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Editor in Chief
Dr. Vinay Kumar Sharma
M.A., Ph.D., D.Litt. - Gold Medalist
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SHODH SANCHAR BULLETIN
448 /119/76, KALYANPURI THAKURGANJ, CHOWK, LUCKNOW -226003 U.P.,
Cell.: 09415578129, 07905190645
E-mail : dr.vinaysharma123@gmail.com

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Advancement in Data Visualization Techniques

Dr. Neelam Yadav*

ABSTRACT

A huge amount of data is generated each day from modern information systems and digital technologies such as mobile and internet. Analysis of this data requires a lot of efforts at multiple levels to extract knowledge for decision making. Data Visualization is a new area in the field of Information technology. Data visualization has many gains in technologies because it is an easy way to represent more complex data in the form of graphics. Data Visualization makes it potential for analyst, consultation, researchers, Businessman's and the technologist to get in sight in these data in an effectual and good manner. There are various techniques to represent data in the form of graphics such as Graphs, Charts, Maps and Images etc. This paper proposes a review of data visualization basic concept, effectiveness of data visualization, techniques, limitation of techniques and comparison of techniques and research on the New Data Visualization techniques.

Keywords : Data visualization, Techniques, Big data analytics ,Datasets, Graphics, Effectiveness Comparison.

INTRODUCTION

The concept of using pictures to understand data has been around for centuries, from maps and graphs in the 17th century to the invention of the pie chart in the early 1800s. Several decades later, one of the most cited examples of statistical graphics occurred when Charles Minard mapped Napoleon's invasion of Russia. The map depicted the size of the army as well as the path of Napoleon's retreat from Moscow and tied that information to temperature and time scales for a more in-depth understanding of the event.

Our eyes are drawn to colors and patterns. We can quickly identify red from blue, square from circle. Our culture is visual, including everything from art and advertisements to TV and movies. Data visualization is another form of visual art that grabs our interest and keeps our eyes on the message. When we see a chart, we quickly see trends and outliers. If we can see something, we internalize it quickly.

Data visualization is the graphical representation of information and data. By using visual elements like charts, graphs, and maps, data visualization tools provide an accessible way to see and understand trends, outliers, and patterns in data.

It's technology, that truly lit the fire under data visualization. Computers made it possible to process large amounts of data at lightning-fast speeds. Today, data visualization has become a rapidly evolving blend of science and art that is certain to change the corporate landscape over the next few years.

With availability of enough visualization techniques it can be very confusing to know what and when should be appropriate technique to use in order to convey maximum possible understanding. The basic purpose of visual representation is to efficiently interpret what is insight, as easy as possible. Different available visualization techniques are use for different situation which convey different level of understanding.

It's hard to think of a professional industry that doesn't benefit from making data more understandable.

*Assistant Professor - L. S. Raheja College of Arts and Commerce, Juhu Road, Santacruz (W)

Every STEM field benefits from understanding data and so do fields in government, finance, marketing, history, consumer goods, service industries, education, sports, and so on.

The amount of information that humans gain through vision is far beyond that of other organs. Data visualization is the use of human natural skills to enhance data processing and organization efficiency. Visualization can help us deal with more complex information and enhance memory. Most people don't know much about statistical data, and basic statistical methods (mean, median, range, etc.) are not in line with human cognitive nature. One of the most famous examples is Anscombe's quartet. It is difficult to see the law according to statistical methods, but the rules are very clear when the data is visualized.

LITERATURE REVIEW

Visualization is a process in which image is formed in mind or a visual representation of an object . Visualization has many definition but the most referred one is "the use of computer-supported, interactive, visual representations of data to amplify cognition", where cognition means the power of human perception or in simple words the use of knowledge . In Analytics field visualization is a graphical representation that best conveys the complicated ideas clearly, precisely, and efficiently. These graphs are easily understood and interpret effectively . The main goal of Visualization is to gain insight about data. The goal of visualization is to analyze, explore, discover, illustrate, and communicate information in well understandable form. Visualization is use to present huge amount of information from different viewpoint. The visualization is a powerful tool that can be use for different cognitive processes like exploratory, analytical and descriptive.

China in 1137 used diagrams and maps visualization techniques to understand data. Lots of development took place in visualization techniques since then. Data Visualization techniques are used in many fields like architecture. Information visualization used to present design data with the aid of drawings and diagrams. For the data which is conceptual , we require scientific visualization techniques like graphs and charts etc.

Visualization is a part of some originative action that needs user to construct hypotheses, searches patterns and exclusion, and the polish their hypothesis. To determine the advantages and disadvantages of their new visualization of information tool the developer or investigator are always interested. Visualization experts such as Stephen Few and Edward Tufte encouraged that visualization should present the data clearly without any perturb and should not include chart junk. Simple and clear visualization are easy to interpret. Memorability experiment result shows that visualization are as such memorable with consistency over people. Visualization are less unforgettable. Visualization of information technique might help to figure out the trouble. Expedition of visual data has lots of applications like data mining and fraud detection utilize visualization of information technique for mended data analysis.

For visualization there a lot of long-familiar methods for data sets are x-y plots, histograms, Graphs, and line plots. These methods are good for exploratory data analysis but are restricted to comparatively minor and small dimensional data . Data visualization benefitted from development in technology that extend innovational ways of showing complex data. Data visualization cover geographical information system, graphical user interface, digital images, graphs, multidimensional tables, virtual reality and three-dimensional animation.

Visualization is a procedure for converting data into figure that allows various exploiter to perceive and act with data more efficiently. Visualization technique builds vast and complex information understandable to everyone. Visualization can be used for data analysis and decision making accordingly. People interaction with visualization tool has strongly effect on the understanding of data and system functions. Therefore human interaction contribute significantly role in the valuation and design of visualization tool. Visualization help human to display data as a graphics. And this can also called cognitive support.

While we'll always wax poetically about data visualization there are practical, real-life applications

that are undeniable. And, since visualization is so prolific, it's also one of the most useful professional skills to develop. The better you can convey your points visually, whether in a dashboard or a slide deck, the better you can leverage that information.

The concept of the citizen data scientist is on the rise. Skill sets are changing to accommodate a data-driven world. It is increasingly valuable for professionals to be able to use data to make decisions and use visuals to tell stories of when data informs the who, what, when, where, and how. While traditional education typically draws a distinct line between creative storytelling and technical analysis, the modern professional world also values those who can cross between the two: data visualization sits right in the middle of analysis and visual storytelling. Of course, one of the best ways to understand data visualization is to see it.

COMMON DATA VISUALIZATION TOOLS

Generally speaking, R language, ggplot2 and Python are used in academia. The most familiar tool for ordinary users is Excel. Commercial products include Tableau, FineReport, Power BI, etc.

1) D3

D3.js is a JavaScript library based on data manipulation documentation. D3 combines powerful visualization components with data-driven DOM manipulation methods.

Evaluation: D3 has powerful SVG operation capability. It can easily map data to SVG attribute, and it integrates a large number of tools and methods for data processing, layout algorithms and calculating graphics. It has a strong community and rich demos. However, its API is too low-level. There isn't much reusability while the cost of learning and use is high.

2) HighCharts

HighCharts is a chart library written in pure JavaScript that makes it easy and convenient for users to add interactive charts to web applications. This is the most widely used chart tool on the Web, and business use requires the purchase of a commercial license.

Evaluation: The use threshold is very low. HighCharts has good compatibility, and it is mature and widely used. However, the style is old, and it is difficult to expand charts. And the commercial use requires the purchase of copyright.

3) Echarts

Echarts is an enterprise-level chart tool from the data visualization team of Baidu. It is a pure Javascript chart library that runs smoothly on PCs and mobile devices, and it is compatible with most current browsers.

Evaluation: Echarts has rich chart types, covering the regular statistical charts. But it is not as flexible as Vega and other chart libraries based on graphic grammar, and it is difficult for users to customize some complex relational charts.

4) Leaflet

Leaflet is a JavaScript library of interactive maps for mobile devices. It has all the mapping features that most developers need.

Evaluation: It can be specifically targeted for map applications, and it has good compatibility with mobile. The API supports plug-in mechanism, but the function is relatively simple. Users need to have secondary development capabilities.

5) Vega

Vega is a set of interactive graphical grammars that define the mapping rules from data to graphic, common interaction grammars, and common graphical elements. Users can freely combine Vega grammars to build a variety of charts.

Evaluation: Based entirely on JSON grammar, Vega provides mapping rules from data to graphics, and it supports common interaction grammars. But the grammar design is complex, and the cost of use and learning is high.

6) deck.gl

deck.gl is a visual class library based on WebGL for big data analytics. It is developed by the visualization team of Uber.

Evaluation: deck.gl focuses on 3D map visualization. There are many built-in geographic information visualization common scenes. It supports visualization of large-scale data. But the users need to have knowledge of WebGL and the layer expansion is more complicated.

7) Power BI

Power BI is a set of business analysis tools that

provide insights in the organization. It can connect hundreds of data sources, simplify data preparation and provide instant analysis. Organizations can view reports generated by Power BI on web and mobile devices.

Evaluation: Power BI is similar to Excel's desktop BI tool, while the function is more powerful than Excel. It supports for multiple data sources. The price is not high. But it can only be used as a separate BI tool, and there is no way to integrate it with existing systems.

8) Tableau

Tableau is a business intelligence tool for visually analyzing data. Users can create and distribute interactive and shareable dashboards, depicting trends, changes and densities of data in graphs and charts. Tableau can connect to files, relational data sources and big data sources to get and process data.

Evaluation: Tableau is the simplest business intelligence tool in the desktop system. It doesn't force users to write custom code. The software allows data mixing and real-time collaboration. But it's expensive and it performs less well in customization and after-sales services.

9) FineReport

FineReport is an enterprise-level web reporting tool written in pure Java, combining data visualization and data entry. It is designed based on "no-code development" concept. With FineReport, users can make complex reports and cool dashboards and build a decision-making platform with simple drag-and-drop operations.

Evaluation: FineReport can be directly connected to all kinds of databases, and it is convenient and quick to customize various complex reports and cool dashboards. The interface is similar to that of Excel. It provides 19 categories and over 50 styles of self-developed HTML5 charts, with cool 3D and dynamic effects. The most important thing is that its personal version is **completely free**.

Common general types of data visualization :

- Charts
- Tables
- Graphs
- Maps
- Infographics
- Dashboards

More specific examples of methods to visualize data :

- Area Chart
- Bar Chart
- Box-and-whisker Plots
- Bubble Cloud
- Bullet Graph
- Cartogram
- Circle View
- Dot Distribution Map
- Gantt Chart
- Heat Map
- Highlight Table
- Histogram
- Matrix
- Network
- Polar Area
- Radial Tree
- Scatter Plot (2D or 3D)
- Streamgraph
- Text Tables
- Timeline
- Treemap
- Wedge Stack Graph
- Word Cloud
- And any mix-and-match combination in a dashboard!

STATEMENT OF THE PROBLEM

In the present lifestyle, educated, well - informed, and techno savvy consumers want to save time and adopt smarter ways to visualize data for better understanding. There are various tools available in the market for visualization. In this context, the study will appear to be highly relevant and indicative by the nature of people's ongoing preference towards using different visualization techniques.

OBJECTIVE OF THE STUDY

1) To analyze the which tool is used for data visualization by majority of people.

RESEARCH METHODOLOGY

This study was conducted in Mumbai. The purposes of study 100 respondents were selected and data were collected through questionnaire. The nature of data

collected for the research is primary data. The data has been collected directly from the sample respondents who are working in data analytics company.

TOOLS USED

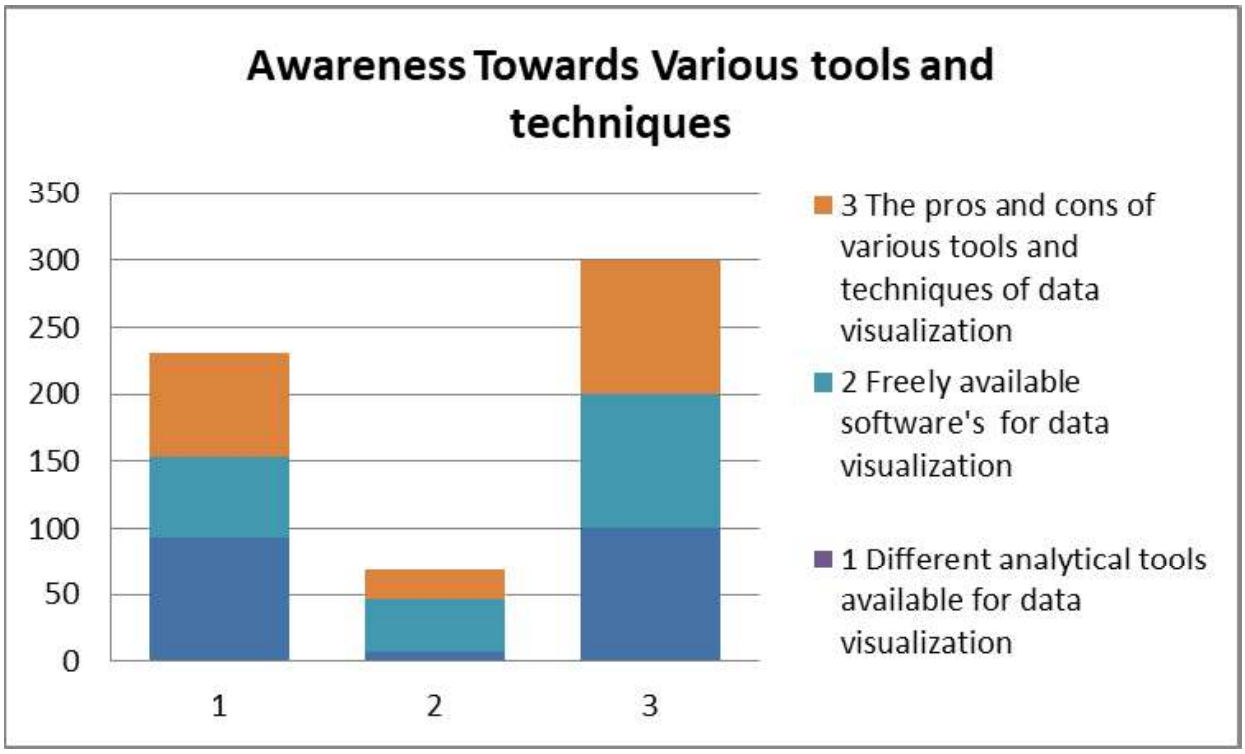
1) Percentage analysis
2) Chi-square analysis

ANALYSIS AND INTERPERTATION

Majority (93%) of respondents are aware of the different analytical tools available for data visualization, (77%) of the respondents are aware of freely available software's for data visualization and (61%) of the respondents aware of the pros and cons of various tools and techniques of data visualization.

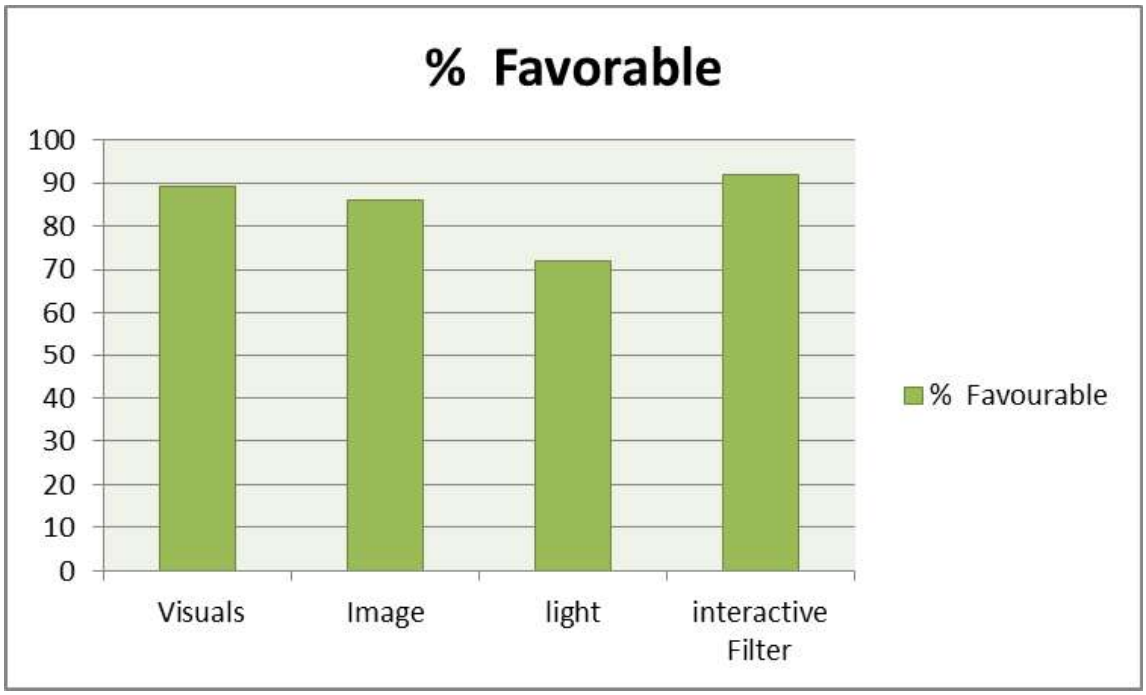
S.NO	MODE	AWARE	NOT AWARE	TOTAL
1.	Different analytical tools available for data visualization	93	07	100
2.	Freely available software's for data visualization	61	39	100
3.	The pros and cons of various tools and techniques of data visualization	77	23	100

Table-1: Awareness Towards Various tools and techniques



89% of the respondents are of view that data is communicated more conveniently with visuals, 86% of the respondents are of view that Image is the best visualization technique available, 72% of the respondents are of view that light color should be used in visualization, 92% of the respondents are of view that visualization increases with interactive filters.

Questions	Result	% Favorable
Data is Communicated more conveniently with	Visuals	89
Best Visualization Technique	Image	86
Visualization color should be	light	72
Effectiveness of visualization increase with	interactive Filter	92



CHI-SQUARE TEST

S.NO	PERSONAL FACTORS	CHI-SQUARE VALU	d.f	P.VALUE	SIGNIFICANT VALUE	S/NS
1.	Gender	7.937	2	0.009	0.05	NS
2.	Age	25.843	6	0.000	0.05	NS
3.	Education	45.139	10	0.000	0.05	NS
4.	Occupation	29.139	8	0.000	0.05	NS
5.	Income	52.958	6	0.000	0.05	NS

Table-3: Personal Factors And Source Of Awareness

It is concluded that Gender, age, education, occupation, Income have significant influence on the sources of awareness of different tools and techniques available in the market for data visualization.

FINDINGS

1) Percentage Analysis

a) Majority (86%) of the respondents are Male.

b) Most (46%) of the respondents belong to the age group of below 30 years.

c) Most (34%) of the respondents are educated at Undergraduate level.

d) Most (33%) of the respondents are Employed.

e) Most (35%) of the respondent's family monthly income range below 20000.

f) Majority (57%) of the respondents are Married.

g) Majority (51%) of the respondents are in data analytics field.

h) Majority (93%) of respondents are aware of the different analytical tools available for data visualization, (77%) of the

respondents are aware of freely available software's for data visualization and (61%) of the respondents aware of the pros and

cons of various tools and techniques of data visualization.

I) 89% of the respondents are of view that data is communicated more conveniently with visuals, 86% of the respondents are of view that Image is the best visualization technique available, 72% of the respondents are of view that light color should be used in visualization, 92% of the respondents

are of view that visualization increases with interactive filters.

2. Chi-square Analysis

It is concluded that Gender, age, education, occupation, Income have significant influence on the sources of awareness of different tools and techniques available in the market for data visualization.

LIMITATION OF THE STUDY

- The study is restricted to Mumbai city only.
- The number of respondents are restricted to hundred only.

CONCLUSIONS

Data visualization is understood as displaying data in the graphics form so that it can be easily understandable. Different data visualization techniques are used to display data in visual form like graph , image, numbers etc. This paper define the literature review on data visualization techniques. This research study provide best knowledge to the beginners who are willing to work on data visualization techniques. This paper provide best understanding about the concept of data visualization techniques.

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