used color filters to represent circles. When the magnitude level is six or greater it is represented by ‘red’ color otherwise ‘yellow’ color has been used. We have dragging and zooming options for the globe. D3 has libraries to handle drag and drop events easily. D3.drag() function has been used here for drag handling. And d3.zoom() is for the zoom handling purpose. Drag option rotates the globe which helps to view earthquake location of different side. On the other hand, zoom option helps to zoom a location that makes it easy to observe the exact location and nearby locations of the earthquake.

**3.Interface Design and Result**

Our Geovisualization contains the continent and countries so it is a simple globe. The primary output of our globe is shown in the figure 1.



Figure 1: Result represents Globe based on world atlas TopoJSON (world/110m.json).

After importing our csv dataset, we placed our earthquake points based on latitude and longitude values. And before applying our filter option we got our result like figure 2. In this time the visualization shows output with earthquake points based on color filtering with magnitude. Where, yellow points are earthquake location with below six magnitude besides red points are shown as greater than six magnitude earthquake points.

![A close up of a blue background

Description automatically generated]()

Figure 2: Result showing earthquake information based on database.csv

We added filter option that includes date range inputs and minimum magnitude scale input. These filter options help to show output depending on specific date range and magnitude scale. Figure 3 shows the output of the globe with the date range January 1st 2010 to December 31 2016 and magnitude level 6.

![A close up of a logo

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Figure 3: Output of the globe after filtering with date range and magnitude.

**4.Insight Gained**

When using the complete dataset (Figure 2), we can see that earthquakes often follow certain lines. These patterns are closely related to the tectonic plate boundaries in the Earth's crust. There seems to be some correlation between these, and based off previous knowledge, movement of the plates causes earthquakes. If we filter the entire dataset for earthquakes with magnitude greater than 7.5 and focus on Chile, we notice a substantial number of earthquakes along Chile. If we look at the dates for these earthquakes, we notice another pattern. Earthquakes of these magnitudes seems to occur around every 5-7 year. Since we filtered the data for magnitude greater than 7.5, we know that these are substantial and if we know that they are likely to occur every 5-7 years, then we can prepare accordingly.

**5.Conclusion**

This project was interesting due to dealing with real data. Based on this visualization, we can identify hotspots for earthquakes, as well as seeing the change over time. This potential information can be helpful for planning for these events.

**6.References**

[1] <https://en.wikipedia.org/wiki/D3.js>

[2] <https://en.wikipedia.org/wiki/National_Earthquake_Information_Center>

[3] <https://www.kaggle.com/usgs/earthquake-database>

[4] <https://en.wikipedia.org/wiki/Geovisualization>

[5]<https://github.com/topojson/world-atlas/blob/master/README.md>