REPORTS OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
ISSN 2224-5227 **https://doi.org/10.32014/2019.2518-1483.47**
Volume 2, Number 324 (2019), 116 – 121

UDK 004.43

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VISUALIZATION BASED ON COMPUTER METHODS FOR PROCESSING INFORMATION

Abstract. Human-centered visualization of information requires reliable and appropriate user research that improves the system or confirms its benefits. New methods, information visualization approaches are usually evaluated by taking a lot of time and money, if they constitute minimal resources, this leads to results that may be invalid. If, the number of participants is usually limited and does not allow to get a reliable assumption about the results. Thus, performance indicators play a key role in the visualization of information, the existing web survey tools are not convenient. In this article, the authors present new ways to evaluate information visualization systems via the Internet. In general, the visualization of information plays an important role in ensuring the possibility of data assimilation and the transformation of raw information into actionable ideas.

Keywords: Information visualization, user research, human perception, assessment methods, information processing.

INTRODUCTION

Our channel of visual perception can perceive and process information much faster than other channels. A person can easily determine the difference and / or patterns in the data, if you present the correct visual presentation of the data. This is what visualization seeks to achieve, that is, to transform or display data into their proper visual presentation, to allow knowledge detection and decision-making assistance. Visualization is an active and popular area of research in the field of data and a suitable technique for almost any real-world application. Methods from computer science, mathematics, cognitive science and the science of perception, and physics often adapt to different tasks of visualization.

Information visualization is the process of presenting data in a visual and meaningful form so that the user can better understand them. Dashboards and scatter plots are typical examples of information visualization. By displaying the overview and displaying the corresponding links, information visualization allows users to efficiently and effectively obtain information from abstract data.

Information visualization plays an important role in enabling data digestion and the transformation of raw information into actionable ideas. It relies, in particular, on the areas of human-computer interaction, visual design, computer science and cognitive science. Examples include world map-style views, line graphs, and three-dimensional virtual building projects or city plans.

MAIN PART

The process of creating information visualization usually begins with an understanding of the information needs of the target group of users. Qualitative research (for example, user interviews) can show how, when and where visualization will be used. By accepting these ideas, the developer can determine what form of data organization is needed to achieve user goals. Once the information is organized in a way that helps users understand it better and helps them use it to achieve their goals, the visualization techniques become the following tools that the designer uses. Visual elements are created (for example, maps and graphics) along with corresponding labels, and visual parameters such as color,

contrast, distance, and size are used to create the corresponding visual hierarchy and visual information path.

Information visualization is becoming more interactive, especially when used on a website or in an application. Thanks to the interactivity, users can manipulate visualization, which makes it very effective for meeting their needs. Through interactive visualization of information, users can view topics from different perspectives and manipulate them until they achieve the desired understanding. This is especially useful if users need a research experience. Visualization, sometimes called visual data analysis, uses a graphical representation of the data as a means of gaining an understanding and understanding of the data.

The main aim is to uncover the problems and ease the issues in visualization of Big Data and at the same time the objective of finding valid solutions for the problems in Big Data Visualization remains. The sections mentioned below elaborates the present tools, techniques and platforms which can be used for Visualization in Big Data. We reveal disadvantages of currently existing visualization methods based on the results. Based on the results, a not so common approach is proposed: the capabilities and methods of virtual and augmented reality could be implemented to achieve Visualization of the big data. We also discuss about the applications of AR and big data and fields where it is used. Further in later sections we discuss about the user interface with presence of tangibility, advantages and disadvantages of trending technologies, such as VR and AR displays on the Big Data visualization.

The use of modern information visualization technologies in modern computer practice in physics allows us to consider physical processes, objects and phenomena from within and at any level of complexity. Openness, i.e. modifiability, allows you to add new features, to consider new, more complex tasks. A computer physical workshop is not independent of other forms of training; moreover, working with it requires preliminary acquaintance with theoretical material and the ability to solve analytically the simplest problems for these cases. For a qualitative understanding of the results, useful and, in some cases, physical analogies from other branches of physics are necessary.

Table 1 - Use of information theorists

Information and theoretical basis for visualization	Information and theoretical metrics in visualization, for measuring	Information and theoretical algorithms
– visualization subdomains, such as volume visualization, network visualization, machine learning through visualization, interaction in visualization, and empirical research in the field of visualization; – perception and cognition in visualization; – visualization of uncertainty; – confidentiality visualization – Distributed data management and visualization.	– abstraction; – aesthetics; – Data complexity, visualization, tasks and user spaces (alphabets); – economic efficiency of visualization processes; – visibility or similarity of visual objects (for example, glyphs); – saving information (or loss) of visual display; – difference in visualization; – uncertainty in visualization; – visualization capabilities.	– filtering and screening (for example, isosurface, seeding); – grouping and clustering (for example, the union of edges); – layout (for example, minimizing interference); – browsing optimization; – Extraction and tracking functions; – time-varying data; – multidimensional visualization; – visualization in place; – visualization of the ensemble; – transfer function design.

The holistic nature of information-theoretic reasoning has allowed many visualization applications, including the placement of a light source, the choice of the type when rendering a grid, the choice of the type when rendering a volume, the focus of attention when rendering a volume, three-dimensional rendering with multiple resolution, the selection of objects in an unstable multipole visualization, the allocation of functions in visualization of time-varying volume, design of transfer function, combining multimodal data, estimating isosurfaces, measuring throughput with aids in observation, measurement of

the content of information in multidimensional data, and confirmation of the mathematical feasibility of visual multiplexing. Perhaps one of the most interesting applications is the ability to use information theory to support the visualization discipline, that is, to explain some or all of the observed phenomena or events in visualization.

Increasing the capabilities of computing technology is today a stimulus for expanding the potential of visualization, which has become an integral part of many branches of human activity.

As you know, the idea presented in a visual graphic form significantly increases its strength - that is why the new trends observed today in visualization technology are of particular interest. In addition to the qualitative changes in the presentation of information today, new developments are noticeable in the visualization, such as integration with various applications from other areas, interactive technologies of visualization and animation of large sets of multidimensional data sets in real time, advanced methods for building the interface, and much more. Of great importance for the visualization of information is the efficiency of the technology, since the visualization itself does not solve the problem, but serves as an auxiliary set of tools and concepts with its own object world.

Since the transformation of data into accurate and meaningful images is an extremely difficult process, the visualization of scientific data is in itself an area of complex and important scientific research. Algorithms, computer architecture and visualization systems are constantly being improved to provide the ability to perform more detailed and detailed analysis of large amounts of data. Research is being conducted to improve the analysis, which makes it possible to identify characteristics and track parameters, and to consider a number of other issues that are crucial for enhancing visualization capabilities.

The main models that allow for a comprehensive analysis of data: analysis and preliminary processing of source data, the clustering model, the classifier construction model, the associative rules construction model. For each of the models, adequate methods for visualizing the results were selected and implemented.

Preliminary data analysis. This stage is very important. If necessary, you can pre-convert the data using different filters. For example, sample data. This is necessary for some algorithms, such as building association rules that cannot work with quantitative data. The accuracy of the further results depends on a competent analysis of the initial data and the choice of an adequate processing model.

Depending on the type of source data (processing of quantitative and qualitative features is allowed), linear graphs or histograms are constructed, respectively. For quantitative attributes, it is possible to display a moving median and a moving average with a given window. It also provides the ability to display dependencies between different attributes. Similar dependencies are displayed using linear and point graphs. Particular attention is paid to the display of changes in parameters over time. Using linear graphs, polynomial and exponential models of the original features are presented.

With the help of computer graphics, the sampling process becomes simple and fast, allowing you to view preliminary results at any time.

Such methods allow you to visually provide the source data itself, the dependencies between the various data.

Classification methods. Often, when analyzing, it is required to determine which of the known classes the objects under study belong to, i.e. classify them. In Data Mining, the classification task is considered as the task of determining the value of one of the parameters of the object being analyzed based on the values of other parameters.

The results of classification methods are also presented in a structural form and in the form of graphs. The creation of classifiers is carried out on the basis of algorithms for constructing decision trees (hereinafter simply “trees”).

Methods for constructing associative rules. Finding association rules is one of the most popular Data Mining applications. The bottom line is to define frequently occurring sets of objects in a large variety of such sets. This task is a special case of the classification problem.

The application of methods for constructing associative rules is possible only to qualitative attributes. It is convenient to display methods for constructing associative rules in three-dimensional space. The OX axis and the OY axis are deferred, respectively, the values of variables located in the left and right sides of the rule, and the OZ axis defers the validity of the rule.

Clustering methods. The task of clustering is to divide the studied set of objects into groups of "similar" objects, called clusters. The word cluster [4] of English origin (cluster) is translated as a clot, bundle, group. Related concepts used in literature, class, taxon, condensation.

Clustering can be used in almost any industry where research of experimental or statistical data is necessary.

Four different ways of visualizing the results of cluster analysis have been implemented, which can greatly facilitate the work of an expert in the analysis of identified similar groups of objects. The distribution of raw data across clusters can be analyzed using dotted graphs. The essence of the method: the values of the selected attributes are plotted along the axes of the chart, the belonging of objects to different clusters is displayed on the chart in different colors. Effective ways to reduce the space of the original features are the main component algorithms and multidimensional scaling. They allow us to present the distribution of the initial data by clusters in the space of two main components; this helps to visually evaluate the grouping of the studied data and the clusters found. Histograms are used to display the probability distribution of the results obtained by clusters.

The visualization subsystem developed in the framework of the analysis software package has made it possible to significantly simplify the interpretation of information obtained in the data analysis process.

Thus, we were once again convinced of the convenience and necessity of visualizing processes when working with data.

The presented visualization methods were implemented in the telemetry information processing software package.

Before embarking on visualization, a search for graphic libraries was carried out. The following libraries were considered: JSCi, JFC, JFreeChart.

The JSCi library almost immediately revealed serious shortcomings that did not allow it to be used for visualizing large amounts of data. For example, the color palette is limited to 8 colors.

The following graphic library is standard in Java, JFC (Java Foundation Classes) is easy to use, universal, but the image quality is inferior to the JFreeChart library.

After reviewing graphic libraries that provide 2D graphics, the JFreeChart library was chosen [5].

The advantages of this library: high quality images; It is possible to scale the image and save graphs in the format * .png, etc. The main advantage is the presence of a large selection of different types of graphs, which made it possible to expand the set of data visualization methods. The library does not have a tight binding to the system, which allows it to be used in various operating systems. This makes the software product multi-platform. And this is not an important aspect at the present time.

With 3D libraries everything is much more serious. Huge selection of different libraries. After the analysis, the choice was stopped on OpenGL. The reason for choosing OpenGL, not DirectX, is in the multi-platform library. A search was made for libraries working with OpenGL. As a result, the main libraries were allocated: LWIGL and JOGL.

We also paid attention to the education system. Our analysis of psychological, pedagogical and methodological literature devoted to the problem of visualization of educational material using computer tools allowed us to state the following:

- there are no approaches to the interpretation of the concepts of "visualization" for various disciplines of general professional training, each of the authors explains the essence of these concepts with particular examples that reveal only some of their aspects;
- the theoretical foundations of visualization with the help of information technologies are not sufficiently developed, their methods of setting, examples, methods, forms, etc., have not been identified and described;
- the methodological features of using a computer in visualizing and implementing the principle of visibility in the process of using mathematical packages have not been disclosed [3–6].

The results of our survey of students of physical and mathematical faculties of pedagogical universities show the need for systematic use of computer in studying mathematical disciplines, as they activate learning activities, increase learning efficiency, develop students' visual, mathematical, functional and research thinking, increase the visibility of learning, the ability to see the method "From the inside." Educational mathematical information is a system of signs - words, formulas, tables, diagrams, graphs, illustrations. It is aimed at mastering the content of mathematical theory and its practical applications. So,

in order for a student to master the ability to visualize information, it is necessary to know the laws of its transformation into a convenient way of presenting information in a particular software environment. In relation to a particular course, a student must first of all know the theoretical foundations of the method of solving a problem to realize this; secondly, the possibilities of the mathematical package for the implementation of the method, and should also be able to illustrate knowledge, clearly presenting one or another method.

CONCLUSION

The library is multi-platform, which allows you to develop visualization projects on many modern operating systems.

To visualize the analyzed data of various processing and forecasting projects, the widespread introduction of computer graphics will make it possible to present the results of solving problems by various methods and algorithms fairly quickly, visually and with minimal cost. Graphics is becoming not only a way to visualize the results, but also a complete tool for working with the results. This direction is promising and developing. Already today, many methods can be more clearly demonstrated in three-dimensional space, for example, methods for constructing associative rules.

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ӨҢДЕУ МӘЛІМЕТТЕРІНЕ КОМПЬЮТЕРЛІК ҚОЛДАНУ НӘТИЖЕЛЕРІНЕ КӨРСЕТУ

Аннотация. Ақпаратты адамға бағытталған визуализациялау жүйені жақсартатын немесе оның артықшылықтарын растайтын сенімді және лайықты пайдаланушы зерттеулерін талап етеді. Жаңа әдістер, ақпараттық визуализация тәсілдері, әдетте, аз уақытты және ақшаны алып, егер олар минималды ресурстар болса, бұл жарамсыз нәтижелерге әкеледі. Егер қатысушылардың саны әдетте шектелген болса және нәтижелер туралы сенімді болжам жасауға мүмкіндік бермесе. Осылайша, өнімділік индикаторлары ақпаратты визуализацияда шешуші рөл атқарады, қолданыстағы веб-сауалнама құралдары ыңғайлы емес. Осы мақалада авторлар Интернет арқылы ақпараттық визуализация жүйелерін бағалаудың жаңа әдістерін ұсынады. Тұтастай алғанда, ақпараттың визуализациясы деректерді игеру мүмкіндігін қамтамасыз етуде және шикізат ақпаратын тиімді идеяларға айналдыруда маңызды рөл атқарады.

Түйін сөздер:Ақпараттық визуализация, пайдаланушылық зерттеулер, адам қабылдау, бағалау әдістері, ақпаратты өңдеу

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ВИЗУАЛИЗАЦИЯ НА ОСНОВЕ КОМПЬЮТЕРНЫХ МЕТОДОВ ОБРАБОТКИ ИНФОРМАЦИИ

Аннотация. Ориентированная на человека визуализации информации требует достоверных и надлежащих пользовательских исследований, которые улучшают систему или подтверждают их преимущества. Новые методы, подходы визуализации информации обычно оцениваются, занимая много времени и средств, если они составляют минимальные ресурсы, то это приводит к результатам, которые могут быть недействительными. Если, количество участников обычно ограничено и не позволяет получить достоверное предположение о результатах. Таким образом, показатели производительности играют ключевую роль в визуализации информации, существующие инструменты веб-опроса не удобны. В этой статье авторы представляют новые пути, которые позволят оценивать системы визуализации информации через Интернет. В целом, визуализация информации играет важную роль в обеспечении возможности усвоения данных и превращения необработанной информации в действенные идеи.

Ключевые слова:Визуализация информации, исследование пользователя, восприятие человека, методы оценки, обработка информации.

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