

Visualizing Global Terrorism

Data Visualization | Instructor: Dr. Shiaofen Fang

Submitted By: Kishan Ramoliya | kramoliy@uemail.iu.edu
Ravikumar Shah | rvshah@iu.edu

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Motivation:

Terrorism is one of the most unlawful use of force and violence against humanity in furtherance of any political or social objectives targeting the whole world. Terrorism occurring throughout the world is known as Global Terrorism. Not only it kills people, but it also destroys entire livelihoods, economies, and the whole world order that took millennia to develop. There have been number of attacks that led to numerous disasters and eventually war too. The most dangerous thing about them is their unpredictability. [1]

Terrorism is one of the most sensitive topic right now. Considering the recent attacks on Germany, Paris, and many more, we are attempting to provide a visualization that shows how much each countries in the world has suffered from it.

The attack of 11 September 2001 on the United States clearly showed the challenge of global terrorism, while some other events highlighted the concern regarding the proliferation of nuclear weapons and the dangers from other non-conventional weapons used by terrorists which has underlined the potential and danger of mass destruction that a terrorist organization can make.

Sadly, some major terrorist attacks has continued over the years since 9-11 that includes attacks on UN headquarters in Baghdad (August 2003), on four commuter trains in Madrid (March 2004), on an office and an apartment block used by Westerners in al-Khobar, Saudi Arabia (May 2004), the London Underground (July 2005), a seaside area and shopping hub in Bali (October 2005), multiple sites in Mumbai (November 2008), the Marriott and Ritz-Carlton hotels in Jakarta (July 2009), and the Moscow Metro (March 2010), and many more. [2]

We can use this visualization to identify the level of threat to some countries that they face and compare them with other countries. There are some organization like UNO who works to achieve World Peace, this visualization can help them to visualize how much each country is suffering and can compare how many people has lost their lives due to this dreadful act of terrorism. By comparing the number of people killed we can predict the severity of the attacks and can predict how much each country is targeted by different terrorist organization. Everybody notices the attacks on major countries but there are some small countries that faces the same amount of attacks on their people. This visualization may help countries with power and ability to help other such small nations to prevent attacks and in the end achieve World Pease.

The above mentioned aspect motivated us to perform this visualization. This is our sincere attempt toward achieving World Pease.

Background and Data Set:

Global Terrorism Database (GTD) designed and maintained by University of Maryland is an open-source database that contains information on different terrorist attacks around the world from 1970 to 2014. There are many other datasets available that have same information but the GTD is the most systematic data on local as well as transnational and international terrorist attacks that have occurred and includes more than 140,000 rows of data. For each incident that falls into this category GTD has information about the date and location of the attack, the weapons used during the attack and nature of the target (i.e. who was targeted, government office or any other private organization), the number of people died, and the group or individual who was responsible for the attack.

Statistical information in the Global Terrorism Database extracted from reports from number of open media sources. All the information added are been validated and verified by the people who manages the dataset. Also the organization modifies the dataset if any new information is obtained about any particular incident regularly. The National Consortium for the Study of Terrorism and Responses to Terrorism (START) has made this data set available in an effort to improve the understanding of terrorist violence throughout the world so that it can be studied and defeated.

Some of the characteristics of the dataset is mentioned below:

- Information on over 140,000 terrorist attacks are included in the dataset.
- One of the most comprehensive and unclassified data base on terrorist attacks in the world contains information on more than 58,000 bombings, 15,000 assassinations, and 6,000 kidnappings since 1970.
- Each attacks is described by total 134 attributes.
- More than 4,000,000 news articles and 25,000 news sources reviewed to collect the information from 1970 to 2014.

There are some basic criteria upon which the data has to satisfy before it can be included in the dataset. They are as given below:

- Attack should be international.
- Attack should result in some level of violence.
- Attack should not be an internal state terrorism act.
- Enough evidence should be available that describes the motive of the attack.
- Attack should be outside the context of the warfare.

However there are some attacks whose definition overlaps between terrorism and other forms of crime and political violence, like insurgency, hate crime, and organized crime. In the same way, for many cases the information available is insufficient so those attacks are not included in the dataset. This demonstrates the how accurate and valid the dataset is. [3]

The data set is perfect for the visualization that we have planned, so we decided to use it and preprocess it and make it suitable for our use.

Technical Description:

Throughout the project following are the technologies and libraries that we have used:

- **Tools:** Visual Studio 2013 (for HTML and CSS portion), X-code 7.3, Tableau.
- **Languages:** HTML, CSS, JavaScript (D3 implementation), Objective C.
- **Libraries for D3:** d3.min.js, d3.js, topojson.v1.min.js, underscore_min.js, datamaps.world.min.js.

Following are the steps that were involved during our visualization:

- Collecting the suitable data from data set.
- Preprocessing the dataset collected.
- Use the processed data to visualize using Geo-visualization technique.

Collecting the suitable data from data set:

As mentioned above we have used Global Terrorism Database (GTD) designed and maintained by University of Maryland for our visualization. Data set has 134 attributes associated with each attack. For our visualization we have decided to use few of these attributes that are required.

Following is the description of the attributes we have used.

- **eventid** - numeric variable
Uniquely identifies each and every incident. First 8 digits is the date record i.e. “yyyymmdd” and last 4 digit is the case number at that particular date.
- **year** – numeric variable
Year in which the attack occurred.
- **month** – numeric variable.
Month in which attack occurred.
- **day** – numeric variable
Date in month on which the attack occurred.
- **country** – categorical variable
Identifies the code of the country in which attack occurred.
- **nkill** – numeric variable
Stores the number of total number of people died in the incident. This number includes all the victims and attackers who died as a direct result of the attack. There are many sources referred to get this number but only the most recent and valid information is stored in the dataset.
- **gname** – Text variable
Contains the name of the group who carried out the attack.

Apart from this there are 134 different attributes associated with each attack but for the sake of simplicity we have decided to use only the above mentioned attributes that satisfy our requirement of the visualization.

The data set has data about the attacks from 1970 to 2014 that has 140,000 entries in total. Incorporating the whole data set was slowing down our visualization, so we decided to visualize the data from 2000 to 2014 only which included 38,175 entries.

Preprocessing the dataset:

The data set has multiple excel sheet that stores data from 1970 to 1991, 1991 to 1992 to 2010 and 2011 to 2014. Since we decide to use just a part from the whole data set covering the 2000 to 2014 years, we were supposed to extract this part and store them separately. We separated the required data from the original data set and sorted them as per our visualizations requirement. The dataset was messy and had lots of null character in it which was important to remove.

The biggest issue in the visualization was to map the country code present in the data set to their actual name. The visualization in D3 expects the data in JSON format, so we created a script that will do so in Objective C that makes it possible.

Once we have obtained the data in the desired format, we used the same data to perform some visualization in Tableau just to make sure the data is proper and is useable and predict the results of the final visualization. D3 has quite a complex structure as compared to Tableau which is simple and easy to use and gives immediate results. Given below is the sample visualization screenshots for the same from Tableau.

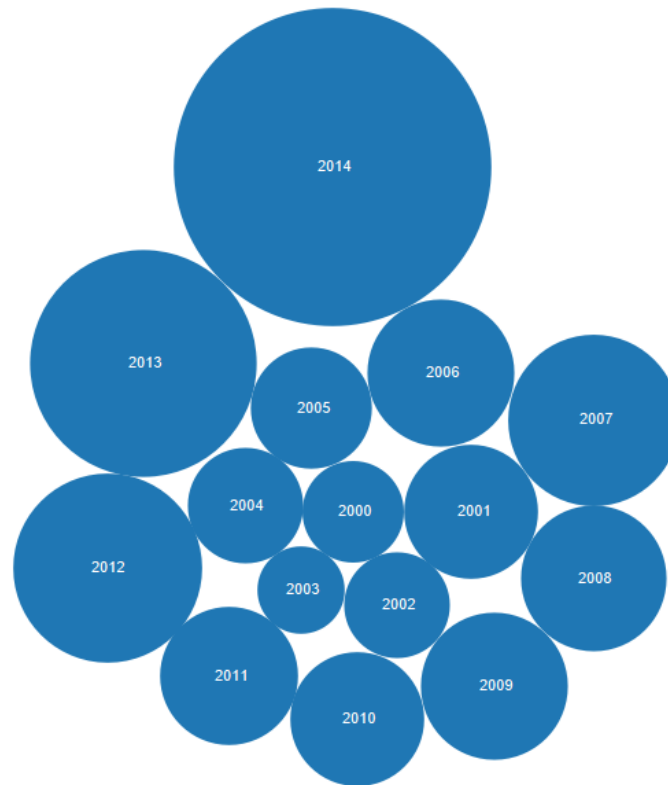


Figure -1

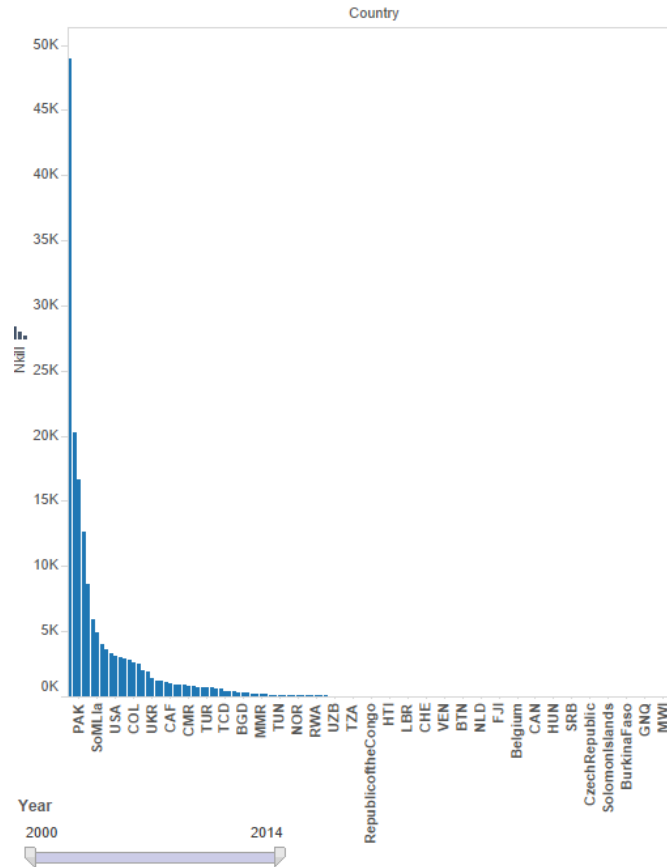


Figure – 2

Figure -1 shows the comparison of number of people died in different years in a bubble graph. Larger the bubble is, larger the number of deaths are and Figure - 2 shows a bar chart of the number of people killed country wise with a slider using which we can alter the range of the year whose result we want.

- Use the processed data to visualize using Geo-visualization technique

For our visualization we have used the Geo Visualization technique which is perfect to show the results country wise. Geo short for Geographic Visualization, refers to a set of tools and methods that supports geospatial data analysis using different interactive visualization. Static maps have a limited exploratory capacity but the Geo Visualization lets us link each region with the data associated to them. [4]

Here we have used D3 to perform the same that lets us to build interactive visualization and ability to render the changes to a map in real time according to the data filtered by the user. D3 is basically a JavaScript library that allows us to manipulate documents based on data. D3 helps us in bring data to life using HTML, SVG, and CSS. D3 combines the powerful visualization components and the data driven approach of the DOM manipulation without using complex frameworks. [6]

D3 is embedded within an HTML webpages, the D3.js library in JavaScript uses in-built JavaScript functions to select different elements and create SVG objects, style them accordingly, applies dynamic effects and add the tooltips to them. We have ability to style them using CSS. One of the

data format expected by D3 is JSON. We have used D3.js along with DataMap with TopoJSON to show the Geo-Visualization on the map. They have different libraries of the country to match the data with the corresponding country. DataMap is intended to provide some data visualizations based on geographical data. It heavily relies on the amazing D3.js library of D3. TopoJSON is just extension of the GeoJSON. It eliminates redundancy and offer much more accurate and clean representation of the world map.

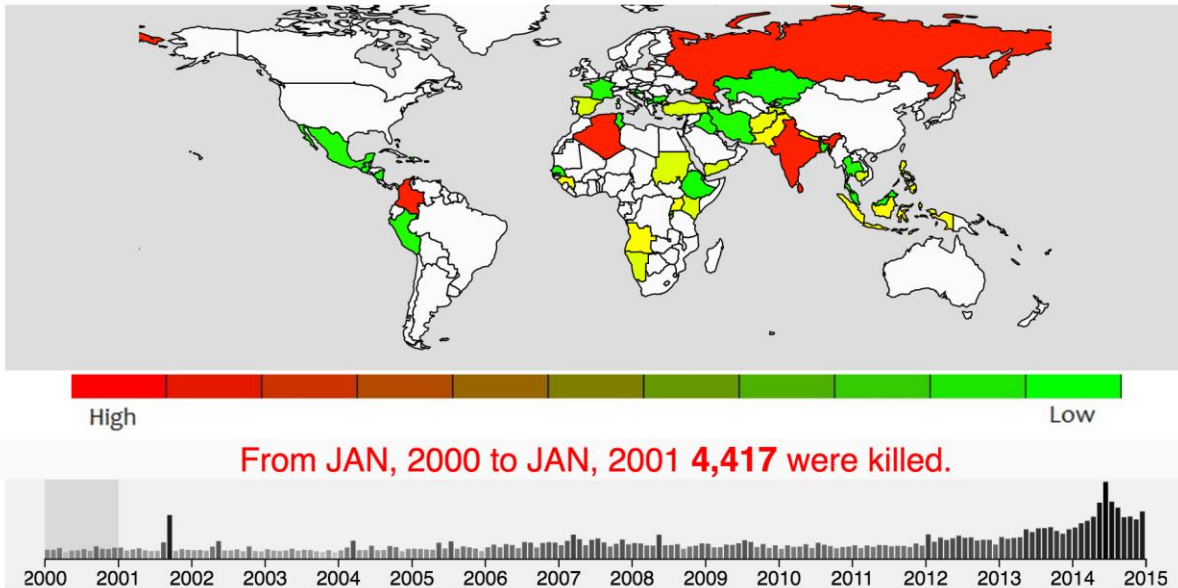
We have used different highlighting method for this visualization. They are described as below:

- **Color Desaturation:** It is used to desaturate the colors among the different countries. We represent different countries as per the threat levels on them, i.e. country highlighted in red is has suffered more number of deaths, countries highlighted in yellow has suffered less as compared to the countries highlighted in red and country highlighted green has suffered less number of deaths. If the number of people killed is zero in some country, it will be highlighted in white.
- **Brush:** Brush is the most crucial tool in our visualization. It provides user the freedom to select the range of the year he/she want to visualize. The brush lets user to play around with visualization and let's allow them to select the range of year that is to be visualized on the map. Moreover the data changing in the brush will change the appearance on the map interactively in real time. Brush contains some inbuilt function to be used in D3.js.
- **Bar Chart:** We have used Bar chart to show the total number of people killed in each month during each years in the brush section of the visualization. We have placed the bar chart in brush function. Moreover the bar graph color with different color density will represent the change in the number of people killed. Darker represents large number of death and lighter represent lower number of deaths.
- **Hover:** We have also provided the hover effect which is one of the important part in our visualization. It shows the number of people killed when the user hover the mouse on the country and it shows how many people have been killed during the attacks in total with the name of the country.

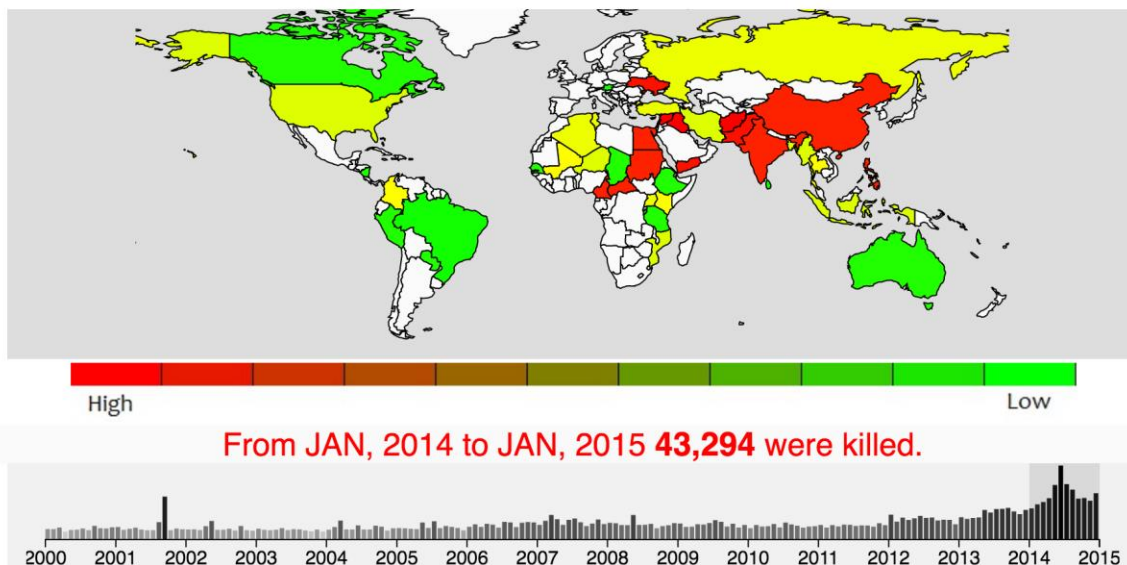
Results:

Following are the images of our visualization:

Visualizing-Global-Terrorism



Visualizing-Global-Terrorism



We can clearly see the variation in the design of the map. In the first image we have selected the range from 2000 to 2001 and in the second image we have selected the range of 2014 to 2015 and the corresponding change in the data maps can be seen in them. The first section shows the map, the image below shows the variation in the color range that varies as per the number of the

people killed. Below that shows the actual number of the people killed and the range that we have selected. In the end is the brush a.k.a. slider that lets us to select the range of the year which we want to visualize.

Future Work:

- We would like to visualize with other different highlighting techniques like categorical highlighting using leader lines, Depth of field etc.
- We would like to use more attributes from the dataset to analyze different type of situations.
- Incorporate the older data from 1970 to now in our visualization.
- We would like to compare with other geo visualization tools.
- We would like to add other parameters, which are useful to the defense department of the country to visualize data efficiently and smoothly, like which group attacked with which weapons and many more other parameters.

Critiques:

Positive Points:

- We can visualize the number of people killed around the world.
- We can see the number people killed country wise.
- The brush is really useful to see the data in the selected range so user can visualize the data as per their choice.
- The use of different color is the excellent choice that we made as without hovering/clicking we can get the idea about most affected country at the first sight.
- The color choice to show data is good, so user can analyses the data only with color.
- The bar chart we are showing in the brush was also a good idea to visualize the data for each month during the years.

Negative Points:

- It would be good if we visualize each month data country wise.
- If the number of kills reach to higher than it is showing all red color at some places.
- It would be good if we visualize the data about the number of deaths of male and female separately.
- It is not showing the group of attacker in the visualization.

Discussions:

We have implemented Geo Visualization technique, which we have learned in the class. We have explored more other highlighting techniques and learned how to implement them in D3. Moreover we have learned how to incorporated different third party library to the project and how to utilize them. We have learned about different highlighting method for geo visualization like color desaturation, depth of field and the crucial one is brush, which are available in D3. We have also learned about the gh-pages provided by GitHub and hosted our visualization on the GitHub itself. We also believe that the key to the visualization is representing the whole data in one page itself and we have achieved this in our visualization.

Visualization Contributors:

Ravi Shah

- Objective C code for data cleaning.
- World Map implementation and brush integration.
- Colors.
- Responsive view.

Kishan Ramoliya

- Page styles.
- Implementation of Brushed time scale on Brushed event.
- Individual Country visualization.
- World Map Optimization.

Acknowledgement:

We would like to thank Dr. Shiao-fen Feng for the great class and the lesson learned in the CSCI 55200 which were key in making this project a success. We would also like to thank Jiang Prince for his guidance during the semester was fruitful.

References:

- [1] <http://www.exampleessays.com/viewpaper/25330.html>
- [2] <http://www.un.org/en/globalissues/terrorism/>
- [3] <https://www.start.umd.edu/gtd/about/>
- [4] <https://en.wikipedia.org/wiki/Geovisualization>
- [5] <https://d3js.org/>