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A Literature Survey of Visual Analytics Science and Technology on Various Informative Applications with Evaluation Methodology

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Abstract: "Computer based visualization systems" can be defined as "providing visual representations of datasets intended to help people carry out some task more effectively". Several information visualization techniques have been proposed that encourage users to explore the data visually, gain insights from the hypotheses [1].The informative Applications includes EHR, MOOC, CMS, LMS and the field includes of Law enforcement, Infrastructure protection, financial and fraud analytics. This literature survey specifies the field of visual analytics helps to apply on several informative applications with evaluation methodology.

Keywords: *Ehr, Visual Analytics, Mooc, Cms, Lms*

I. INTRODUCTION

The information visualization deals with heart of nature known as interaction on the dataset. Interaction allows users to dynamically change the mapping of the data (Eg: Color, Shape, Size), the view of the mapping (eg: zoom, pan, rank) or the scope of the data being visualised (Eg: search, Filter) [2]. Visualization and visual analytics show great potentials as methods to analyze, filter, and illustrate the vast sea of electronic data and interprets the volume of data [3]. There are multiple techniques has involved to evaluate the informatics data and to the development of an evaluation methodology for visual analytics environments. The Visual Analytics Science and Technology Challenge was created as a community evaluation resource which helps to test out their designs, visualisation and compare the results [4].

Fig 1. National Visualization and Analytics Center

II. BACKGROUND OF VISUAL ANALYTICS

The formation of the U.S. Department of Homeland Security (DHS) National Visualization and Analytics Center™ (NVAC™)1 in March 2004 resulted in increased interest in the field of visual analytics. In 2005, a diverse team of academic and laboratory researchers, government managers, and industry scientists turned a vision into a science direction indicated R&D Agenda for visual analytics. in 2005, NVAC began hosting semi-annual Consortiums to bring academia, industry and national laboratories together with end users, government sponsors and international partners to advance this new, potentially significant field of research . In 2006 IEEE launched Visual Analytics Science and Technology (VAST). Currently the technology has joint hands with National Scientific Foundation(NSF) and DHS program on the foundation of Data and Visual Analytics [5].

III. VARIOUS FIELD OF INFORMATION VISUALIZAITON

A. Educational datamining patterns

Visualizing Educational Patterns We used the result of sequential pattern mining that had been applied to data gathered for nine years on an undergraduate study program on computer science [Ant08]. The goal of sequential pattern mining, given a set of sequences and some user-specified minimum support threshold, is to discover the sequences that exist in at least σ sequences in the dataset [AS95]. Sequential pattern mining with three different support threshold values (50%, 25% and 20%) has been performed, resulting in a number of textual patterns. c The Eurographics Association 2014. S. Gama & D. Gonçalves / Visualizing Educational Datamining Patterns

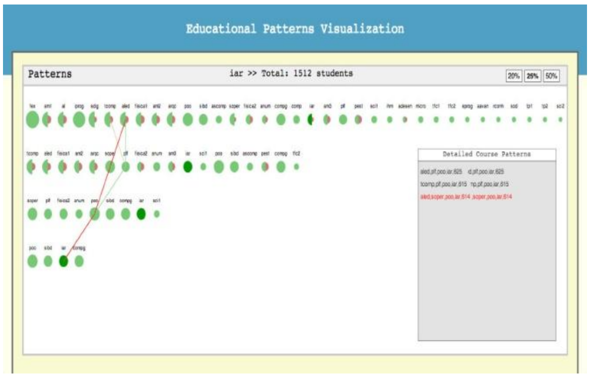

Figure 2: A multi-layered visualization for educational data mining patterns, revolving around course patterns' representation.

We created an interactive visualization (Figure 1). The main area consists of a multi-level visualization. Each level corresponds to a program's semester and represents its courses that are displayed as circles with size proportional to the number of students who completed or failed them. When there is information on failure, course circles are sub-divided into two semicircles displaying information on approval and failure through western conventional positive-negative color coding. Their size is proportional to course approval or failure numbers, making it possible to immediately comparing success and failure rates. Moving the mouse over a specific course circle highlights it (by assigning more saturation to its hue) and displays information on course relationships. The course is linked to all the courses with which it has any type of interrelation through line connectors. Connector thickness is proportional to the number of students who verify the pattern. Color is assigned to each pattern individually, in order to avoid visual confusion and allowing immediate line discrimination. We did not use fully saturated colors, in order to keep our visual artifacts from competing for the user's visual attention [War12]. When a course is selected, additional information on the total number of students is displayed on the additional course information panel, located at the top of the visualization (which also displays three buttons (20%, 25% and 50%) for the selection of different data mining support thresholds). The total number of patterns is shown at the upmost part of the detailed course patterns' panel and each pattern is listed below. Our visualization allows interactive course comparison. If we select one course, it is locked and its information is shown throughout the visualization (without being cleared when the mouse leaves the circle). Moving the mouse to another course will also display its information, making it possible to compare patterns. With this combination of mechanisms we can immediately perceive aspects such as the number of semesters and the number of courses for each semester, as well as the most successful or unsuccessful courses, leading to the use of visualization for improving success rates[6].

B. Visual Analytics for Law enforcement

Visual analytics for law enforcement A central challenge in visual analytics is the creation of accessible, walkup-usable, widely distributable analysis applications that bring the benefits of visual discovery to as broad a user base as possible. The Scalable Reasoning System (SRS)9 provides web-based and mobile interfaces for visual analysis through a service-oriented analytic framework

Figure 3: Visual analytics supports emergency responders in the office and in the field.

The goal of SRS is the straightforward deployment of pervasive visual analytic environments that can be rapidly deployed in a platform-agnostic fashion across an enterprise The SRS lightweight platform, which uses web distribution and simplified interfaces to visual analytics, is being used at three regional law enforcement agencies, by more than 10 000 users as part of their daily activities. Users at the Port Authority of New York and New Jersey (PANYNJ), the Automated Regional Justice Information System (ARJIS) in San Diego, and the Seattle Police Department (SPD) are using and evaluating SRS visual analytics techniques to improve law enforcement practices and help save lives. Visual analytics tools allow officers to analyze the narrative information present in incident reports and case files; this information has been historically underutilized because it is not readily available to officers on the street and in command or analysis centers. SRS enables those officers and analysts to explore relationships in the information in fundamentally new ways. Furthermore, law enforcement officers deal with large quantities of heterogeneous data from multiple sources with varying levels of uncertainty and indeterminate quality. The decisions made by those officers directly and often immediately affect public safety and societal quality of life issues. Such decisions are either tactical, with only minutes or seconds available to analyze and respond to a situation, or strategic, where complex relationships are analyzed to help develop proactive plans to reduce crime and counter terrorism threats. Developing an analytical tool suite to support law enforcement and counter-terrorism field units brought together different ongoing research threads in a single, yet powerful deployable application. Early work in the use of visual analytics on mobile appliances11 looked at how to provide easy-to-use interactions to visual analytics and how to better distribute quickly digestible knowledge to a wide range of users. Visual analytics researchers also had been looking at the importance of and challenges associated with decomposable reasoning artifacts and the distribution of knowledge through analytic environments that attempt to bridge the divides among information retrieval, information analysis and information dissemination tools.10 It is the combination of these research areas that drove the development of new analytical tools and the creation of SRS in order to support the demands of law enforcement professionals. Nevertheless, many of the analytical needs of law enforcement and counterterrorism field units are common to those found in other domains. The lessons learned from the efforts for the PANYNJ, ARJIS and the SPD will inform future work in those domains.

C. Visual analytics for critical infrastructure protection

Visual analytics inherently requires interactivity between the analyst and the visual representations. However, maintaining interactivity becomes a significant or even impossible challenge as the quantity of information or the complexity of the system increases. Large semantic graphs or networks illustrate this challenge. Analysts use semantic graphs to organize concepts and relationships as graph nodes and links and as a way of discovering key trends, patterns and insights. The Have Green12 framework was designed to maintain interactive analysis of semantic graphs with up to one million nodes. Have Green fills the theoretical and developmental limitations found in many related systems by creating an analytical environment in which analysts (not researchers) conduct network analysis in terms and concepts that are intuitive and meaningful to them. A variant of Have Green, GreenGrid,13 was created to allow engineers to explore and monitor the North American Electricity Infrastructure. The system, commonly referred to as the electrical grid is made up of generators, distribution centers, transmission lines, consumers and other elements that can be treated as a graph. For many years, the electrical grid has been limited to depictions as information on top of a geographic layout or a quasi circuit diagram. While these traditional visualizations are valuable tools, they are but a subset of the possible ways of depicting and exploring the possible relationships in the high-dimensional information space that is the electrical power grid. GreenGrid's interactive exploration, weighted-graph design and linked visualization approach represent a significant innovation in applying visualization in the electric power industry .

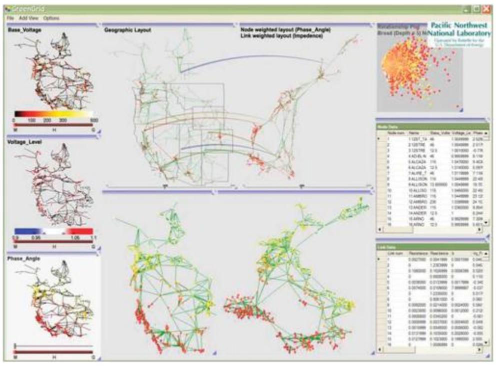

Fig 4. GreenGrid: The left side shows the geographic layout of Western Electricity Coordinating Council. The right side shows the GreenGrid layout.

GreenGrid provides previously unavailable freedom for engineers to express the power grid layout in terms of variables of their choosing. GreenGrid was used to analyze the electricity blackout that occurred within the Western U.S. power grid on 10 August 1996. Comparisons of GreenGrid results with the conclusion of the post disturbance analysis revealed that many of the disturbance characteristics could be readily identified using its advanced visual analytics tools[7].

D. Visual Analytics for real-time situation assess

Large interaction displays provide opportunities for colocated synchronous collaboration by providing groups of people with walkup interfaces. Large interactive displays can also be designed as ambient information portals providing casual access to continually updated information through robust analytical capabilities usable by individuals and groups alike. Ambient displays located in gathering locations such as kiosks have been used for many years to provide vital information. This concept was expanded in a technology called the Assessment Wall to incorporate visual analytics techniques in appealing, walkup appliances, offering real time multiple source situation assessment.

Figure 5: The Assessment Wall consists of linked interactive visualizations for streaming text documents on a high resolution touch-screen interface.

The system is deployed and being tested in a wide variety of analytical environments, such as group interaction spaces and officer break rooms in law enforcement agencies. In all of them, the result is the same – the Assessment Wall helps users easily monitor and analytically explore continually updating streaming information sources through easy-to-learn, engaging, high-value interactions. The Assessment Wall occupies a singular position among large displays for work and ambient systems. In an ambient capacity it conveys important themes that change with the data, persistent query matches and patterns in time, any of which can be perceived at a glance. Unlike many ambient systems, it also supports interaction that helps the discovery of relationships between concepts and temporal patterns without training or special equipment. With this balance of ambient and interactivity, novice users can maintain awareness of the data, dig deeper into topics of interest and use the system as a focal point for discussion and impromptu collaboration on work-related data. Usability studies guided the initial Assessment Wall design choices, and the first installations at a large government client provided the opportunity for user feedback and observing the system in use. Several ongoing projects will use the Assessment Wall in operational environments to support a variety of missions. Continued operational use promises many future opportunities to support effective display and analysis while maintaining a lightweight and intuitive interface [8].

IV. INTERACTION AND VISUALIZATION

Volume Visualization denotes the set of techniques used in the presentation of volume data, i.e., data associated to positions (often regularly) spaced in some 3D domain. In general, volume visualization is a projection process of a multidimensional data set in a plane. Volumetric visualization techniques can be classified as surface visualization or direct volume rendering. Surface visualization algorithms usually separate the volume subset that represents a specific anatomical surface using segmentation. During the process, this volume subset is approximated by a set of polygons and exhibited with conventional computer graphics techniques. Examples are the contour technique [17] and the marching cubes algorithm [16]. The second group of volume visualization techniques is based on a transfer function that establishes the relation between voxel values (denoting, for example, tissue density) and color/opacities. A well-known algorithm of this group is ray casting [15]. While the surface visualization techniques are faster but present an approximation of the structure of interest, direct volume visualization techniques demand greater storage capacity and higher processing time, but display original data. Initially, volume visualization algorithms were only developed to show the interior of the volume to allow the identification of its inner regions and structures and to facilitate the comprehension of its complex structure. Often, classification tables are used to assign colors and transparency levels to different intervals of voxel values. Later on, user interaction during the visualization process became important in order to allow the user to change parameters and perform a dynamic navigation process. Some examples of interactive visualization tools are: cross sections (Fig 6.1a), selection of different regions and structures (Fig 6.1b), cut volumes (Fig 6.1c), and cut planes (Fig 6.1d).

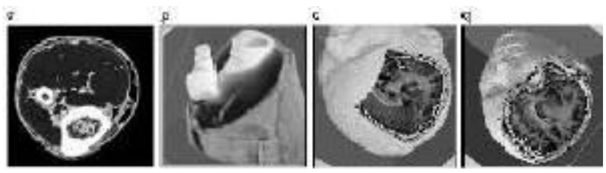

Fig 6: Selection of different region and structures, cut volumes, cut planes

A complex application of interactive manipulation of medical data is surgery simulation, which has gained higher importance in the last few years, especially because of its great utility in helping the training of new physicians. Simulators allow the achievement of virtual surgeries emphasizing real time interaction between the user and medical instruments, surgical techniques and models that represent several anatomical structures and physiologic processes. Many simulation systems exist nowadays, and most of them were developed to deal with a specific human body organ [14] thus allowing researchers to study in detail one organ each time. Surgery simulation has also been improved in the last few years with Virtual Reality (VR) techniques, which allow the development of virtual environments that are presented with so high accuracy that the user perceives it as real [10]. Many systems that join VR and medicine were developed in the last few years [11, 12]. Moreover, haptic displays provide force feedback allowing users to feel the physical properties of the objects that are being manipulated [13]. However, some technical problems, such as precision, real time interaction, poor realism in the images, and absence of a convincing touch simulation still block the acceptance of this technology [9].

Aspect	Collaborative Visualization Challenge
Users	Multiple Participants, domain specific e.g. multiple software developers
Tasks	Collaborative activity centric e.g. pair software analysis
Cognition	Collaborative foraging and collaborative sensemaking e.g. mining software for increased understanding
Results	Consensus, shared insight e.g. what parts of a system need refactoring
Interaction	Multiple inputs e.g. how to design systems to avoid interaction conflicts
Visual Representations	Multiple displays, novel display, and input technology e.g. different views of a software system like structure and evolution
Evaluation	Social interaction e.g. how to evaluate the possible additional insights or the group learning effect that can be achieved using such a system

V. EVALUATION METHODOLOGY

Estimation or Evaluation of software can take many forms range from algorithm exactness and performance to evaluations that focus on the value to the end user [4]. Evaluation is needed to verify that algorithms and software systems work correctly and that they represent improvements over the current infrastructure. Additionally to effectively transfer new software into a working environment, it is required to ensure that the software has utility for the end-users and that the software can be incorporated into the end-user's infrastructure and work practices. Evaluation test beds require datasets, tasks, metrics, and evaluation methodologies. As noted it is difficult and expensive for any one beneficiary to set up an evaluation test bed so in many cases evaluation is setup for communities of researchers or for various research projects or programs [19]. Examples of successful community evaluations can be found in

such areas as message understanding, information retrieval, and facial recognition [20]. Some methods widely used in Human-Computer Interaction seem readily adaptable and have been used to assess information visualization tools and technique (e.g. observation); others, can be more difficult to employ, as heuristic assessment, which involves a list of heuristics fine-tuned to the situation. In this case, more "open-ended" strategies should be used as a first approach to the evaluation. It may be useful to organize discussion sessions where the tool or technique is offered and participants are asked to freely use it, find problems, censure any aspect, and give suggestions as how to improve it [21]. Exploratory Data Analysis [5] an interesting first method to data analysis, since it provides general data on the structural dealings, showing the amplitudes, asymmetries, localizations, outliers, etc.; it also usually provides some clues to further analysis, namely on the statistical methods to be used to test the original hypothesis, or ideas on other hypothesis[22].

VI. CHALLENGES OF INFORMATION VISUALIZATION

Visual representations of data to achieve additional understanding, knowledge, and handy into the data and to signify individually [18]. The process of obtain the results is also very important to analyst so we needed the teams to explain how they reached their conclusions. Analysts could then focus on the submitted explanation and supply feedback which would cut down on the time analysts needed to expend during the evaluation process. [4].

CONCLUSION

This paper is giving the perception about information visualisation and discuss about the experience of relative fields which is practically using to improve the analysis of information and techniques. Applications of VAST has pointed out in the field Medicine, Education using Electronic Health Record, Massive Open Online Course, Content Management System, Learning Management System. In addition to that as the heart of visualisation interaction explained using contour techniques and its challenges. Process of image visualisation is given conclusion with various evaluation methodology.

References

[1] http://hcil2.cs.umd.edu/trs/2010-19/2010-19.pdf

[2] G. Falkman, "Information visualisation in clinical odontology: Multidimensional analysis and interactive data exploration," Artificial Intelligence in Medicine, vol. 22, no. 2, pp. 133–158, May 2001

[3] http://visualanalyticshealthcare.org/docs/VAHC2014_proceedings.pdf

[4] http://hcil2.cs.umd.edu/trs/2013-31/2013-31.pdf

[5] https://pdfs.semanticscholar.org/ce99/a490bc0ddc68c79f255fe0e39b985ba54b61.pdf

[6] http://web.ist.utl.pt/~daniel.j.goncalves/publications/2014/educareEuroVis.pdf

[7] Wong, P.C. et al. (2009) A novel visualization technique for electric power grid analytics. IEEE Transactions on Visualization and Computer Graphics 15(3): 410–423.

[8] Ebert, D., and Ertl, T. (eds.) (2008) IEEE Symposium on Visual Analytics Science and Technology: VAST '08, 21 – 23 October 2008, Columbus, OH. Los Alamitos, CA: IEEE Computer Society

[9] http://lsi.ugr.es/~mgea/docencia/docto/articulos/mans00.pdf

[10] Haase, H.: Symbiosis of Virtual Reality and Scientific Visualization System. Computer Graphics Forum, Cambridge, Vol. 15, No. 3, Aug. 1996. Presented work at EUROGRAPHICS, 1996, FuturoscopePoitiers, France

[11] Poston, T.; Serra, L.; Solaiyappan, M. et al.: The Graphics Demands of Virtual Medicine. Computers & Graphics, Oxford, Vol. 20, No. 1, p. 61-68, 1996

[12] Zajtchuk, R.; Satava, R. M.: Medical Applications of Virtual Reality. Communications of the ACM, New York, Vol. 40, No. 9, p. 63-64, Sep. 1997.

[13] Srinivasan, M. A.; Basdogan, C.: Haptics in Virtual Environments: Taxonomy, Research Status, and Challenges. Computers&Graphics, Oxford, Vol. 21, No. 4, p. 393-404, July/Aug. 1997.

[14] Goble, J. C.; Hinckley, K.; Pausch, R. et al.: Two-Handed Spatial Interface Tools for Neurosurgical Planning. Computer, Los Alamitos,CA,Vol.28,No.7,p.20-26,July 1995.

[15] Levoy, M.: Efficient Ray-Tracing of Volume Data. ACM Transactions on Graphics, New York, Vol. 9, No. 3, p. 245- 261, july 1990.

[16] Lorensen, W. E.; Cline, H. E.: Marching Cubes: A High Resolution 3D Surface Construction Algorithm. Computer Graphics, New York, Vol. 21, No. 4, July 1987.

[17] Keppel, E.: Approximating Complex Surfaces by Triangulation of Contour Lines. IBM Journal of Research and Development, New York, Vol. 19, No. 1, p. 2-11, Jan. 1975

[18] https://softvis.wordpress.com/2012/01/18/collaborative-visualization-definition-challenges-and-research-agenda/

[19] Thomas, J. and Cook, K. (Eds.) Illuminating the Path: The Research and Development Agenda for Visual Analytics, Los Alamitos, CA:IEEE CS Press, 2005.

[20] Chinchor, N and Hirschman, L. Evaluating message understanding systems: an analysis of the third message understanding conference (MUC-3), Computational Linguistics 1993;19, 3:409 – 449. 6. Voorhees, E, TREC: Continuing information retrieval's tradition of experimentation, Communications of the ACM; 2007; 50, 11:51-54. 7. Face Recognition Grand Challenge, http://www.nist.gov/itl/iad/ig/frgc.cfm (accessed Nov 8, 2012)

[21] http://www.dis.uniroma1.it/beliv08/pospap/santos.pdf

[22] Hoaglin, D., Mosteller, F., and Tukey, J. 1983. Understanding Robust and Exploratory Data Analysis. John Wiley & Sons.