Data Visualization: A problem solving technique

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***Abstract*—**Data is being generated every minute in very large amount from heterogeneous sources. The data storage devices are used to store data .Improvement of these devices has led to tremendous change in the domain of storage system with synchronization of the collection of datasets leading to virtual accumulation in data sources and thus the need of effective methods for extraction of knowledge from these virtual datasets from data storage increases. Analytics by Visual aids is an approach to tackle the data redundancy problem. It is stated and defined as the science of analytical reasoning supported by the interactive tools. when we exhibit information, we are referring to data, datasets data sheets, or data relations. Here, data. Visualization is termed as the presentation and representation of data in graphical sense of information, data with the goal for providing the viewer with a brief of quality understanding of the data and information of data contents. The process of transforming objects, concepts, and numbers into a form, that is effective to human for knowledge growth and analysis of data. Fields such as banks, airports, railway, education, banks, government and corporate sections have implemented data visualization and had made a interrogative change leading to growth and development in their respective fields as shown in figure 1.There are many free(openly available on internet) and paid data visualization tools available that make data interactive and easy to visualize such ones are:- zoom charts, ibm visual aids, OECD index, NCDrisc height index these are some widely used visualization tools.

Keywords*—*Data visualization, abstract visualization, database.)

I. INTRODUCTION

Information visualization is use of visual aid which makes interactive representation of abstract data. Data is interpreted quality or quantity variables of information [1] and that uses powerful image, graphic processing of human brain. Data is widely used in basic raw figure formats such as spread sheets and CSV files [3] Information visualization is an active topic since 19th century as increase in globalization lowered computer cost. It directly increased user interaction and connectivity to latest network medium and gradually leads to database generation per unit value .increasing technological growth is reason for the growth of digitalization globally, lowering computing cost and communication interaction between mediums lead to increase in the accumulation of huge amount of data into databases.

Figure 1: The various types of data

Information visualization is basically divided into two categories.

1. Scientific Visualization
2. Abstract Visualization or Data Visualization.

All global and international researchers' initiates the learn that makes the Coordination for affiliation in Action leading to visual analytics field. [4]Scientific visualization is category that deals with large set of data in scientific interest such as human body, molecules (their structure and numeration), earth, and metrological data sets.

Data visualization handles abstract, non-physical, ordered, data that can be designed in tress and graphs like schemas. Mostly data visualization is used to signify specific technological database in and of respective field [11-19] such as Industry, engineering, medical, government, corporate, media, business, research, human perception, web content, data management or other abstract data.

Information visualization has led to raise the visual analytics thus is termed and defined as " part of science used in analytics reasoning used for communicative and interactive interface of visual analytics ".Storage devices are aids to collect and store data physically, dynamically and virtually. Complex, heterogeneous, conflicting, dynamic information is manually or automatically visualized. Thus information visualization provides analytical reasoning and optimized to human perception. Visual analytics researchers studied on security applications of data sets such as in border security to secure and provide privacy to data.

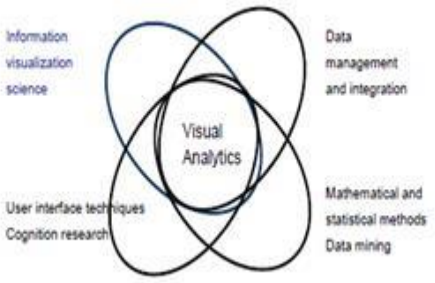


Figure 2: Visual Analytics

The above figure2 shows the parts of visual analytics. With its sub divisions such as information visualization science, user interface techniques in and about cognition research, data management and integration, mathematical statically methods for data mining that combine together and lead to visual analytics. Visual analytics lead to conversion of data (raw) into abstract data that reduces similarity, redundancy, relational data and complexity (memory, time and space) of data which thereby helps in simulation, prediction, data retrieval, browsing, exploration data extraction and data mining.

II. DATABASE INTEGRATION FOR DATA VISUALIZATION

Foundation of data visualization is database. Database can be physical, virtual, static, or dynamic accordingly as per the availability or requirement of the user. Data is being generated every minute in very large amount from numerous sources. The data storage devices are used to store data. Data is collection of set of values. Data becomes Information when several factors are taken into consideration by creator of data and desired information is attained. Data is basically and widely available in basic schema extensions like spread sheets and other format files [6] .Data have various multiple perspectives as per need and requirements. Schematic (categorized data), structured, unstructured (narrative), ordered, unordered, geospatial (temporal association) discrete data, continuous data, image data, video data. As growth of technology is in its rapid increase Thereby there is huge manipulation in database and data.

Syntactic problems in many basic cases are neglected by using standard methodologies or standard data formats and algorithms. The export of data takes place from applications from legal datasets and databases. These are normally, openly and freely available formats on all applications software on internet, but by using these basic formats solution does not occur to all schematic or semantic problems on database whereby: redundancy occurs many times, same data or same information is shown in many formats in single output, data is often represented in different structures or nomenclated differently in either two standard systems. Thus such problems are solved by using semantic and syntactic integration level algorithms.

The biggest integration defection faced is during implementation of visual analytics .maybe a problem related to the system or structure of database problem may occur. Users using the visual analytics tools must use user interfaces, leading them to explore about use and easily use them from many datasets tools used for analytics done in visual applications. It is easily used by user if knowledge of tools and exporting database files between application and user tools is with the user, but if direct integration of these application programming takes place user interfaces for visual analytics provide a range platform, that enable integrated data sources of various types, analysis of methods and methodologies that lead to visualizations use and its implementation. Such a platform is used and implemented for the reusable integration of these components for visualization. It results in making point-to point integrations. Data modeling components uses several integrated data sources, which include file import or direct interface application used for programming interface. It also uses and include different visualization components, that show types of visualization leading to analysis methods worldwide [7]. Fig 3 shows platform of data integration

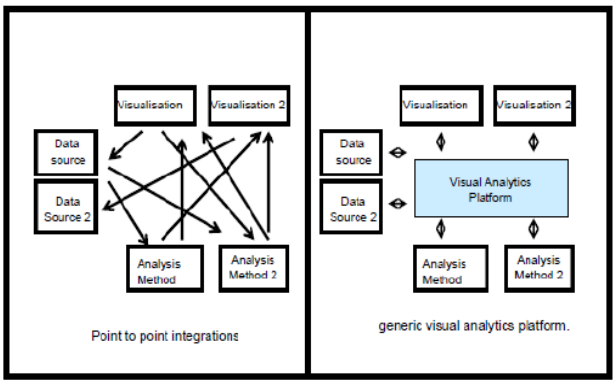


Figure 3: visual analytics and their platform

III. DATA INTEGRATION USING AUTOMATED TOOLS

Database, datasets or data storage is physical or virtual accordingly data can be schematic (categorical data), unstructured (narrative, geospatial data), discrete data, continuous data, image data, video data, traditional structured data. Computer scientists are contributing their study and research for the study of database and dataset cleaning and manufacturing. For example, Lakshmanan, Sadri, and Subramanian (1996) gave an extension for changes in language of database to SQL to amend and manipulate SQL to do operational manipulation on huge datasets, Raman and Heller stein (2001) developed an open source framework for manipulation in datasets to amend the redundancy of data in datasets, and Kandel, Paepcke, Heller stein, and Heer (2011) developed communicative tool with a easy, friendly user manipulation interface environment which is based on automation algorithms and methodologies that creates code to amend data for cleaning data in database. These tools are useful as they are open source available and where it lacks is making connections for the tools for data analysis [14]. Tidy data is seen as a standard way that helps in creation of the mapping of the structure of a dataset and visualize its structure in schematic structure. A dataset may be messy or tidy totally

depending on row, column and table and their structure up in variables and data types.

In tidy data following aims are necessary

a. Variable should be in a column.

b. Formation and arrangement of data should be in a row.

c. Formation of a module.

Tidy data is the easiest way for an analysts in real world or a computer in virtual world to is used for using variables from dataset as it provides threshold in a way of structuring a database. It checks that variables are stored in a format specified and, are in manner. Tools are basically messy for widely two reasons: messy input datasets as (messy-input tools) or output of messy datasets (messy- output tools). In both Messy-input tools are unworthy, more complicated than tidy-input tools as some parts of the tidying process for database processing. This makes the tidy data function complex to use; implement and harder to database maintenance. The wide use is to change one format to another format schema of datasets, database, data visualization and data in modeling state.

IV. VISUALIZATION FOR HUMAN PERCEPTION

In Perceiving data and interpreting structural motion is a basic fundamental capability for humans and perceptioning it with deep roots is in our evolution: moving objects attract much and stand out in our visual analytics field of study and research, and the Gestalt principle of common visual perception states that entities that are in same medium, moving in the same direction with respective speed are seen as a unit. [15]

The study and research in the field of human perception with enormous growth over the last 20 decades and great change in results are seen relevant to information in database visualization. The deploying point is only that information is not accessible to information visualization data users from data ware houses. There is a long way path to change the design and methods and principles that bring change in human race and for the everyday use of human perception to solve problems to make easy life and prospective schedule [8].

It has exact information for studying and understanding the sensory information based on patterns. Human eye and brain forms a parallel processor and processing of data this processing of data takes place. Processing of crucial symbols, perception processing, perception of eye (shape, size symmetry), perception of visual attention (bold, italic, stimuli and its focus), underline pattern perception (pattern or image based and structure based).perception of distance and size (motion, depth, focus, surface), perception of visual interaction (user and data interaction).thus it can be said in brief human perception is a field of data visualization that makes human problems to ease out solutions.

V. COLOR IN VISUALIZATION

Color is prime unit to attract eyes and is basic need to encode data sets, in data visualizations. For color encodings to be very effective, mapping of color, datasets is needed color differences is thus that make attractive and impressive data. Effective color choice and implementation of color in visualization is based on color variation perceptions using small, large, non-uniform uniform, discrete datasets in optimal viewing environments or on qualitative or quantitative factors. Misinterpretation of data in visualizations is very rare, which frequently data encoding one elongated marks. It is to develop quantitative logical methods and metrics that help users to use and implement color in visualization.[9].Substantial evidence of the impact of individual color on affect is given in brief. For example, warm colors have been shown to be more physiologically stimulating than color of blue and green[10]. Accordingly red is shown for hot, vibrant, intense look across cultures [11] and most likely to show arousal look. Blue is used to show serious while yellow looks unprofessional [12].However, while there are many design approaches to organizing colors into palettes (e.g. Color Brewer[13]]) there are no rigorously validated models of affective palettes for visualization. Color plays most important role in field of visualization as thus.

VI. ANIMATION

Animation is display and communicative used for static and dynamic sequences to create the illusion of graphics. It is extensively studied by psychologists, researchers and implemented in films and computer graphics and also for improving user interfaces and visual attractiveness in data visualization [16-18], algorithm animation and program visualization [19-22] animation demonstrate and help [23- 26]. Simple animation clarify data, database or programs, or information by using interface, but by not on the operational use of the interface. Animated transitions are used in many visual analytics applications But they are difficult to implement, especially when many objects move at the same time in the graphic image. Cartoon-style animation is interface medium and is animation of transition and is used to borrow from the informal taxonomy.[27].Making user interface methods, objects are made to behave like cartoon variables and objects that are beneficial, but user interfaces are not at all cartoons indeed. The important difference is the cartoon is a passive medium of animation, while the user interface is a communicative and an interactive medium of animation. As the user is in control, the output is responsive as such to the user's need and requirements [28, 29], an environment of medium to create build an interactive simulations, that are used in to show and exhibit the properties behavior, layout of objects in the datasets. The Information Visualizer framework [30- 32], leads to data more visual able, using three-dimensional visual graphics of image to further heighten the concreteness that leads to effective animation. Implementation of the cone tree, in Information visualizer implements fast uses 3D animation to aid in where user tracked objects and make change position and state. By using and making these interactive visual analytics that are leading to data interactivity

and graphics interaction we are simply solving problems and increasing user interaction.

VII. VISUAL FORMS USED IN VISUALIZATION

A research has claimed and investigated that degree to Visual analysis fig 4 is encoded in variables such as position, length, Area, shape, and color of data sets in database. Following Cleveland [33], the term graphical Perception is used to denote the ability of viewers to interpret Visual encodings from database and thereby decoding information in graphs is widely done as a way to interpret visualization. Bertin [34] showed the first systematic method for treatment of visual encodings, including rank-ordering, visual variables and objects according to the effectiveness needed for encoding nominal interpretation

ordinal interpretation, and quantitative data analysis. Data but poorly for quantitative and qualitative data. Bertin states his readings on basis of ranks of his experience as a graphic designer, cartographer. Cleveland and McGill [35] place the ranking of visual encodings on a rigorous scientific footing on and through perceptual experiments with human subjects used in visual analytics.

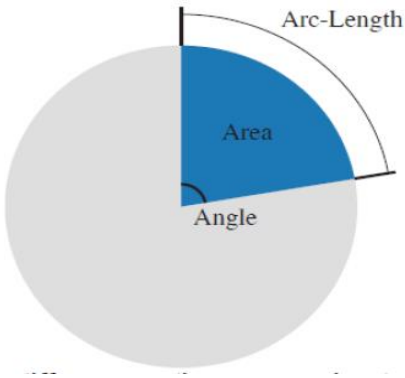


Figure 4: the three different encodings representing data in a pie or donut chart: central angle, wedge area, and arc length.

Subjects were decided, revised and studied and at last charts and graphs were drawn. Scientists compared the quantitative values on different basis example marks, percentage, smaller value, larger value. This accurate measure was used for the ranking in and of different visual objects.

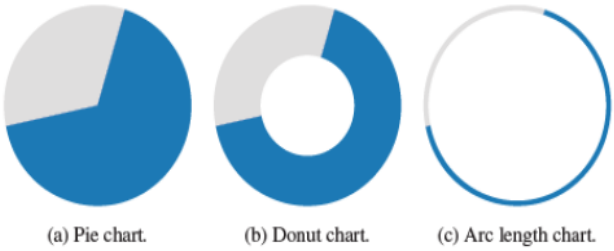


Figure 5

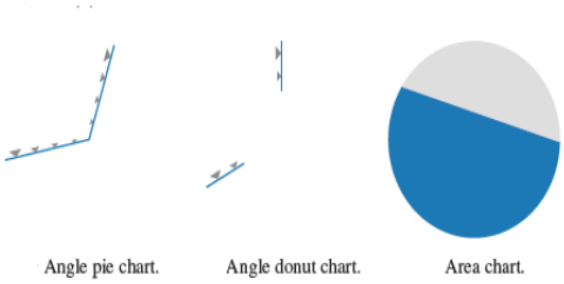


Figure 6

Simkin and Hastie [36] test and evaluated value discrimination change and estimated bar charts, and divided bar charts, and pie charts fig 7. Spence and Lewandowsky [37] uses two different alternative discrimination task that investigate in percentage the perception of bar , pie charts, and tables Pie ,arc and donut charts used in all forms of interactive and graphical communication with databases, when used as part of graphics. Sampling of info graphics on visual content website visually, 40% of info graphics charts uses pie or donut ch art. Angles are determined when implementing pie and donut charts; there are three variables in encoding data: angle of circle, area on plane of the circle wedge, and the line segment length of the circle.

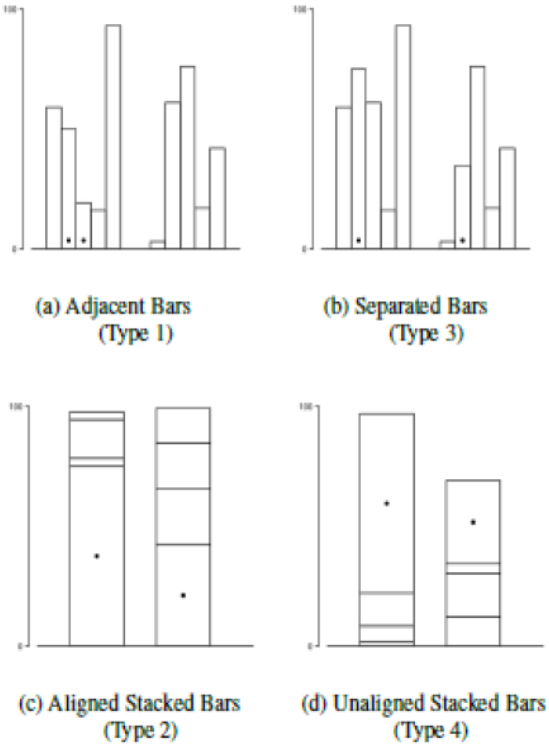


Figure 7

Above are the types of visual variations widely available and used:-as shown in fig 5, fig 6, and fig 7.

Line chart, pie chart, mirror chart, horizon graphs, stacked graphs, glyph:-dot glyph, line glyph, bar glyph, star glyph, stripe glyph, clock glyph.

Use and implementation of large graph datasets or database is a basic method that is used in fields such as science, education datasets, represented as graphs or networks, as online medium in online social networks (who user is connected to different Whom user), online network traffic (which user computers are communicating in medium), intelligence analysis of data (which user is communicating with which other user), and online auctions globally worldwide (who as a user is buying from whom as end user) and technology. The state in art of graph sense making uses two of its components: scalability of data and design for data. By the work of visualization and building drawing study or research from interaction with human with computers, leading to information visualization, data visualization, machine learning, data warehouse, data mining, systems interaction, and information analysis, the area of graph sense making for visualization is leading aspect [38].Graphs is and has become a growing research field. A graph is sense making hierarchy structure making schema consisting of global variables, local variables, and hybrid views of variables or objects of data. Theories suggest two predominant implementation in sense making paradigms: top-down parsing methodology or global views and bottom-up parsing methodology or local views according to the need and requirements. Global approaches is best characterized By Shneiderman's mantra "overview of dataset in database zoom & filter on database, details- on-demand" pattern in visual analysis and information seeking is easiest way to study data [39], Landesberger et al also investigated the variety of visual analytics and generated a new graph visualization method trend since 2000. Static graphs, the dynamic graph are two visualization techniques used for visualization [40]. Graphs are large display of data at once in full detail, several classes and toolkit make them more manageable for exploration and making it analytically easy to understand and visualize.

The Combination of schematic and behavior or attribute variable of object in information leads to a perfect set of the graph whereas clusters are both schematic tight and of same behavior and attributes [41], [42]. Zhouetal. Proposes a novel that states distance measure of fields in graph that combines with both structural design and complexed distance and node attribute similarly [42]. Pivot Graph [41] aggregates with graph nodes and its edges based on its behavior and attributes; using a grid-based layout for focusing on the relationship between nodes of graph, its behavior attributes and connections of the graph nodes. Tt allows users to generate, implement and amend own clusters of datasets making an exploration of data more flexible to use and to amend in datasets. Research in fields of human, computer, interaction, information visualization, machine learning, data warehouse data mining, recommendation systems, and information retrieval, are the areas of graph sense making and analytical visualization that has been a growing research field or discipline.

VIII. TOOLKIT FOR VISUALIZATION

Network has a wide range of software architecture that supports and practically implementing information visualization, which was often difficult in past to identify, evaluate, and reapply the design methods and solutions leading to data extraction from database within such frameworks easily available. Popularity and effectiveness of these toolkits have made globalization a vital market approach. For addressing these toolkits is now no more difficult. Meaning, if to capture successful solution to a problem and make data visualized through design patterns, abstract descriptions, these interactive toolkits and software components are used to solve design problems. Reviewing the existing frameworks and making real time use and our own experiences make area to implement the framework on our costly data. The structure, schema context and data interrelations of pattern in data representation in visualization, image graphics, and visual interaction tools. Representation of knowledge and information from database in an effective and worthy use to validate, facilitate and amend software design, user implementation for data evaluation, and thus leading to improve developer experience with the toolkit. With the increase of database the demand for visual analytics toolkits, software has risen; leading visualization researchers to have developed numerous software toolkit frameworks to meet and fulfill the needs. The cost structure has changed governing the design wide use and implementation of visualization has leaded such frameworks carry the potential that lowered the barriers to entry and rapidly increase the state of visualization in analytical designing. Never a single tool or framework till date could solve all problems; this is reason for development for new technologies in the domain. Developers migrate and switch between toolkits according to need when developing on a new platform or build their own systems as per needs and requirements to achieve functionality not available elsewhere. Inspection, study and research of tools and software make it easy for implementation of visualization as it becomes easy and sorted to use which toolkit for which problem. Also source code of application and design documents, if available on internet, make it easy to use them widely.

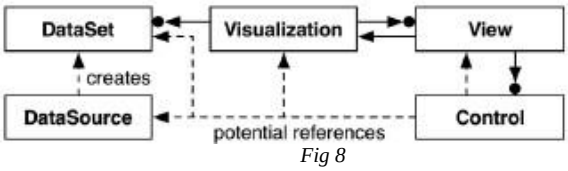


Fig 8

The above figure8 gives the layout how visualization takes place with the help and manipulation of toolkit as Reference type Model-The pattern that provides a simple template means for visualization in structural format.

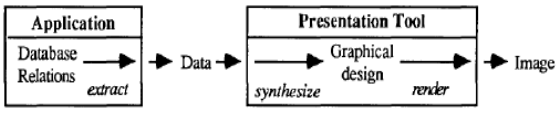


Figure 9

The above fig 9 gives the brief of output obtaining from database with toolkit available in open source as well as in licensed visualizations technologies: such as HTML , CSS JavaScript, SVG and so on. DOM is known as best representation model and is best platform in the seamless cooperation of visualization technologies, document type

object model (DOM). It exposes the hierarchical flow of structure of page as content, words, paragraph, table elements, for reference and manipulation. Technology reuses, utilizes knowledge and reference materials that improve accessibility. Tools to improve efficiency avoid the complexity of an approach and provide full access to the real native database [57] basis of DOM is debugging fundamental of development and the learning is trial and error; accessible tools are thus structured to support and implement. Debugging is used when the trail is done and error is occurred. Performance wise visualizations are enhanced by interaction and animation [58] .Abstractions limits ability of developer to execute and process information. Redundant computation is reduced by specific toolkits widely available. Focusing on factor of transformation other than representation is responsibility from the developer, for improving and complexity performance in enabling the wide use of animation and interaction.

IX. NARRATION OF DATA IN VISUALIZATION

The Oxford English Dictionary brief narration as "an account in a series of logical facts and events as in order with the connections. Narrative visualizations merge names of exploratory and communicative information visualization to depict an intended virtual story. As an analytical framework user, it takes into account how design techniques are prioritized at the particular interface level for interpretations of data in visualizations o and tells rhetoric that "telling a story" can affect front and end-user relation of interpretation in database. [12]

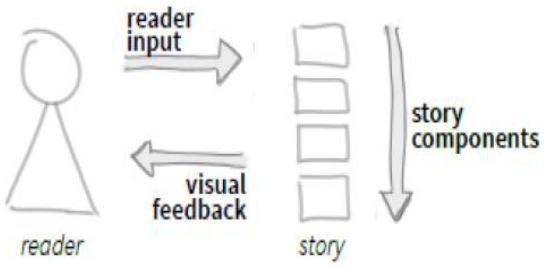


Figure 10

The figure 10 shows the narration layout and component generation.

Narrative information visualizations show the interaction between aspects of explores and communicates between datasets [60]. "Molding in datasets the value of the skills of computer science, statistics study, artistic design and storytelling as visualization is the review A recent Economist [6] exploration of the proliferation data of digital data it is noted that notes of visualization designers is: - "Static visualizations used to supportive and exhibit storytelling, in the form of line diagrams, images and charts embedded in a structure of text.

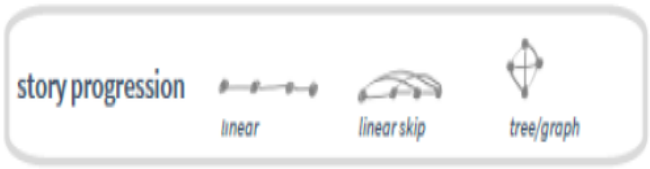


Figure 10.1

The text basically conveys and exhibit the story in narration, the image provides proof as evidence and other related details. An object and class of visualization narrates with an interactive graphics of visual. Storytellers, narrators' online journalists, are highly using and integrating complex visualizations into the narratives that possess the relevant information.

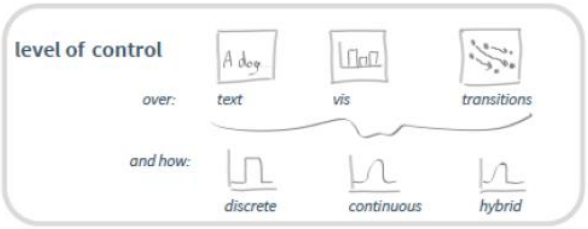


Figure 10.2

Crafting successful "data stories" requires a diverse set of skills and use of technological gains leading for complexity of work done to decrease simultaneously.Fig10.2 shows how data stories are generated Gershon and note that effective story-telling "require skills like those familiar to movie directors, beyond a technical expert's knowledge of computer engineering and science."

Figure 10.3

Figure 10.4

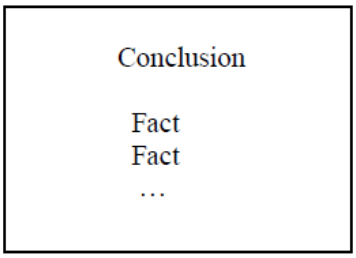
Rigorous application present, narrate and at last inform to the Devices for understanding the nature of narrative information visualizations and its concepts from hypothesis and theory, knowledge for how to design tactics present in additional or omissions of information at several levels the datasets, visual representation of data, textual visual and other annotations of narration and interactivity and communication of datasets. A systematic analysis of techniques is done on regular basis that identify recent narrative visualizations presentations, characterized accordingly on their basic value and rhetorical contribution in the respective field of visualization.[59]fig 10.4

Figure 10.5

A basic way of writing in journalism is called the inverted pyramid, sometimes also the inverted triangle: first is stating the most important piece of information in the headline, then follow that with the next most important information in the opening and then continue adding information. Then after the 3 scheduled steps the journal is obtained which is widely used in journalism.

Narrative visualizations has an opportunity for increasing research and study as understanding of the complementary relationship is not too easy and the globalization is leading to depict its real world use thus difference between explorative and communicative dimensions in Information Visualization making the study more applicable and the tools could communicate their findings to improve Communication in collaborative visual analytics. Below is shown widely used inverted pyramid for narration in data processing.

Standard inverted pyramid



The classic inverted pyramid structure starts with the conclusion and then presents a list of facts without a clear ending.

X. CONCLUSION

Literature review suggests that ways and methods the Data visualization is opting for creating conclusions from database This paper gives an impact, from my study research, exploration and explanation, I find "Merely the impact on "how to the visualization of data is done , but also on how and why can we make the visualization useful and understandable to viewers." Make the visualization cost worthy and meaningful to users, and how the viewers can get meaningful and problem solving methodology to solve problems by Visual analytics and what they want from this visualization ,graphical presentation, human perception ,animation, graphs, colors, visual forms, narration etc. by using toolkit available on internet openly. Diverse change in fields of industries, education, astronomy, defense, corporate, banks, medical, airports, railway, and government have been seen.

Data visualization make complexity of space memory and time in databases which directly makes humans to compare and contrast on its practical benefit leading to greater opt rate for intense use data visualization makes it possible that even a lay man can understand the evaluation and methodological aspects of technical globalized era. Students, scholars, researchers are the key role models of visualization. The data visualization is in real sense helping and developing the column of viewer in mining the data and growing independently in aspect of knowledge and power.

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