

TERRORIST WATCHER: AN INTERACTIVE WEB-BASED VISUAL ANALYTICAL TOOL OF TERRORIST'S PERSONAL CHARACTERISTICS

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ABSTRACT

Terrorism is a phenomenon that rose to its peak nowadays. Counter terrorism analysts work with a large set of documents related to different terrorist groups and attack types to extract useful information about these groups' motive and tactics. It is evident that terrorism became a global threat and can exist anywhere. In order to face this phenomenon, there is a need to understand the characteristics of the terrorists in order to find if there are general characteristics among all of them or not. However, as the number of the collected documents increase, deducing results and making decisions became more and more difficult to the analysts. The use of information visualization tools can help the analysts to visualize the terrorist characteristics. However, most of the current information visualization tools focus only on representing and analyzing the terrorist organizations, with little emphasis on terrorist's personal characteristics. Therefore, the current paper presents a visualization tool that can be used to analyze the terrorist's personal characteristics in order to understand the production life cycle of a terrorist and how to face it.

KEYWORDS

Terrorism, Terrorism analyst, Visualization, multiple views, data analytics.

1. INTRODUCTION

Terrorism existed since before the dawn of recorded history [5]. It becomes a concern to governments and a topic of interest to scholars. The ease of information transfer and the availability of the mass destruction weapons to small terrorist groups present danger to the security of the world. Most of the currently available tools and research focus on analyzing and understanding the terrorist organizations as a whole and the relationships among those organizations. Given the fact that the terrorism dominates global news and politics, it is remarkable how little we know about the members of those terrorist groups. There is an increasing need to study and understand the personal and demographic characteristics of the terrorists as well as their motivations. Therefore, there is a growing interest and a need in using visualization tools to make the analysis process more efficient, effective, and easier to perform.

Visualization is a promising solution because it takes advantage of the parallel processing capabilities of the human visual system and thus it allows for analyzing large quantities of data at a glance [1]. Moreover, visualization allows analysts to learn from exploration and to spot unexpected trends.

This paper presents, Terrorist Watcher, as a visualization tool to focus on the terrorist as a person rather than the organization as a whole. Terrorist Watcher can support the counter terrorism analysts to:

- analyze the personal characteristics of the terrorist and understand the relationship among them.
- examine how the terrorists that are from the same region can share similar demographic and behavioural characteristics.

Terrorist Watcher provides different levels of data analysis ranges from grouping visualizations to detailed visualizations. The design is human-centric that is based on simple interactive dashboards, bar charts, scatterplots, and a dynamic query tool. Those visualizations were selected because of their familiarity and ease of use. An in-depth description of the design choices is provided in section 3. The main contribution of this research can be summarized as follows:

- The focus is shifted from group based examination to individual based examination.
- The development of a web based tool that can be approachable and informative to the analysts.

This paper is organized as follows: section 2 provides a review of background and related work; section 3 presents the tool description; section 4 introduces a case study; section 5 discusses the future work, and the final section presents the conclusion.

2. BACKGROUND AND RELATED WORK

Terrorism becomes a critical problem for many countries. The human nature has not been changed but the elements that can make a terrorist has been changed. The greatest security threat that faces any country is not from well identified enemies but from terrorist organizations that target innocent people or forces informally. Those organizations use terror at any time and any place with the goal of spreading fear and instability in any country. The best choice to fight terrorism is through knowledge [7]. There is a noticeable increase in the number of literature related to terrorism as well as an increased interest in studying the terrorism phenomena. However, it is difficult to gain access to relevant data. Most of the available data are incomplete and they are not well presented. Several tools have appeared during the last few years with different concentration areas. World of Terror [10] is an interactive visualization of the 25 most prolific global terrorist groups and their activities since 1970. It shows the number of incidents for each group, along with the numbers killed and wounded, for each year the group was active.

Global Terrorism-Visualization (GTD) [2] consists of information on date, location, number of people killed and injured, weapons used, intention, group or individual involved and target. GTD Explorer is an interactive visualization tool that allows users to explore the trend of terrorism incidents over time [4]. Another interactive visualization tool is Jigsaw [8]. It represents documents and their entities such as people, places, dates or organizations to help analysts examine reports more efficiently. All of these tools are designed either to examine or visualize the different terrorist groups and how they are connected with each other or to visualize the different terrorist attacks. There is no tool that is developed to visualize the characteristics of the terrorists themselves as individuals. The tool that will be presented in this paper will add this new dimension to the terrorism visualization tools.

3. TERRORIST WATCHER TOOL FRAMEWORK

The proposed visualization tool framework used two phases to analyze the collected data such as follows:

1. **Phase 1:** The Data retrieval and clean-up
2. **Phase 2:** Data visualization and analysis

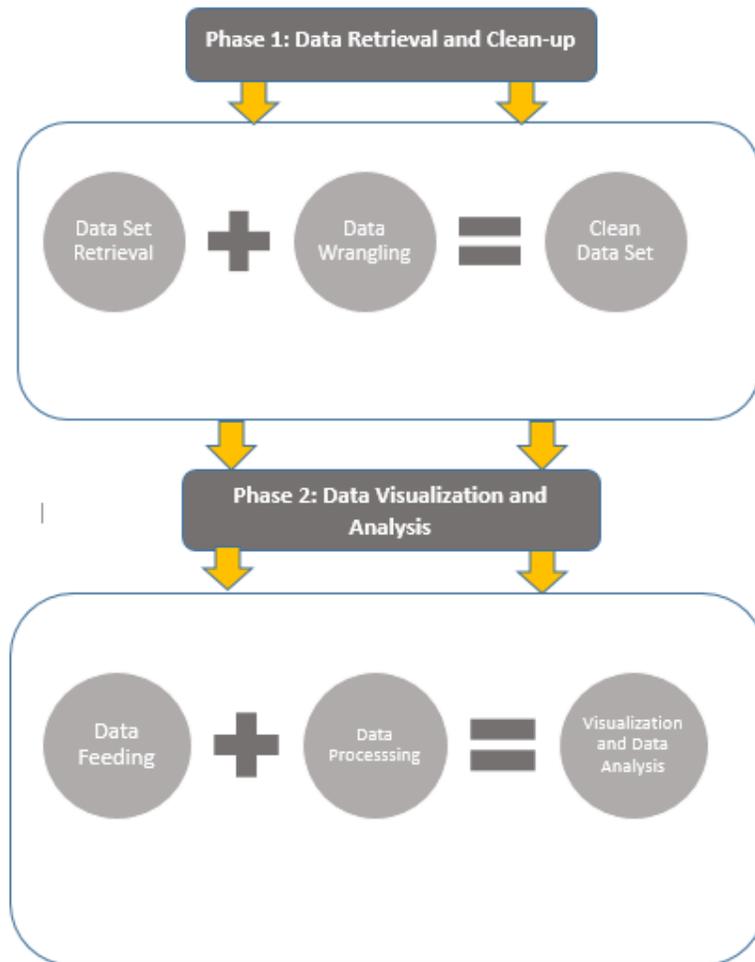


Figure 1. Terrorist Watcher Tool Framework

4. TOOL DESCRIPTION

4.1. Overview

As mentioned in the introduction, the idea of developing the Terrorist Watcher tool started with the analysis of the currently available visualization tools that are mentioned in the above section. The main limitation of the current tools is that they did not focus on the terrorist as a person and examine his personal characteristics which in turn prevents the analysts from drawing a big picture of what a terrorist is. With a better view of terrorist characteristics, the analysts and decision makers in every country will be able to identify how and which individuals in a given

environment may become a terrorist. In turn, they will be able to face the corrupted elements in that environment and take clear and strong actions to secure their people from the exposure to extreme behaviors and beliefs. The environment and motives that generate terrorists are different from one country to another and more broadly we can say from one region to another. With this fact in mind, the researcher developed a tool that focuses on the country as well as the regional level to examine the terrorist characteristics.

The proposed tool focuses on visualizing the interaction between the terrorist's personal characteristics as well as visualizing how the terrorists from the same country and even from the same region may share the same characteristics. The design of the tool is based on Schneiderman Mantra "Overview, Zoom and Focus, Details on Demand". The tool is developed with the assumption that all users prefer to get a general overview about the data and the topic before getting any further details. Figure 1 introduces the Terrorist Watcher visualization tool that depicts information about terrorists through three visualization views and a query engine.

Each view provides a different perspective onto the data. The query allows users to filter data based on their interest. The views that will be discussed in more details in the following sections include:

- The dashboard view that contains a bar chart and a pie chart in which connection between the entities are shown by coloring related entities.
- The scatter plot view that gives an overview of the relationships between any two characteristics of the terrorists.
- The bar chart view that displays the number of terrorists who are sharing the same characteristics in each country. Each demographic is presented in a separate bar chart.

4.2. Dashboard View

The dashboard consists of a bar chart and a pie chart. When the user interacts with any of the two charts, the view on the other chart will be updated automatically. Dashboard view is used to provide two levels of overviews.

The first overview is a General Overview that presents the continents. It visualizes the number of terrorists in each continent and then it divides the terrorists and displays their numbers and percent based on their immigration status.

When the user places the mouse over the bar of a certain continent, the pie will display the number of terrorists of this continent only based on their immigration status. When the user places the mouse over a pie slice, the bar chart will be updated to display the number only for the selected segment by continent and the color of the bars will be changed to the color of the selected segment as well.

The second level of overview is Per Continent Overview. Multiple dashboards are used. Each dashboard represents only one continent and each continent includes a group of countries. When the user places the mouse over the bar of a certain country, the pie chart displays the number of terrorists of this country only based on their immigration status. When the user places the mouse over a pie slice, the bar chart will be updated to display the number only for the selected segment by country and the color of the bars will be changed to the color of the selected segment.



Figure 2. The whole Terrorist Watcher’s interface

4.3 Scatterplot View

The Scatterplot View as shown in figure 1 highlights pairwise relationship between two different demographic characteristics. One characteristic is represented on the X axis and the second characteristic is represented on the Y axis. The user specifies through checkboxes the country to visualize. The user also uses two drop menus to select the characteristics that should be displayed on each axis.

4.4. Bar Chart View

The Bar Chart View as shown in Figure 1, counts the number of terrorists falling in each category. When the user selects a specific bar, its color will be changed and the number of the terrorists in this specific criteria will be displayed on the top of the bar.

4.5. Dynamic Interactive Query Tool

The Interactive Query as shown in Figure 1, is created to allow users to interact with the multi-dimensional dataset. The Interactive Query adds many advantages to the tool. First, it shows a large information space in a small display space. Second, it creates an interactive environment between the user and the data. Third, it allows the user to just focus on the data that is part of his interest. The users can select any country of their choice and conduct further analysis on its data. The results will be represented in two different bar charts. The first bar chart displays the number of the terrorists. The second bar chart displays the percent of the terrorists under the selected categories compared to the total number of the terrorists from that country.

5. CASE STUDY

This section will present a real example to describe the Terrorist Watcher capabilities in a more integrated fashion and to give an idea about what kind of information can be extracted with it. The data will be collected, visualized and analysed according to the framework that was presented in section 3.

5.1. The Data retrieval and clean-up

In this section the researcher presents a real-world example to describe the Terrorist Watcher capabilities in a more integrated fashion and to give an idea about what kind of information the analyst can extract. The case study used John Jay & ARTIS Transnational Terrorism Database (JJATT) [3]. The terrorists in the JJATT database are those who have directly contributed to the occurrence of terrorist attacks through participation in active terrorist networks. JJATT describes various demographic, organizational, and behavioral characteristics of individuals within the database. Demographic data contain socio-economic and country-specific information. Organizational data describe the positions that individuals attained within their respective groups. Some records have some missing data. In this case, the whole record was deleted in order to provide accurate results. Table 1 presents all the characteristics and the value of each characteristic.

Table 1. Used personal characteristics and their values

Database Attributes Codebook	
EdAchv	Education Achievement Highest educational level achieved by the individual Value Label 0 Less than High School 1 High School (completed) 2 Some College 3 Bachelor's 4 Graduate
FSES	Family SES For the first 10 years of life Value Label 0 Lower 1 Middle 2 Upper
POS	Position in Organization Value Label 1 Amir 2 Military Committee 3 Religious/Fatwa/Ideology Committee 4 Finance 5 Logistics 6 Local Leader 7 Regional Leader 8 Central Leader 9 General Subordinate

SocBG	Social Background Engagement in criminal and/or political activity Value Label 0 Nothing Abnormal 1 Criminal 2 Politically Active
YNatStat	Youth National Status Immigration status of the individual as a youth Value Label 1 Native (Family (parents/grandparents) 2 2 nd Generation / Minority (Born there, but family had immigrated) 3 Immigrant

5.2. Data visualization and analysis

Figure 2 shows the tool general overview. The bar chart presents the number of terrorists in Africa, Asia, Europe, and North America from left to right. The pie chart displays the overall number of the terrorists in each immigration status. In addition, when the user places the mouse on one of the bars, the color of the bar will be changed to a dark blue color and the pie chart will display the number of the terrorists in each immigration status in this specific continent (figure 3).

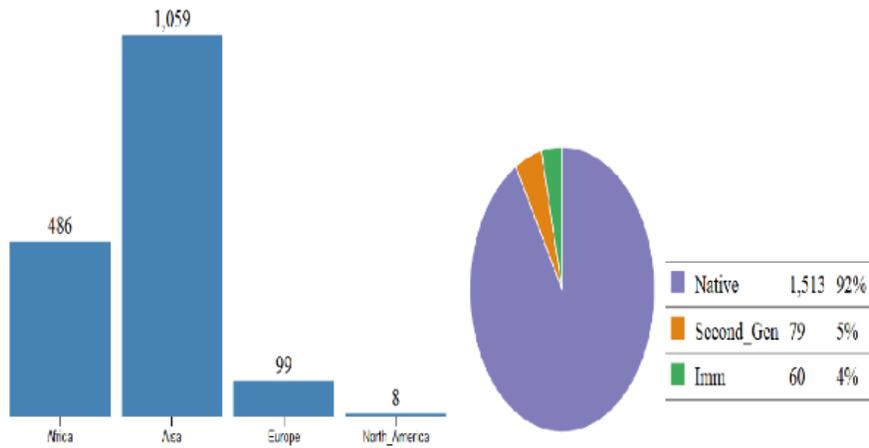


Figure 3. The overall overview-1

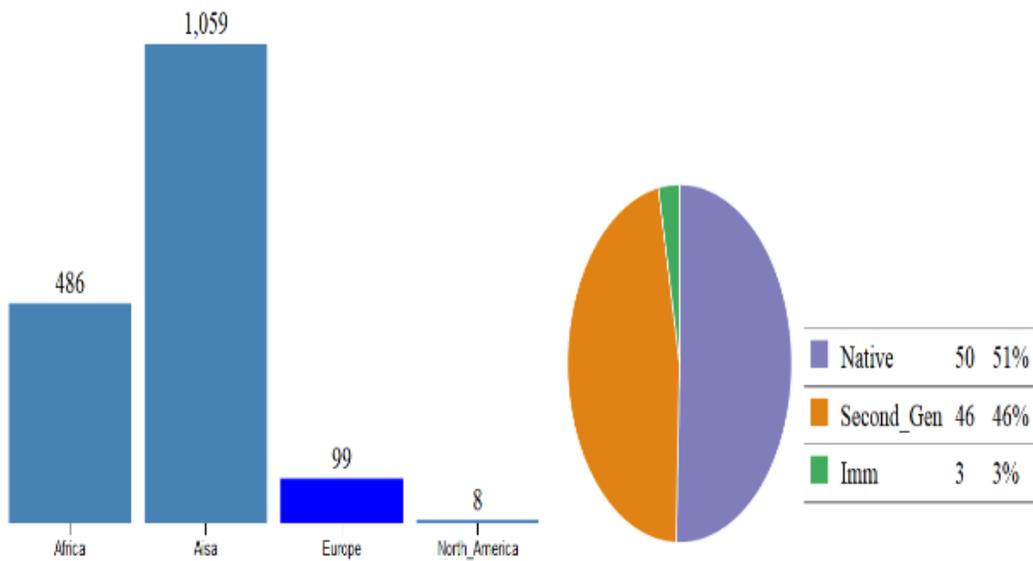


Figure 4. The overall overview-2

The second level of the overview is per continent overview. In this view, the bar chart presents the number of terrorists in the countries per continent. When the user places the mouse on the bar of a specific country, the color of the bar will be changed to dark blue and the pie chart will display the number of terrorists in each immigration status. Figure 4 displays that France has 48 terrorists. Five of the terrorists were native, 38 were second generation, 2 were immigrant and 3 were unknown. Figure 5 displays that Morocco has 138 terrorists. Seventy-six of the terrorists were native, 1 was second generation, 8 were immigrant and 51 were unknown.

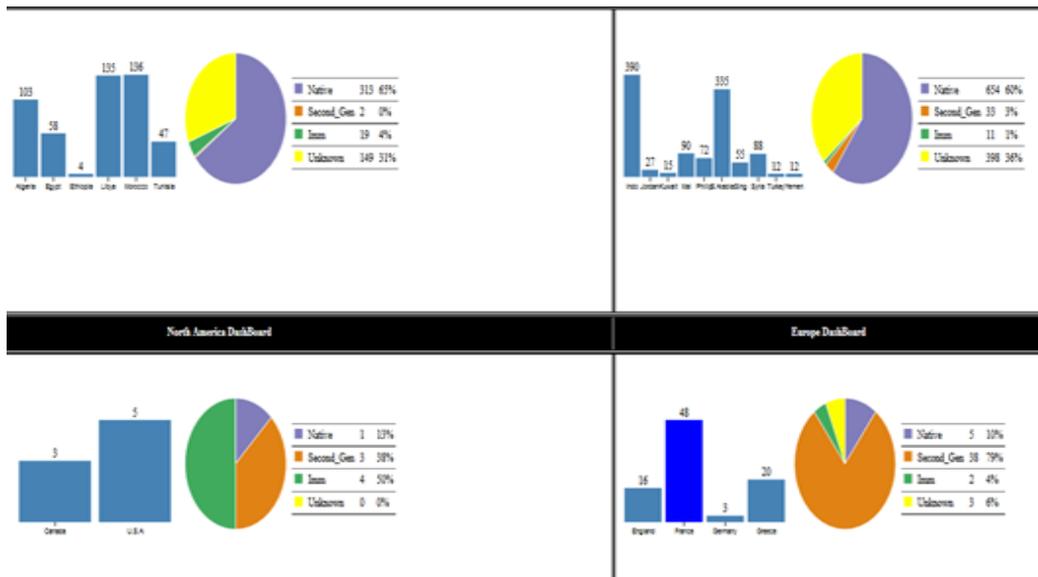


Figure 5. Per continent overview for France

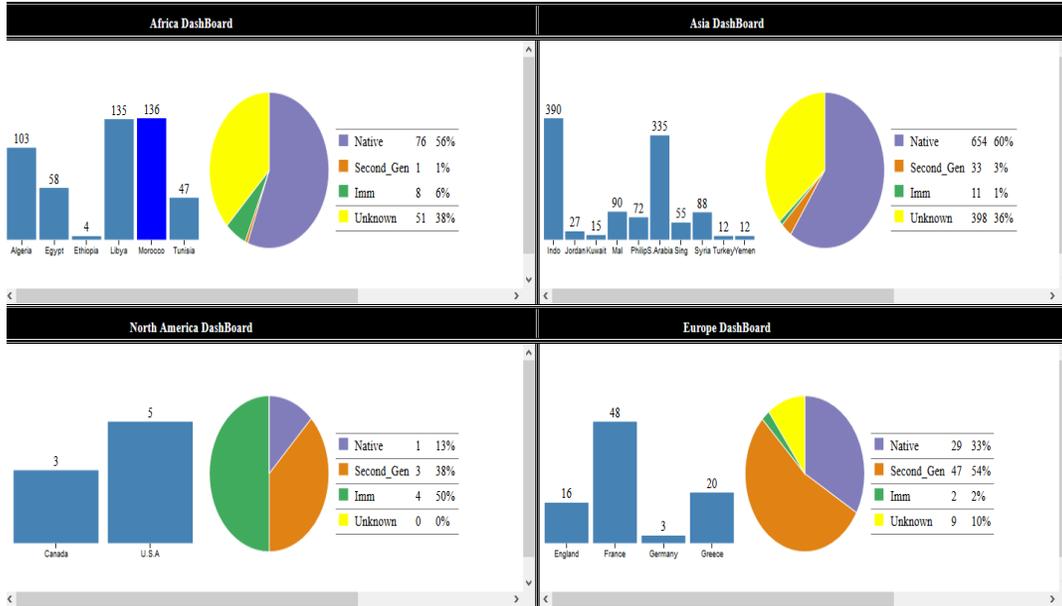


Figure 6. Per continent overview for Morocco

Figures 6 and 7 present the bar chart view for France and Morocco in sequence. When the user places the mouse on a certain bar, its color will be changed to dark orange and the number of the terrorists will be displayed on top of the bar. The figures present that number of terrorists who fall in the four main categories which are educational achievement, family socio economic status, positions inside the terrorist organization, and the social background. Figure 6 indicates that most of the terrorists in France have a high school degree, are from low income families, and most of them worked as leaders or general subordinate in the terrorist organization. In addition, figure 6 shows that most of the terrorists did not have a criminal history.

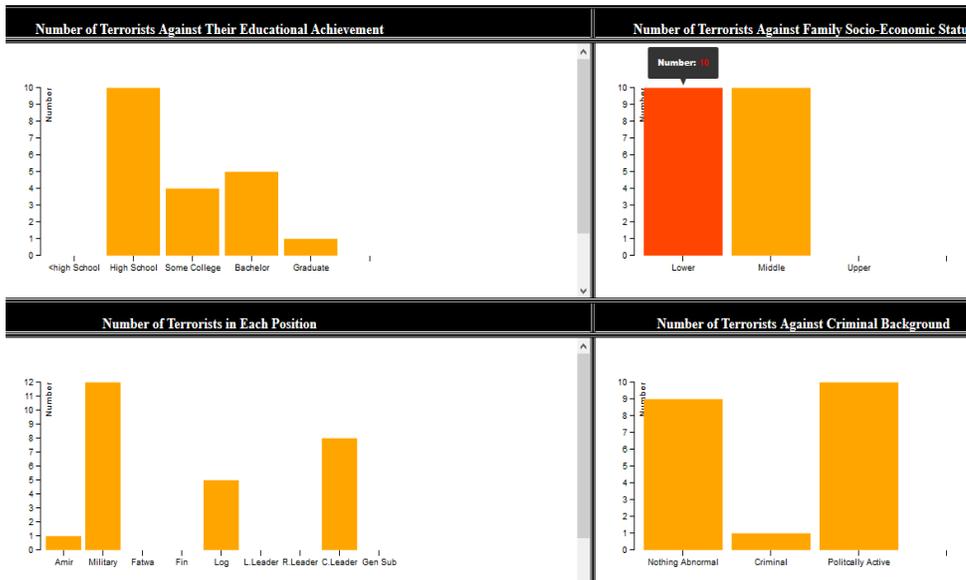


Figure 7. France Bar Chart View

Figure 7 indicates that most of the terrorists in Morocco hold graduate degrees. Most of them are from middle socio-economic class. In addition, the majority of them worked in the military as general subordinates and leaders inside the terrorist organization. Finally, the majority of them do not have a criminal history.

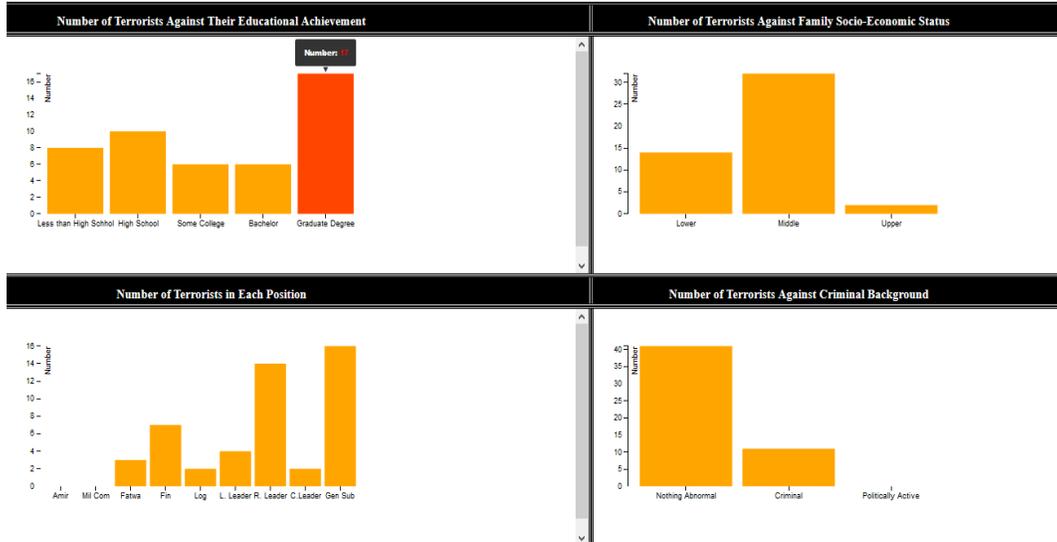


Figure 8. Morocco bar chart view

Then the analyst can use the scatterplot view in order to investigate the relationship between any two characteristics of the terrorists with the hope to find a trend in the nature of the relationship. For example, figure 8 presents the relationship between the terrorist position in the organization and his educational achievement level in both France and Greece. The scatterplot view provides the user the ability to select the country to examine and the characteristics to study.

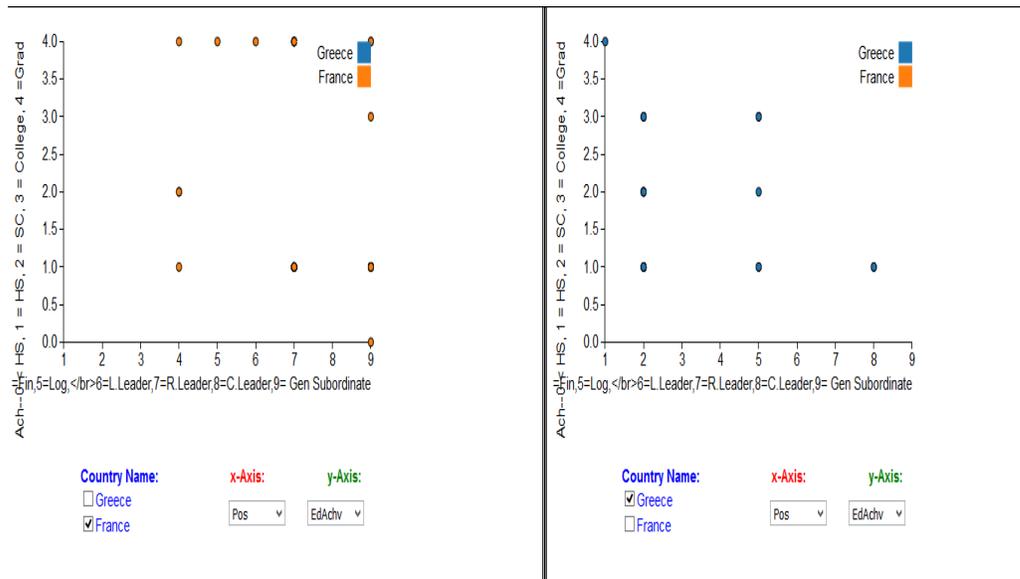


Figure 9. Scatterplot view

Finally, the analysts can use the dynamic query tool to get more specific results. The analysts can filter the data based on five different characteristics which are educational achievement, immigration status, criminal history, socio-economic status, and country. Figure 9 presents three different queries for Morocco, Egypt and France. The two different bar charts illustrate the queries results.

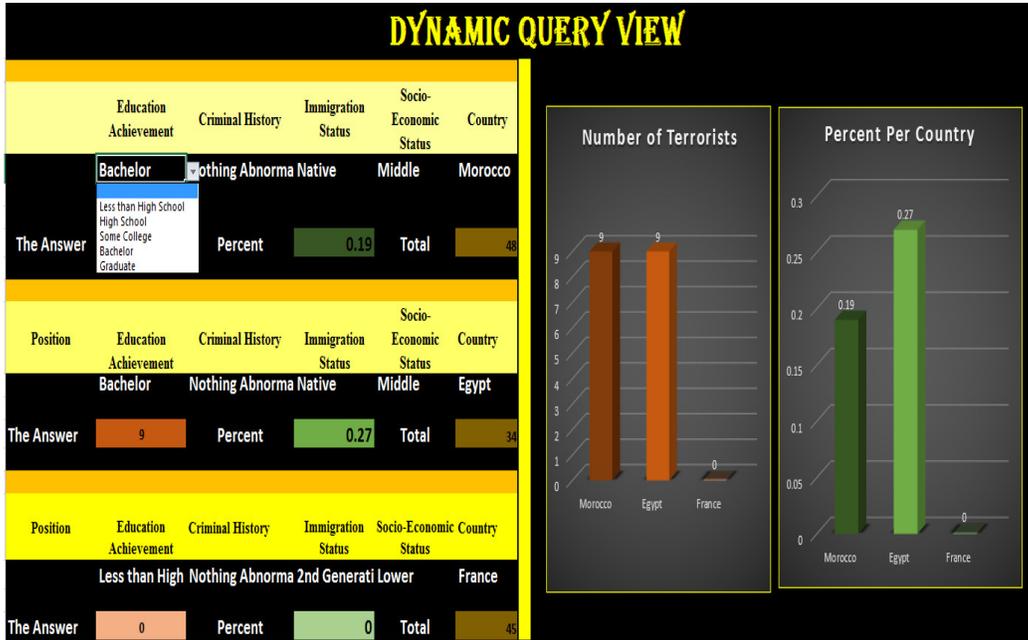


Figure 10. Dynamic query view

6. FUTURE WORK

One of the main goals of this tool is to visualize and get a better understating of the terrorists' personal characteristics with the goal of finding a pattern in their characteristics. The researcher will conduct another case study to examine the tool by using different datasets from different resources in order to find if there is consistency in the results. Although, Terrorist Watcher is almost the first tool that focuses on the terrorist as an individual, it needs further work to become both visualization and analytical tool that can provide the analyst with more details and insight. The researcher would like to concentrate on creating a tighter integration of data mining and visualization techniques. The goal is to implement clustering techniques to detect interesting grouping and to segment terrorist population. Creating a tool that combines both visualization and data mining can extremely benefit each other. Visualization will help in representing the clustering results and explaining their relationship with the original data so that trust and understanding can be improved.

7. CONCLUSION

Every day counter terrorism analysts face a challenging task of assessing and making sense of large sets of data. Advanced technological analysis aids that support data examination and promote analysts' exploration capabilities should hold promise as an effective way of contributing to analysis activities. One of the main goals of this tool is to use visualization and visual analytic techniques to support counter terrorism analysts in their work through examining the terrorist' personal and positional characteristics in order to assess the factors that can help in making a terrorist.

Unlike other existing tools, the presented tool in this paper focuses on the characteristics of the individual terrorists rather than focusing on the terrorist groups and organizations. This enables the analysts of different countries to focus on the characteristics of the terrorists from the aspect of their countries only. The presented tool introduces a suite of views that highlight Terrorists characteristics as well as relationships between the characteristics. Through the interactive exploration, the analysts will be able to form a mental model about the terrorists' characteristics in each country.

Terrorist Watcher acts as a visual index that present data in a form that are more easily to be perceived and examined by analysts. The implemented approach is to develop a tool that contains multiple views with simple and clear interaction as well as providing the analysts with more details based on demand through the interactive queries. The development of simple, interactive, informative, and easy to use visualization tool is the main contribution of this research.

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