Interactive Visualization - A Review

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Abstract - *The Visualization research has reached its new height and the interactivity and analytics part of it also helps in analyzing the data. As there is tremendous growth in the data that has to be analyzed it becomes necessity that data has to be analyzed with interactiveness. Voluminous data and handling them has become a biggest task now. Visualization helps to identify the results in a meaningful format. Visualization is the graphic presentation of data sets to reveal the information at a sight. It gives lot of understanding about the data. Information technology offers unprecedented capabilities to access, assimilate, analyze, and act on this rapidly growing universe of data. Next-generation tools must address the lack of dynamic integration, exploration, and collaboration while allowing analysts to apply their expertise and empowering them to quickly detect hidden relationships, collaborate with others, and act on the results. For this Visualization of the data is required. To explore the expanse of data the Interactive analytics holds great promise for quickly and effectively getting the results. In this paper review of various areas where interactive visualization researches are done is discussed.*

The aspects of Principal Component Analysis and Tableau Software in these research areas are also identified.

Key Words: Visual Analytics, PCA, Tableau, visualization tools

1. Introduction

The usage of Interactive Visualization, Visual Analytics helps in finding out the different dimensionality of the data which was not identified previously.

Interactive Analysis provides more meaningful solutions in many real-life applications.

- Visual Analytics is an important discipline for understanding/analyzing large scale data
- True integration of both automated algorithms and interactive visualization is the key
- Practice of multi-disciplinary research and problem driven foundational research required

The key lies in identifying the proper integration of all the aspects listed above to identify a Proper Visualization Technique and good interactiveness involved in the research to come out with a proper result.

Visual Analytics (VA) tools and techniques are intended to amplify researchers' thinking and analyzing cognitive and perceptual capabilities and enabling them to understand complex data. In this study, we explore how visualization tools can facilitate the analysis of the data.

Analyzing and extracting useful information from these data impose a great challenge on the medical research community. It is the argument that efficient and effective visualization tools can facilitate the exploration and analysis of complex data. Interactive visualizations provide researchers and analysts with efficient tools and techniques to amplify their cognitive skills and enhance the initial understanding of the data during the analysis process.

Visual Analytics (VA) is defined as "the science of analytical reasoning facilitated by interactive visual interfaces" [1]. These interactive visual interfaces depends on advanced visualizations of data and interactive techniques to improvise the data analysis process, increase insights, acquire knowledge and make the efficient usage of decision-making [2]. The implementation of interactive visualization tools was introduced in various disciplines to amplify analysts' cognitive capabilities and address the challenge of extracting useful information from enormous datasets to provide better ideas and better results.

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2. Interactive Principal Component Analysis (iPCA)

Interactive Principal Component Analysis (iPCA) is an interactive visual analysis tool developed by the Charlotte Visualization Centre. iPCA uses the Principal Component Analysis (PCA) technique to reduce high dimensional datasets and convert data into new meaningful representations in order to facilitate user's analytical

reasoning and increase the data exploratory analysis process [3].

Tableau Software: - Tableau is a commercial tool used for data exploration; it uses interactive visual dashboards to represent data and facilitate the exploratory data analysis process [4]. Visual Analytics tools and techniques amplify analysts' cognitive and perceptual skills in order to observe and comprehend complex medical data, complex geo spatial data, Temporal data sets to derive scientific insights and acquiring the Visual Analytics empowers analysts with the ability to reason and make sense of data under investigation.

Visual Analytics uses interactive and intuitive visualizations to help medical researchers determine hypotheses, formulate research questions and conduct exploratory data analysis efficiently.

With the help of visual analytics tools we will discuss in this paper some research areas.

In order to assess and evaluate the effectiveness and usefulness of using visualization tools to enhance analysts' data exploration, we analyzed the use of Tableau and iPCA by researchers to explore immunological data. Our findings reveal that VA tools are efficient and powerful tools that can be integrated into systems to help health researchers get insights and generate knowledge from their complex medical data.

Sub-Saharan Africa has the largest HIV-infected population in the world [5]. The vast majority of infants born to HIV positive mothers are not infected themselves. However, those HIV Exposed but Uninfected (HEU) infants are at a high risk of mortality during their first year of life; they suffer severe immune system deficiencies and an abnormal susceptibility to infections and diseases [6]. The causes of this mortality and morbidity are unclear and are currently the subject of a biomedical research carried out by immunologists and biologists at the Child and Family Research Institute (CFRI) in Vancouver, BC. The main analytical goal of this research project is to understand the immune responses of HEU infants and link these responses to causes of high mortality and morbidity. Based on the visualization of the HEU (HIV Exposed but Uninfected (HEU)), VA provided powerful interactive visualizations needed to assist immunologists and medical researchers in data exploration as well as to generate hypotheses and test these hypotheses. VA enabled immunologists to engage and interact with the high dimensional HEU data, discover details and relationships among data variables recognize relevant patterns, identify data clusters and outliers, and ultimately advance their research. Immunologists' experience motivates other health professionals and promotes the use of VA tools and techniques to explore complex data and to integrate powerful and effective visualization software in clinical practices.

Interactive PCA and Tableau Software were found to play a vital role in this research.

Visualization is generally believed to be very important to attain cyber situational awareness. Tamassia et al. [7] offer a survey of approaches. Some work is closely connected to human-computer interaction, e.g. Erbacher [8] who uses a human in the loop design to find appropriate visualizations or D'Amico et al. [9] who employ cognitive task analysis to create a visualization framework to support the work of analysts. Other work focuses more on using machine learning methods such as artificial neural networks and self organizing maps (Wu et al., [10]) or swarm analysis (Beaver et al., [11]) to sift through IDS data and present relevant information to the human user. There is also work on the visualization of attack graphs (O'Hare et al., [12]), and cascading threats in critical infrastructures (Kopylec et al., [13]). Michel et al. [14] investigate the use of virtual worlds to better convey the large amounts of data involved in real-time cyber situational awareness. Somewhat in a similar fashion, D'Amico and Salas [15] explore the use of 3D models to visualize the impact of information security events on military missions. Klein et al. [16] address the cyber situational awareness problem in two stages: first data is collected into a comprehensive model, and then this data is visualized in a way that supports human understanding. Phan et al. [17] present a system that focuses on making temporal relationships apparent and allows users to interactively classify events, work iteratively and they themselves create a visual structure. Williams et al. [18] also focus on dynamic and interactive exploration of network security data. Pike et al. [19] goes beyond the computer network and describe a visualization tool that captures the larger threat landscape organizational, social, and geopolitical events. Visualization techniques are seldom mentioned in national strategies, but there are exceptions. In Japan, "Frameworks Will be examined for visualizing the degree of vulnerability of Japan's cyberspace, degree of malware infections and other overall trends" (National Information Security Center, 2013).

Research in the cyber crime using visualization tools will provide better results in analyzing the data.

As Internet applications have moved to the mobile environment, governments need to develop new ways to interact with their citizens. The new Internet and mobile

phone technologies can provide innovative ways to connect government and citizens.

The Android application can use the phone's GPS to determine the user's current position and calculate the closest People's information. The user can then select one of the People's Centre from the list of closest centres and obtain more information about the centre (such as contact information for the centre), or request directions to the centre, which are provided on a Google map. The interactive aspect can also be used to visualize the data. With the help of Mobile Phones and the Applications the user will be able to view the data.

Research in this area with the help of tableau software can provide more constructive analysis of data.

Interactive visualization can also be found useful in the area of education. For example, in countries where most of the data are not updated (automated) finding a right place for higher studies becomes difficult. In order to provide the user with a better idea, for example in a particular place (example state or province) with their specific preference (educational interest) and for their specific fees data can be analyzed from the feedback of the user, and details can be provided to the user. Research in these areas where the further analysis can be useful to the user in identifying the place and preference on the data, interactive visualization and tableau software can be used.

This involves spatial data mining and interactive visualization.

3.Conclusion

These interesting areas of research when expanded to the various other datasets, the resultant would be definitely help in analyzing the data in a better prospective way with user interaction. The use of Visualization tools can be extended in the research area.

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