Information Or Data Visualization And Techniques

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Abstract: In today's world, the exponential growth of data is transforming the way we operate. The sheer volume of data being generated from diverse fields is astounding. Consequently, the value of data has become crucial in every aspect of decision-making. In the Big Data era, data exploration and visualization systems hold immense significance. Navigating and visualizing vast datasets pose a complex challenge for companies. To gain accurate insights from this massive data deluge, organizations must adhere to specific protocols. Implementing the right strategies for data analysis empowers businesses to optimize their processes and uncover untapped product and service opportunities. Failing to do so might lead to missing out on valuable insights. To address this, recent exploration and visualization systems should meet certain prerequisites and overcome various challenges. These systems must efficiently handle massive volumes of data from diverse sources to remain effective. In this context, understanding the different techniques and tools available for visualizing datasets becomes crucial. Their capabilities to handle and support extensive data from various sources will be instrumental in making sense of the ever-expanding data landscape.

Keywords: Data Visualization, Big Data, SNA, BA, SMA, BIA, BDA, Tableau, Power BI.

I. INTRODUCTION

Data analytics, also known as data analysis, is a powerful approach used to study raw data and extract valuable insights and knowledge. Companies leverage data analytics to understand their customers' needs better and refine their business strategies. By collecting data from various sources, companies can categorize and organize it based on patterns and techniques. This allows for a more structured and effective data analysis process, leading to actionable insights that can drive business growth and success. Through data analytics, companies can make informed decisions, identify opportunities, and enhance their overall performance. The data analysis encompasses various classifications area a) Social Network Analytics b) Business Analytics c) Business Impact Analytics d) Big data Analytics are some of the important analysis which is carried in the present world for analysing the data..

II. TYPES OF ANALYTICS

2.1   Social Network Analysis (SNA)
Social Network Analysis (SNA) involves both qualitative and quantitative analysis of data from social networks like Facebook, Twitter and LinkedIn, etc. This method aims to measure customer activities by monitoring their interactions through chat, posts, comments, and more. SNA can be applied in various contexts, such as groups, communities, and organizations, to measure the flow of data among customers. It offers insights into customer behaviour and preferences, helping businesses understand their needs better. The analysis results can be presented in both mathematical and visual formats, making it easier for businesses to comprehend and act upon the information. By leveraging SNA, companies can optimize their strategies and improve their overall performance based on a deeper understanding of their customers and their interactions on social networks.

2.2.   Business Analytics (BA)
Business Analytics (BA) is a crucial analysis method used by organizations to measure their performance, evaluate their market position, and identify areas for improvement in their strategies. This type of analytics employs statistical methods tailored to specific products or processes within the company. The primary objective of implementing business analytics is to monitor the flow of business operations and identify shortcomings in existing processes. By extracting meaningful data, companies gain insights into areas that need improvement, paving the way for future growth and effective handling of challenges. Business analytics plays a vital role in decision- making and improving business strategies, enabling companies to stay competitive in their respective industries. By leveraging data-driven insights, organizations can optimize their operations and make well-informed decisions to drive success and achieve their business goals.

2.3.   Social Media Analytics (SMA)

Social media analytics involves the collection and analysis of data from various social media platforms and blogs. By monitoring this data, companies can improve their processes and deliver better-quality products. This type of analytics offers valuable insights into various business functions, including marketing and customer service, helping enhance customer experience. Social media analytics is a powerful tool to understand real-time customer choices and behaviours. Organizations use this tactic to gain detailed information about their customer base on an emotional level, enabling them to tailor their strategies accordingly. During social media analytics, companies aim to identify business objectives that can increase profitability. They achieve this by optimizing customer service, gathering feedback from customers on their products and services, and leveraging public opinions to enhance their business strategies. Overall, social media analytics plays a pivotal role in improving company growth and performance by harnessing the power of customer data and real-time insights.

2.4.   Business Impact Analysis (BIA)

Business Impact Analysis (BIA) is a critical analytics process that helps organizations identify the impact of both critical and non-critical systems. By analysing the data obtained through BIA, companies can gain valuable insights and take precautionary measures to prepare for potential disasters. This type of analysis provides information about estimated recovery times and recovery requirements, which are essential in planning disaster recovery strategies. It also helps in measuring the risks associated with system failures and evaluating the costs of upgrading a particular system. By conducting a thorough BIA, companies can identify major risks and their potential consequences, such as the loss of data on the company's main servers. This enables organizations to make informed decisions and develop strategies that can mitigate risks and improve overall methodologies. Every organization should prioritize conducting a Business Impact Analysis to understand the impact of their decisions in the present and future, helping them build resilience and enhance their disaster preparedness strategies. Ultimately, BIA is a crucial tool in ensuring the continuity and stability of a company's operations in the face of potential disruptions.

2.5   Big Data Analytics (BDA)

Big data analytics is indeed a crucial and highly relevant type of analysis in the present world. It involves the processing and analysis of massive volumes of data, often referred to as big data, collected from various sources such as social networking sites, climate sensors, videos, sale transaction records, and more. The primary goal of big data analytics is to uncover hidden patterns and connections within the data, providing accurate and valuable insights. It enables organizations to make better business decisions by harnessing the power of data. Traditional Business Intelligence (BI) systems may struggle to handle large and diverse data sources like web server logs, social networking activity reports, internet click-stream data, and sensor-captured data. To address this challenge, new technologies such as Hadoop, MapReduce, and NoSQL databases are utilized to efficiently manage and process vast amounts of data for analytics purposes. Big data analytics allows for the extraction of significant value from large datasets and facilitates fast data analysis. The use of new visualizations and analytic techniques capitalizes on the unique characteristics of big data, empowering businesses and data scientists to gain deeper insights and stay ahead in today's data-driven world.

III.   DATA VISUALIZATION

Data visualization is a powerful technique that emphasizes the significance of data by presenting it in a visual context. It involves creating and studying visual representations of data, transforming raw information into meaningful insights. By employing data visualization, users can gain a deeper understanding of data collected from various sources. Dashboards are commonly used in data visualization, allowing users to visualize and interpret hidden patterns, correlations, and textual information with ease, using specialized visualization software.

3.1.   THE KEY USES OF DATA VISUALIZATION ARE

3.1.1.   Improve In Decision Making

Data visualization plays a vital role in improving decision- making within organizations. By presenting data in visual formats such as charts, graphs, and dashboards, decision- makers can easily grasp complex information and gain valuable insights. Data visualization allows organizations to view their current position, performance, and processes in a clear and concise manner. This enables them to identify trends, patterns, and areas that need improvement. Armed with this information, companies can make more informed and data- driven decisions. The Data visualization facilitates real-time monitoring of key performance indicators (KPIs) and other critical metrics, empowering organizations to adapt their business strategies as needed. The ability to quickly interpret and understand data visually enables faster responses to emerging opportunities and challenges. Data visualization significantly enhances decision-making by providing a comprehensive and accessible view of data, ultimately leading to better outcomes and improved business performance.

3.1.2. Communicating Insights

Data visualization is a powerful tool for communicating insights effectively. By presenting data in visually appealing and easy-to-understand formats, it simplifies complex information for a broader audience. Graph, charts, and infographics are some common data visualization techniques that transform raw data into visually compelling representations. These visualizations help convey trends, patterns, and relationships in the data, making it more accessible and digestible for both technical and non-technical audiences. Instead of presenting raw numbers and statistics, data visualization allows storytellers to present data-driven narratives that captivate and engage the audience. This makes it an essential tool for professionals across various fields, from business and marketing to academia and journalism. By leveraging data visualization, organizations can present insights and findings in a visually appealing manner, which not only enhances understanding but also leaves a lasting impact on stakeholders and decision-makers. This ultimately fosters better communication and collaboration, leading to more effective actions and strategies based on the data-driven insights presented through visualizations.

3.1.3. Presenting Data Stories

Data visualization is a powerful tool for presenting data-driven stories in a compelling and engaging manner. Instead of simply displaying data points and statistics, data visualization allows storytellers to create narratives that revolve around the data, making it easier for stakeholders and audiences to understand the insights and implications. By using various visual elements such as charts, graphs, maps, and infographics, data visualization brings data to life and enables a more immersive storytelling experience. It allows presenters to highlight key findings, trends, and correlations in the data, weaving a cohesive and persuasive narrative that supports their message. Data-driven stories presented through data visualization can have a profound impact on stakeholders, decision-makers, and audiences. They enable better comprehension of complex information, fostering a deeper understanding of the subject matter. As a result, data-driven stories become more memorable and influential, driving informed decisions and actions. Whether in business presentations, academic research, or public communications, data visualization empowers storytellers to make data more accessible, relatable, and impactful. By presenting data stories through visualization, organizations and individuals can effectively convey their message, spark interest, and drive positive outcomes based on the insights derived from the data.

3.1.4. Improvement In ROI

Data visualization plays a crucial role in improving Return on Investment (ROI) for companies. By analysing and visualizing data, organizations can gain insights into the strengths and weaknesses of their business flow. Data visualization allows companies to identify inefficiencies, bottlenecks, and areas that need improvement. By rectifying these issues, businesses can optimize their processes, reduce costs, and enhance overall performance. This, in turn, leads to increased efficiency and productivity, which directly impacts ROI. Data visualization enables companies to make data-driven decisions, which are more likely to yield positive outcomes. It allows them to focus on strategies that have proven to be effective, minimizing risks and maximizing returns. By continuously monitoring and analysing data through data visualization, companies can stay agile and responsive to market changes and customer demands. This adaptability further contributes to improved ROI as companies can quickly adjust their business strategies to align with emerging opportunities and challenges. Data visualization helps companies gain valuable insights, optimize their operations, and make informed decisions, ultimately leading to improved ROI and better financial outcomes.

3.1.5. Information Sharing

Data visualization plays a significant role in information sharing within a company. By analysing and visualizing data, organizations can gain valuable knowledge about their past and current business flow, which can then be effectively shared with relevant stakeholders. Data visualization simplifies complex information, making it easier to understand and interpret for a broader audience. By presenting data in visually appealing formats, such as charts, graphs, and infographics, organizations can convey insights and trends in a clear and concise manner. Sharing information through data visualization helps avoid misconceptions and misunderstandings.

It provides a common understanding and a clear view of the data, enabling all stakeholders to make more informed decisions and align their actions with the data-driven insights. Data visualization also aids in improving collaboration and communication within the organization. Teams can easily share and discuss data findings, facilitating a more data-driven and cohesive approach to problem-solving and strategy development. The data visualization enhances information sharing by providing a visually compelling and accessible representation of data. By sharing insights through visualization, companies can foster better understanding, collaboration, and decision-making across all levels of the organization. This ultimately leads to improved business processes and better outcomes based on data-driven knowledge.

3.1.6.   Information Sharing

Time-saving is a significant advantage of using data visualization in a company. Rather than relying on trial and errors methods or spending hours analysing raw data, data visualization allows organizations to quickly identify problems and take immediate counter measures. By presenting data in visual formats, such as charts and graphs, data visualization enables stakeholders to quickly grasp key insights and trends. This efficient understanding of information leads to faster decision-making and problem-solving processes. The data visualization tools often offer interactive features, allowing users to explore and drill down into the data to uncover deeper insights. This interactivity further speeds up the analysis process and helps users retrieve accurate information in a short span of time. Time-saving through data visualization is especially beneficial in fast-paced business environments, where quick and informed decisions are essential to stay competitive. By streamlining the data analysis process, data visualization empowers organizations to act promptly and confidently, leading to improved efficiency and overall performance. Data visualization's ability to present information clearly and quickly enables organizations to save time in data analysis, decision-making, and problem-solving. This time-saving aspect contributes to increased productivity, agility, and the ability to adapt swiftly to changing market conditions.

Fig. 1 Data Visualization Graphs

3.2.   BASIC GRAPHS AND CHARTS

3.2.1.   Bar Charts

Bar charts are simple and intuitive visualizations used for comparing categorical or discrete data. They display data as rectangular bars, allowing easy identification of patterns and trends. Whether single or grouped data, bar charts efficiently communicate information and facilitate quicker decision- making. Their simplicity and versatility make them a popular choice in data analysis and reporting.

3.2.2.   Line Charts

Line charts are powerful tools for visualizing data trends over time. They are particularly useful for representing data that changes continuously or across a sequential period. Line charts display data points as connected line segments, allowing viewers to observe trends, fluctuations, and correlations. These visualizations are widely used in various fields, including financial analysis, where they help track stock market trends and analyse economic data. Additionally, line charts are commonly employed in scientific research to represent data that evolves over time, such as temperature changes, population growth, or experimental results. By connecting data points with lines, line charts make it easy to spot trends and identify patterns in data. The upward or downward slopes of the lines provide valuable insights into the direction and magnitude of changes. Overall, line charts serve as valuable tools in visualizing time-based data and are essential for understanding trends and patterns in data sets with sequential observations.

3.2.3.   Pie Charts

Pie charts are effective visualizations for illustrating the composition of a whole dataset. They display the proportion of each category as a slice of the entire pie, where the size of each slice represents the relative percentage of that category compared to the total. Pie charts are commonly used to visualize data with distinct categories and are particularly useful when showcasing the distribution of a set of data points in a clear and straightforward manner.

3.2.4. Scatter Plots

Scatter plots are valuable visualizations that show the relationship between two variables. They plot data points on both the X and Y axes, allowing for the examination of how the variables interact with each other. Scatter plots are particularly useful in identifying correlations, patterns, and outliers within the data. By analysing the distribution of data points, one can gain insights into the strength and nature of the relationship between the two variables being compared. This makes scatter plots a powerful tool in various fields, such as scientific research, data analysis, and exploratory data visualization.

3.3. ADVANCED VISUALIZATION TECHNIQUES

3.3.1. Heatmaps

Heatmaps are visualizations that represent data density using colour intensity. They are highly effective for revealing patterns, concentrations, and clusters within a dataset. Heatmaps use colours to show the varying levels of data density, with darker colours indicating higher density and lighter colours representing lower density. Heatmaps find extensive use in various fields, such as data mining, biology, and finance. In data analysis, they help identify trends and relationships between data points. In biology, heatmaps are employed to visualize gene expression levels and identify gene clusters. In finance, heatmaps assist in visualizing market movements and identifying trends in asset prices. By using colour gradients to represent data density, heatmaps offer an intuitive and accessible way to analyse and interpret complex datasets. They provide a clear overview of the distribution of data points, allowing users to quickly identify areas of interest and patterns within the data.

3.3.2. Treemaps

Tree-maps are hierarchical visualizations that use nested rectangles to represent the hierarchical structure of data. They are especially useful for illustrating file systems, organizational structures, and resource allocation. Tree-maps display the relative proportions of data within each level of the hierarchy, making it easy to understand the distribution and relationships between different categories. By using nested rectangles of varying sizes, tree-maps provide an intuitive and space-efficient way to visualize complex hierarchical data sets. These hierarchical visualizations use nested rectangles to represent the hierarchical structure of data. Tree-maps are particularly useful for illustrating file systems, organizational structures, and resource allocation.

3.3.3. Bubble Charts

Bubble charts are versatile visualizations that combine the concept of scatter plots with an additional dimension represented by the size of the bubbles. In a bubble chart, each data point is represented by a circle (bubble) positioned on the X and Y axes like a scatter plot, but the size of the bubble conveys a third dimension of the data. The size of the bubbles in a bubble chart indicates the magnitude or value of the third dimension, providing an extra layer of information for data visualization. This added dimension can represent various factors, such as the frequency, quantity, or importance of each data point. Bubble charts are effective for visualizing data sets with three variables, allowing viewers to quickly perceive patterns and relationships between different data points. By incorporating both position and size as visual cues, bubble charts offer a comprehensive way to analyse and interpret multi-dimensional data.

3.3.4. Choropleth Maps

Choropleth maps are powerful tools for visualizing spatial data. They use color-coding to represent data values on a map, where each region or area is shaded or filled with a colour based on the corresponding data value. Choropleth maps are particularly effective in highlighting regional variations and patterns within the data. With choropleth maps, decision-makers and researchers can gain insights into regional disparities and trends, facilitating informed decision-making and policy planning. This makes choropleth maps valuable tools for understanding spatial data and identifying geographic patterns in a visually compelling and accessible manner.

3.3.5. Sankey Diagrams

Sankey diagrams are flow diagrams that illustrate the movement of resources or values between different entities. They are particularly useful in visualizing the flow of energy, materials, or information through a system. These diagrams find wide-ranging applications in fields such as energy flow analysis, where they visualize the flow of energy between different sources and end-users. They are also used in supply chain management to map the movement of materials and goods through the supply chain network. Sankey diagrams are beneficial for understanding complex systems and optimizing processes. By visually depicting the flow of resources, they help identify areas of inefficiency or potential bottlenecks in a system. This makes them valuable tools for decision-making, resource management, and performance analysis in diverse industries and applications.

3.4. INTERACTIVE VISUALIZATIONS

Interactive visualizations play a crucial role in enhancing data exploration, understanding complex data sets, and empowering users with actionable insights. They have become increasingly popular in data-driven industries, research, education, and many other domains.

3.4.1. Interactive Dashboards
Interactive dashboards are dynamic and user-friendly tools that empower users to interact with data and explore insights on their own terms. They provide a wide range of interactive features, such as filters, drill-downs, and real-time data updates, which enhance the data exploration and analysis experience. Interactive dashboards are instrumental in facilitating data-driven decision-making and providing users with a comprehensive view of their data. They have become a crucial component in modern business operations, research, and data-driven decision-making processes.

3.4.2. Tooltips And Hover Effects
Tooltips and hover effects are essential elements in interactive visualizations that enhance the user experience and provide valuable context and details. Tooltips are small pop-up boxes that appear when users hover over data points or elements in a visualization. They offer additional information, such as labels, values, descriptions, or any relevant metadata associated with the data point. Tooltips help users understand the data better without cluttering the main visualization, providing context and insights in a concise and unobtrusive manner.

3.4.3. Filters And Drill-Downs
Filters and drill-downs are essential interactive features in data visualizations that empower users to explore and analyse data more effectively. Filters allow users to selectively include or exclude specific data subsets based on certain criteria. By applying filters, users can focus on specific aspects or categories of the data, allowing for targeted analysis and insights. Filters are especially valuable in large datasets, where users can quickly narrow down the data to relevant subsets for a more in-depth examination. Drill-downs, on the other hand, enable users to delve deeper into the data hierarchy or levels of detail. With drill-down functionality, users can expand or zoom in on specific data points or categories to reveal more granular information. This hierarchical exploration allows users to understand the underlying patterns and trends within the data, promoting a more comprehensive analysis.

3.5. INFOGRAPHICS

Infographics are a powerful and effective means of blending data visualizations with textual information, illustrations, and icons. They are a popular and captivating way to present complex data and information to a general audience in a visually appealing and easily understandable manner. Infographics find widespread application in various fields, including marketing, education, journalism, and corporate communications. They are particularly valuable for social media posts, blog articles, presentations, and reports, where capturing the audience's attention and delivering information effectively is crucial. Infographics are an excellent tool for simplifying complex data, capturing audience attention, and delivering compelling visual narratives. They bridge the gap between data visualization and textual information, providing a seamless and engaging experience for a broad audience.

IV. BIG DATA VISUALIZATION

In the big data environment, data visualization plays a crucial role in understanding and analysing large volumes of complex data. Here are some important features and the role of data visualization in the context of big data:

4.1. Real-Time Data Analysis
Real-time data analysis is one of the most critical features of data visualization. It allows users to gain deep insights into the data as it is generated, updated, or modified in real-time. This capability is particularly valuable in fast-paced and dynamic business environments where timely decisions are crucial. With real-time data visualization, business people can monitor key performance indicators (KPIs), track operational metrics, and respond to changing trends immediately. The visual representations provided by dashboards and interactive visualizations enable users to quickly grasp the current state of the data and identify any emerging patterns or anomalies.

4.2. Dynamic Nature
The dynamic nature of data visualization allows users to change the view and representation of data in various formats, such as bar graphs, line charts, pie charts, scatter plots, and more. This flexibility enables users to analyse and explore data from different perspectives, gaining deeper insights and understanding of the underlying trends. By switching

between different types of visualizations, users can effectively convey different aspects of the data and uncover patterns that might not be apparent in a single representation. For example, bar graphs are ideal for comparing categorical data, while line charts are useful for illustrating trends over time. On the other hand, scatter plots are valuable for showing relationships between two variables. The dynamic nature of data visualization empowers users to explore and understand data in versatile ways, facilitating better decision-making and enabling organizations to extract maximum value from their vast and diverse data sources.

4.3.   Interactive Presentations

Interactive presentations through data visualization tools provide companies with a powerful way to engage their audience and communicate data-driven insights effectively. By incorporating interactive features into their presentations, COMPANIES CAN DELIVER A MORE ENGAGING AND IMMERSIVE EXPERIENCE TO THEIR STAKEHOLDERS. WITH DATA VISUALIZATION TOOLS, companies can create interactive dashboards and reports that allow users to explore data, apply filters, drill down into specific details, and interact with visualizations. These interactive elements enable users to gain a comprehensive understanding of the data and make informed decisions based on the insights presented. Interactive presentations through data visualization tools provide companies with a powerful way to communicate complex data in a user-friendly and impactful manner. They facilitate better engagement, understanding, and decision-making, making them an essential component of modern data-driven organizations.

4.4.   In-Memory

In-memory data visualization refers to the practice of storing data and visualization results in memory, allowing for quick and easy access by multiple users. This approach significantly enhances the speed and responsiveness of data analysis and exploration. By storing visualization results in memory, users can quickly access and interact with the data without the need for time-consuming data retrieval from external storage sources.

4.5.   Secured

Data security is a critical aspect of big data visualization in any environment. In the big data context, where massive volumes of sensitive data are involved, ensuring the security of data becomes even more crucial. Data security is vital to building trust among users and maintaining the integrity of the data visualization process in a big data environment.

V.   ERROR TO AVOID IN DATA VISUALIZATIONS

While data visualization in a big data environment can provide valuable insights, it's crucial to be aware of potential errors and pitfalls that can lead to misinterpretation or confusion. Here are some common errors to avoid in data visualizations:

5.1.   Exposing All Data

Exposing all data without proper context and organization is a common error in data visualization. While data visualization aims to provide valuable insights, presenting too much data without clear structure and focus can overwhelm users and hinder their ability to understand and draw meaningful conclusions.

5.2.   Displaying Errors

Displaying errors in data visualization can lead to incorrect conclusions and decisions. It is essential for companies to be aware of the potential pitfalls and take steps to minimize errors in their visualizations.

5.3.   Lack Of Planning

Lack of planning in data visualization can lead to ineffective and confusing presentations of data. Selecting the right type of dashboard and visualization tools is crucial for effectively conveying insights and making the data understandable to the intended audience.

VI.   DATA VISUALIZATION TOOLS IN BIG DATA

6.1.   DATA WRAPPER

Data wrapper tools are powerful solutions that simplify the process of creating data visualizations and make it easy for end users to grasp insights from raw data. These tools offer a user- friendly web-based GUI (Graphics User Interface) that allows users to generate graphs and visualizations with simple steps, eliminating the need for complex coding or technical expertise

6.2.   Chart Js
Chart.js is a popular JavaScript library used for data visualization in the form of charts. It provides a simple and effective way to create various types of charts, such as line charts, bar charts, pie charts, and more. To use Chart.js, the user needs to include the Chart.js library in their frontend code, typically by linking to the library in the HTML file. Once the library is loaded, the user can then use the API provided by Chart.js to create and customize charts.

6.3 Charted
Charted is a data visualization tool that provides a simple and user-friendly way to create charts from input data in .csv file format. It offers a straightforward process for users to upload their data files and generate visualizations without the need for complex coding or technical expertise.

6.4. Data-Driven Documents (D3)
Data-Driven Documents, is a powerful JavaScript library for data visualization. It allows users to bind data to the Document Object Model (DOM) and apply data-driven transformations to create dynamic and interactive visualizations.

6.5.   TABLEAU

Tableau is a popular and powerful data visualization tool widely used in big data environments. It provides a user-friendly interface that allows users, including non-programmers and business professionals, to gain insights from their data through various charts, graphs, maps, and interactive graphics.

Tableau's combination of ease of use, interactivity, and scalability makes it a valuable tool for data exploration, analysis, and visualization in big data environments. It empowers users to discover meaningful insights and patterns from complex datasets, helping organizations make data-driven decisions and uncover valuable business opportunities.

6.5.1.   KEY FEATURES OF TABLEAU

6.5.1.1. Data Connectivity
Tableau can connect to various data sources such as spreadsheets, databases, cloud services, and big data platforms, allowing users to analysis data from multiple sources in one place.

6.5.1.2. Data Visualization
Tableau provides a drag-and-drop interface to create visualizations like bar charts, line graphs, pie charts, heat maps, scatter plots, maps, and more. Users can easily customize the visualizations to suit their needs.

6.5.1.3. Dashboards And Storytelling
Users can combine multiple visualizations into interactive dashboards, providing a comprehensive view of the data. With storytelling capabilities, users can create a sequence of visualizations that lead to a data-driven narrative.

6.5.1.4. Data Analysis
Tableau offers various analytical tools like calculated fields, grouping, filtering, forecasting and more, empowering users to perform in-depth data analysis.

6.5.1.5. Collaboration And Sharing
Tableau allows users to share their visualizations and dashboards with colleagues, clients, or the public through Tableau Server or Tableau Online. This enables collaborative decision-making and data sharing across teams.

6.5.1.6. Mobile Support
Tableau provides mobile apps for iOS and Android devices, allowing users to access and interact with their data visualizations on the go.

Fig. 2 Tableau Software

6.6. Chartblocks

Chartblocks is an online data visualization tool that offers a user- friendly interface and does not require programming skills. It allows users to create interactive and responsive visualizations using various data sources, such as databases, live feeds, and spreadsheets.

6.7. Plotly

Plotly is a user-friendly data visualization tool that allows users to create charts quickly and easily. It provides a simple and intuitive interface, making it accessible to users with varying levels of technical expertise.

6.8 Ember Charts

Ember Charts is a data visualization library that is built on the Ember.js framework and utilizes D3.js for rendering the visualizations. It offers a wide range of chart types, including time series, bar charts, pie charts, and scatter plots. Ember Charts is a valuable tool for developers working with the Ember.js framework and seeking efficient and powerful data visualization capabilities. It allows users to create visually appealing and interactive charts that enhance data exploration and communication of insights within Ember.js applications

6.9. Power Bi

Power BI is a powerful business analytics service developed by Microsoft that enables users to connect to a wide range of data sources, transform and model the data, and create interactive data visualizations and reports. It is widely used by organizations across different industries to gain valuable insights from their data, monitor key performance indicators (KPIs), and make data-driven decisions.
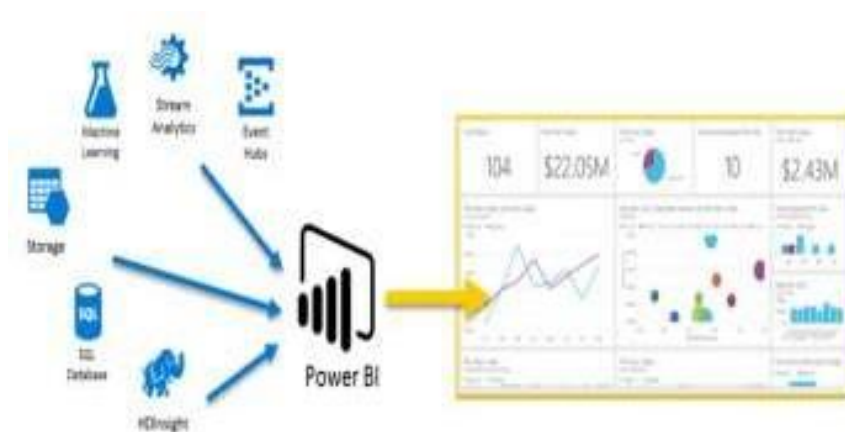

Fig. 3 Power BI Software

6.10.   Python Libraries

Python is a popular programming language for data science and offers a rich ecosystem of libraries and frameworks that make it a go-to choice for data analysis, machine learning, web development, and more.

6.10.1.   Matplotlib

A widely-used library for creating static, interactive, and animated visualizations in Python. It allows users to generate various types of plots, charts, and graphs for data visualization.

6.10.2 Seaborn

Built on top of Matplotlib, seaborn is another data visualization library that provides a higher-level interface and enhances the visual appeal of plots.

Fig. 4 Report generated from data visualization software

6.5.   TECHNIQUES IN BIG DATA VISUALIZATION

Big data visualization techniques play a crucial role in gaining deep insights from massive volumes of data. These techniques are categorized based on various factors, including the user's task, data dimensions, and interactivity requirements. They enable users to analysis data effectively and make data-driven decisions. Here are some important big data visualization techniques:

7.1.   One Dimensional (1-D)

One-dimensional (1-D) data visualizations are used when the dataset contains only one variable, and each data item has a single value. Histograms are a common type of 1-D visualization used to represent the distribution of data along a single axis. Histograms are particularly useful for understanding the central tendency, spread, and shape of the data distribution. They are widely used in various fields, such as statistics, finance, and scientific research, to explore and analysis one-dimensional datasets effectively.

7.2.   Two Dimensional (2-D)

Two-dimensional (2D) data visualizations are commonly used to analysis datasets with two variables, allowing users to explore the relationship between these variables. There are various types of 2D visualizations that represent data in different ways, each providing unique insights into the data. Each type of 2D visualization offers different advantages based on the nature of the data and the insights users want to gain. By utilizing these visualizations, analysts can better understand the relationships, patterns, and distributions within the data, leading to informed decision-making and actionable insights.

7.3.   Three Dimensional (3-D)

Three-dimensional (3D) data visualizations offer a more comprehensive view of data by representing values in three-dimensional space. They provide valuable insights and help users understand complex relationships and patterns within the data. 3D visualizations are valuable when dealing with spatial data, volumetric data, and complex datasets that involve multiple dimensions. They provide a more intuitive understanding of data relationships and patterns, helping users gain deeper insights and make informed decisions in various domains, including scientific research, engineering, and computer graphics.

7.4.   Multi-Dimensional

Multi-dimensional visualizations are used to explore datasets with more than three variables, allowing users to gain insights from different perspectives and understand complex relationships between multiple dimensions of data. Multi-dimensional visualizations are crucial for gaining a comprehensive understanding of complex datasets and identifying hidden patterns and trends that may not be apparent in lower-dimensional visualizations. These techniques help researchers, analysts, and data scientists to explore and analysis data from different angles, leading to valuable insights and informed decision-making.

7.5.   Temporal Technique

The temporal technique is a powerful data visualization method that focuses on displaying data over time. It allows users to analysis trends, patterns, and changes that occur within the data over specific time intervals. Temporal visualizations play a crucial role in understanding time-based patterns, detecting anomalies, and forecasting future trends. They are widely used in fields such as finance, sales, climate analysis, and many other domains where data evolves over time. By using temporal visualization techniques, analysts can gain valuable insights and make data-driven decisions that are time-sensitive and informed by historical trends.

7.6.   Network Technique

The network technique is a powerful data visualization method used to analysis and represent relationships and connections between data points. It is particularly useful for understanding complex relationships in various domains, such as social networks, website traffic, supply chains, and more. In network visualizations, data points are represented as nodes, and the relationships between them are represented as edges or links. The structure of the network provides insights into the connections and interactions between different entities or data points. Network visualizations are valuable for revealing hidden patterns and structures in data and providing a more holistic view of complex relationships. They empower analysts and decision-makers to uncover valuable insights, optimize processes, and improve overall performance in various industries and business scenarios.

VII.   CONCLUSION

Data visualization is a powerful tool that helps organizations gain valuable insights from the large volume of data produced from various sources. To effectively utilize data visualization, companies need to consider the 3V's of data - volume, variety, velocity, and value. This includes selecting the right database, processing techniques, scripting languages, and data visualization tools. Data visualization empowers executives to accelerate their understanding of data, gain deep insights, and identify valuable business opportunities quickly. As the world continues to experience a drastic growth in data, data exploration and visualization systems will remain crucial for organizations to harness the potential of their data, make data-driven decisions, and enhance their business processes. By leveraging data visualization effectively, companies can stay competitive, adapt to market changes, and discover new opportunities for growth and success.

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