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DATA VISUALIZATION

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ABSTRACT

Data visualization involves presenting data in graphical or pictorial form which makes the information easy to understand. It helps to explain facts and determine courses of action. It will benefit any field of study that requires innovative ways of presenting large, complex information. The advent of computer graphics has shaped modern visualization. This paper presents a brief introduction to data visualization.

Keywords- *Data visualization, Information Visualization, Scientific Visualization, Big data.*

I. INTRODUCTION

There has been the need for displaying massive amounts of data in a way that is easily accessible and understandable. Organizations generate data every day. As a result, the amount of data available on the Web has increased dramatically. It is difficult for users to visualize, explore, and use this enormous data. The ability to visualize data is crucial to scientific research. Today, computers can be used to process large amounts of data. Data visualization is concerned with the design, development, and application of computer generated graphical representation of the data. It provides effective data representation of data originating from different sources. This enables decision makers to see analytics in visual form and makes it easy for them to make sense of the data. It helps them discover patterns, comprehend information, and form an opinion.

Data visualization is also regarded as information visualization or scientific visualization. Human beings have always employed visualizations to make messages or information last in time. What cannot be touched, smelled or tasted can be represented visually [1].

II. VISUALIZATION TECHNIQUES

Visualization is the use of computer-supported, visual representation of data. Unlike static data visualization, interactive data visualization allows users to specify the format used in displaying data. Common visualization techniques are as shown in Figure 1 and include [2]:

- *Line graph*: This shows the relationship between items. It can be used to compare changes over a period of time.
- *Bar chart*: This is used to compare quantities of different categories.
- *Scatter plot*: This is a two-dimensional plot showing variation of two items.
- *Pie chart*: This is used to compare the parts of a whole.

Thus, the format of graphs and charts can take the form of bar chart, pie chart, line graph, etc. It is important to understand which chart or graph to use for your data.

Data visualization uses computer graphics to show patterns, trends, and relationship among elements of the data. It can generate pie charts, bar charts, scatter plots, and other types of data graphs with simple pull-down menus and mouse clicks. Colors are carefully selected for certain types of visualization. When color is used to represent data, we must choose effective colors to differentiate between data elements.

In data visualization, data is abstracted and summarized. Spatial variables such as position, size, and shape represent key elements in the data. A visualization system should perform a data reduction, transform and project the original dataset on a screen.

It should visualize results in the form of charts and graphs and present results in user friendly way.

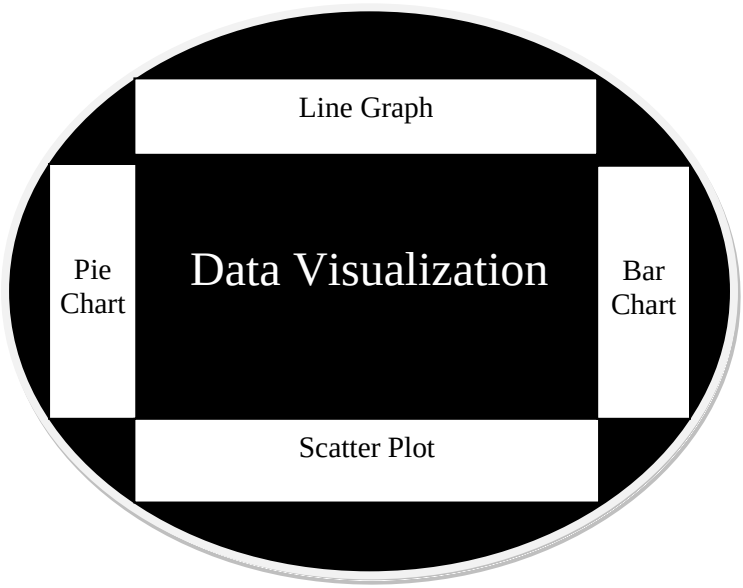

Figure 1. Commonly used data visualization techniques.

III. APPLICATIONS

Most visualization designs are to aid decision making and serve as tools that augment cognition. In designing and building a data visualization prototype, one must be guided by how the visualization will be applied. Data visualization is more than just representing numbers; it involves selecting and rethinking the numbers on which the visualization is based [3].

Visualization of data is an important branch of computer science and has wide range of application areas. Several application-specific tools have been developed to analyze individual datasets in many fields of medicine and science.

***Public Health*:** The ability to analyze and present data in an understandable manner is critical to the success of public health surveillance. Health researchers need useful and intelligent tools to aid their work [4]. Security is important in cloud-based medical data visualizations. Open any medical or health magazine today, and you will see all kinds of graphical representations.

***Renewal Energy*:** Calculation of energy consumption compared to production is important for optimum solution [5].

***Environmental Science*:** As environmental managers are required to make decisions based on highly complex data, they require visualization. Visualization applications within applied environmental research are beginning to emerge [6]. It is desirable to have at one's disposal different programs for displaying results.

***Fraud Detection*:** Data visualization is important in the early stages of fraud investigation. Fraud investigator may use data visualization as a proactive detection approach, using it to see patterns that suggest fraudulent activity [7].

Library-Decision Making: Data visualization software allows librarians the flexibility to better manage and present information collected from different sources. It gives them the skill to present information in a creative, compelling way [8]. Visualization of library data highlights purchasing decisions, future library needs and goals. Librarians, as de facto experts of data visualization, can assist students, faculty and researchers visualize their data [9].

Several information visualization algorithms and associated software have been developed. These software enable users to interpret data more rapidly than ever before. These include ManyEyes from IBM, SmartMoney for stock market, Insights from Facebook Corporation, Visual Analytics from SAS,

and Thoth from California Institute of Technology, Tableau, and TOPCAT [10, 11]. They make data visualizations easy to interpret and rapid to produce. Each tool has its own good features and limitations. Visualization of a large-scale multidimensional data sets can be combined with new approaches of interacting with a computer using the Web application (as a service).

IV. CHALLENGES

Large, time-varying datasets pose great challenge for data visualization because of the enormous data volume. Real-time data visualization can enable users to proactively respond to issues that arise. Animation generation approach is used for interactive exploration process of time-varying data. It visualizes temporal events by mimicking the composition of storytelling techniques [12].

Users differ in their ability to use data visualization and make decisions under tight time constraints. It is hard to quantify the merit of a data visualization technique. This is the reason for having a multitude of visualization algorithms and associated software. Most of these software have not taken advantage of the multi-touch interactions and direct manipulation capabilities of the new devices.

Big data, structured and unstructured, introduces a unique set of challenges for developing visualizations. This is due to the fact that we must take into account the speed, size, and diversity of the data. A new set of issues related to performance, operability, and degree of discrimination challenge large data visualization and analysis [13]. It is difficult and time-consuming to create a large simulated data set. It is also difficult to decide what visual might be the best to use.

V. CONCLUSION

Data visualization is the process of representing data in a graphical or pictorial way in a clear and effective manner. It has emerged as a powerful and widely applicable tool for analyzing and interpreting large and complex data. It has become a quick, easy means of conveying concepts in a universal format. It must communicate complex ideas with clarity, accuracy, and efficiency. These benefits have allowed data visualization to be useful in many fields of study.

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