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Exploration of Social Networks with Visualization Tools

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ABSTRACT: *In recent years, we have witnessed a dramatic popularity of online social networking services, in which millions of people publicly communicate for a kind of mutual friendship relations. Social network research is one of the fastest growing academic areas as it is continuously expanding within our society. One key element of this field of research is social network visualization, which refers to the use of sociograms / illustrative diagrams of the joins that connect various actors in social networks. The use of graphical representations is one of the main defining properties of social networks. Researchers make use of pictorial images of social networks in order to communicate and understand the content and patterns within social networks. In this paper, we have made every possible effort to remove the fear from mind of people that understanding networks is a difficult process as it is difficult to visualize, navigate, and find patterns in networks. For this, we begin by defining what constitutes a social network analysis (SNA) and then present our introduction of SNA by drawing basic concepts of social networks, and then discussed about various visualization approaches used and its advantages along with most popularly used visualization tools.*

Keywords: *Social network analysis (SNA), visualization, illustrative diagrams, Social Media services, tools of visualization.*

I. INTRODUCTION TO SOCIAL NETWORK ANALYSIS (SNA)

Since recent years, social network analysis (SNA) has emerged as a powerful method for understanding the importance of relationships in networks. However, interactive exploration of networks is currently challenging because of two reasons:

- *It's difficult to comprehend the structure of networks using patterns of various nodes and links,*
- *As current systems are mostly a mixture of statistical methods and visual outputs, this confuses analysts about how to explore in an orderly manner.*

Social network analysis is based on an assumption of the importance of relationships among interacting units [1]. Social network analysis (SNA) is the process of investigating social structures through the use of network and graph theories. It characterizes networked structures in terms of *nodes* (individual actors, people, or things within the network) and the *ties, edges, or links* (relationships or interactions) that connect them. Social network analysis is a powerful key to ensure useful visualization of a social network. Using SNA, users can flexibly iterate through visualizations of nodes and links, thereby understanding system clearly; aggregate it's various available networks on the basis of subgroups of interest; explore networks by finding patterns across different networks. A visualization system works for end-users of social networking services to provide an increased awareness and discovery of the online social community [2]. The visualization of networks is important because it is a natural way to communicate connectivity and allows for fast pattern recognition by humans and is useful to grasp the perceptive abilities of humans, but overlapping links and indistinct labels of nodes often ruin this approach. Network analysts have always been able to learn by generating and sharing visual images. Modern technology promises to enhance our ability to learn from images by continuing to provide new tools that allow for more powerful visualizations.

II. APPROACHES USED IN VISUALIZATION

As we all know that social media generates huge amounts of data; the explosive growth of social media is one of the reasons that 90% of data in world has been generated in last 3 years alone. When we use Social Media services like facebook and twitter; we let the companies to store our data like photos, public observation, comments and/or communications. In exchange, they structure that information for our comfort and make it easy for us to access data of today as well as yesterday comfortably. Visualization is the technique that makes all this possible. Visualizing social networks in an interactive format offers faster and more accurate access to

the network analysis. It helps us to group our relationships and friend groups by visualizing the concepts and links that were used. Visualizing social networks is more than simply creating intriguing pictures; it is about generating *learning* situations: "images of social networks have provided investigators with new insights about network structure and have helped them communicate those insights to others" [3]. They help the marketers and advertisers to get benefit from that big data. When exchange of information between users and social network is transparent; people can view their life patterns on social media in entirely new way.
In this paper, seven less-common yet very useful data visualization approaches have been discussed briefly:

- Slopegraphs
- Parallel Coordinates
- Alluvial Diagrams
- Sunbursts
- Circle Packing
- Horizon Charts
- Streamgraphs

Though these approaches of visualization are somewhat well-established and have proven their worth for many applications; however, communicating complex topics like hierarchies, longitudinal data, and multi-variable comparisons, and so on—often involve more advanced visualizations with corresponding depth [4].

1. Slopegraphs – Slopegraphs are a special type of a line chart where two or more sets of values are compared by connecting each group's values on one scale to their values on the second scale. The two scales have identical maximum and minimum values to make it very easy see whether each group increases, decreases, or remain similar between the two categories: highlighted to show interest and graying out for disinterest.

2. Parallel Coordinates – A parallel coordinates graph shows multiple variables alongside one another with each scaled from highest to lowest value :highest at the top, lowest at the bottom and with lines connecting each entity's position for each variable, horizontally across the graph.

3. Alluvial Diagrams – Alluvial diagrams show how various nodes flow together or apart across stages representing multiple time periods. In these diagrams, width of the streams shows size within each category.

4. Sunbursts – Sunbursts show a hierarchical structure in a circular layout, with each ring outward representing a deeper level of the hierarchy. Ring segments are usually sized by the number of members within that segment.

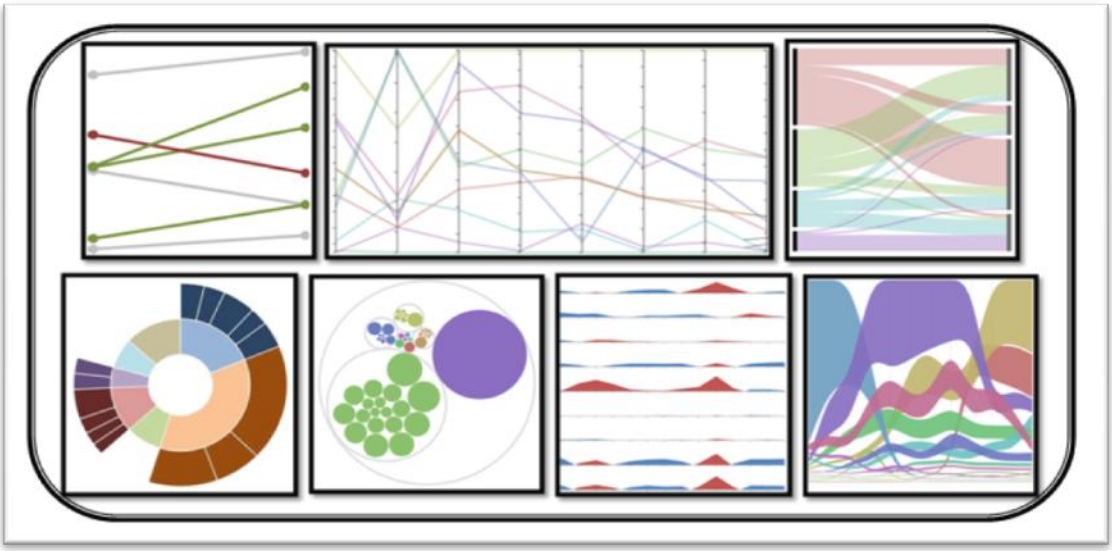

Figure 1: Figure of Slopegraphs, Parallel Coordinates, Alluvial Diagrams, Sunbursts, Circle Packing, Horizon Charts and Streamgraph(from top to right)

5. Circle Packing – Circle packing diagrams show groups as tightly-organized circles, and are often used to show hierarchies where smaller groups are either colored similarly to others in the same category, or nested within larger groups.

6. Horizon Charts – Horizon charts show time-series data with both negative and positive values on the vertical scale, using coloring or shading to show negative values.

7. Streamgraph – Streamgraphs show how the size or proportions of groups vary over time, with vertical width of the "stream" representing the size of that entity. Streamgraphs can use either a fixed scale, where change in the overall size of all groups can be seen, or a relative scale, where all groups consistently add to 100% (similar to an area chart).

III. ADVANTAGES OF VISUALIZATION

The modes of network communication evolve constantly to improve its efficiency and clarity. Generally, there are no wrong ways to communicate information but the traditional methods are slowly giving their way to data visualization. Although data visualizations are easier to understand and look more attractive to the audience, it is crucial to achieve a perfect balance between visual appeal and functionality. Data visualization is in the first place used to improve efficiency of the communicated information. A beautiful presentation which, however, fails to emphasize relevant data or is not clear enough is of little value. For that reason it is highly important to make sure that the presented data are clear and understandable, and only then focus on aesthetically appealing and attention drawing design. Just as important is to support the communicated information with additional materials such as official statistic data, facts, examples, etc. if you want the audience to accept your view/interpretation.

If one is unable to decide between communication of data in the "raw" form or using visualisation methods such as graphs, dials, charts, etc. instead, the following overview of advantages of data visualisation may help to clear the doubt:

- **Clarity.** It is a lot easier to understand a dial or graph than numbers i.e. viewer understands what you are trying to say at a first sight.
- **Saving time.** Since a "picture is worth a million words", using data visualisation helps the audience quickly absorb and interpret the presented data. As a result, data visualisation enables you to present a considerably larger amount of data in comparison to the textual format which often requires repetition in order to help the audience understand the information.
- **Less confusion.** It is not difficult to get confused when dealing with lots of numbers as you actually need to memorize them to be able to understand the communicated information. Using visual presentation of numbers, however, dramatically reduces confusion because the audience does not need to process the numbers to be able to see where you are going.
- **Aesthetic appeal.** Visualizations look better and attract more attention than the textual format. They are also more likely to keep the audience interested in your presentation.

IV. TOOLS OF VISUALIZATION

Here is a tabular description of top Social Network Analysis and Visualization Tools [5] [6]:

Visualization Tool	Description of Visualization Tool
COMMETRIX	It is an exploratory analysis tool for dynamic network data. Its focus is on analyzing evolving patterns of electronic communication.
CENTRIFUGE	It offers analysts and investigators an integrated suite that can help them rapidly understand and visualize discoveries by interacting with data, collaborate to draw conclusions.
CUTTLEFISH	It is a network workbench application that visualizes the networks with some of the best known layout algorithms.
CYTOSCAPE	Cytoscape is an open source software platform for visualizing molecular interaction networks
EGONET	EgoNet helps you create the questionnaire, collect data and provide general global network measures.
GEPHI	Gephi is an interactive visualization and exploration platform for all kinds of networks and complex systems. Gephi is a tool for people that have to explore and understand graphs.
GRAPH-TOOL	Graph-tool is an efficient Python module for manipulation and statistical analysis of networks.
GRAPHCHI	It is to bring web-scale graph computation, such as analysis of social networks, available to anyone with a modern laptop.
GRAPHVIZ	It is open source graph visualization software and has many useful features for concrete diagrams, such as options for colors, fonts, tabular node layouts, line styles, hyperlinks, and custom shapes.
INFLOW	InFlow performs network analysis AND network visualization in one integrated product.
JUNG	It is a software library that provides a common and extensible language for the modelling, analysis, and visualization of data that can be represented as a graph or network.
KEYNETIQ	Keynetiq is an innovative platform for Organizational Network Analysis. It's designed to map, visualize and analyze networks of people and relations between them, revealing how organizations really operate in day-

	to-day business.
MEERKAT	MeerKat offers facilities for automated community mining, various layout algorithms for helpful visualizations, and timeframe event analysis for dynamic networks that have been observed at multiple points in time.
NETLYTIC	Netlytic is a cloud-based text and social networks analyzer that can automatically summarize large volumes of text and discover social networks from online conversations on social media sites
NETMINER	NetMiner is an application software for exploratory analysis and visualization of large network data based on SNA.
NETWORK WORKBENCH	Network Workbench is a Large-Scale Network Analysis, Modeling and Visualization Toolkit for Biomedical, Social Science and Physics Research.
NETWORKIT	NetworKit is a growing open-source toolkit for high-performance network analysis. Its aim is to provide tools for the analysis of large networks in the size range from thousands to billions of edges.
NETWORKX	NetworkX is a Python language software package for the creation, manipulation, and study of the structure, dynamics, and functions of complex networks.
NODEXL	NodeXL is a free, open-source template for Microsoft® Excel® that makes it easy to explore network graphs.
POLINODE	Polinode is a flexible tool that helps cut through complexity. At its core is the ability to map, visualize and analyze network data.
R	R is a general purpose analytics tool, but several libraries are available for social network analysis.
SOCNETV	SocNetV (Social Networks Visualizer) is a cross-platform, user-friendly tool for the analysis and visualization of Social Networks.
SOCIOVIZ	Socioviz is a social media analytics platform powered by Social Network Analysis metrics.
PAJEK	Pajek is a program, for Windows, the main motivation for development of Pajek was the observation that there exist several sources of large networks that are already in machine-readable form.
POLINODE	Polinode is a flexible tool that helps cut through complexity. At its core is the ability to map, visualize and analyze network data.

V. CONCLUSION

To be more precise, we can say that interactive exploration of networks is a challenging task because it is difficult to find patterns and analyze the structure of networks with a set of nodes / links, so analysts are uncertain about how to explore nodes in an orderly manner. Despite this wealth of social network visualization, we believe there is still a need for new designs and techniques, especially as articulated social networks become increasingly common in web services for signifying various kinds of relationship. Visualization of profile attributes unique to online social networks is needed, and techniques for incorporating analytical tools within the simplified domain of end-user visualization may prove useful.

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