

Exploration Tool for Effectively Interpreting the Visual Metaphor Process of Sentiment Visualization

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Figure 1: The visualization tool to explore the visual metaphor process. (a) The Network View, (b) The Sankey Diagram View, (c) The Paper View (Demo URL: <https://hm00081.github.io/metaphorViz/>).

ABSTRACT

This study proposes an exploration tool for users' intuitive understanding of visual metaphor processes in sentiment visualization cases. To create the exploration tool, we conducted the following procedure 1) Extract sentences about visual metaphor and use 'Target, Intermediation, Representation, Visual Variables, Visualization Technique' as a taxonomy to analyze metaphor processes in the collected cases. 2) Create Network to suggest the relationship between representation and intermediation. 3) Utilize Sankey Diagram to perceive the frequent metaphor process patterns in stages.

Index Terms: Human-centered computing—Visualization—Visualization systems and tools—Visualization Toolkits

1 INTRODUCTION

Sentiment visualization represents various targets (entity, sentiment, opinion holder, time, etc.) from text data to visualization techniques. Since the progress of data mining, large-scale sentiment data has been collected with multiple polarities and aspects, and some complicated visualization techniques are used for sentiment visualization. Therefore, it takes time and effort to understand those visualizations. Many researchers used visual metaphors to visualize sentiment data to assist with this process. Consequently, the number of related cases

has grown. The visual metaphors in sentiment visualization help to understand by using familiar objects or phenomena.

This study presents an exploration tool for an intuitive grasp of diverse metaphor processes detected from sentiment visualization. First, the relationship between intermediation (the aim or background for the use of metaphor) and representation (the visual element and process in metaphor) from collected metaphor processes presents in Network Visualization. Secondly, in Sankey Diagram, users can search for separate metaphor processes in order or analyze usage patterns of representation, visualization variables, and visualization techniques according to the most common intermediation.

The contribution of this paper is summarized as follows:

- 1) Subdivide taxonomy from previous research, Ha et al. [2], to organize complex and various metaphor processes on sentiment analytics visualization and presents the taxonomy as levels on Sankey Diagram. This work helps get comprehensive analyses of sentiment visualization has diverse targets and aims.
- 2) Link Network Visualization and Sankey Diagram for users to clarify the distribution of representation according to the aim or background, and often appearing patterns in metaphor processes.

2 DATA COLLECTION & VISUAL METAPHOR PROCESS EXTRACTION

We gathered the sentiment visualization cases using visual metaphors from the international journal (IEEE TVCG, Computer Graphics Forum) and conference proceeding (IEEE-VIS, EuroVis, PacificVis, ACM- CHI, Siggraph) in data visualization. We found a total of 60 cases. Furthermore, related sentences crawled from research and presentation materials, and video clips' subtitles from 60 cases.

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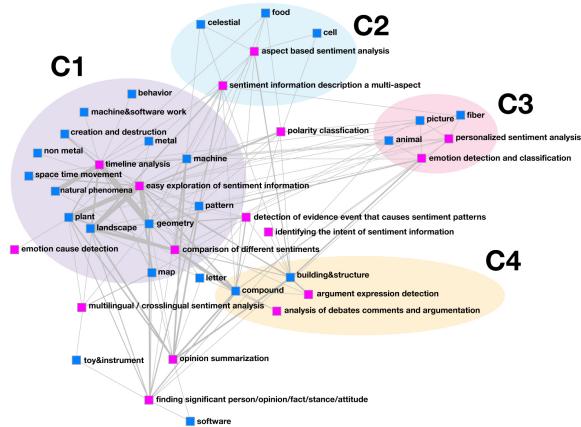


Figure 2: The Network View represents four significant clusters.

Therefore, a total of 432,330 sentences were obtained. Also, the visual metaphor processes (See Appendix, Table 6) from the sentences were analyzed with the taxonomy (See Appendix, Table 1-5). As a result, 508 metaphor processes were extracted and used to generate links in the Sankey Diagram. We referred to Liu et al. [3] and Federico et al. [1] studies to extract, analyze and visualize the metaphor processes.

3 SYSTEM INTERFACE AND INTERACTION

Fig. 1 represents the exploration tool. First, Fig. 1 (a) is the Network View. In the Network, intermediations are encoded in pink nodes and representations in blue nodes. When a user selects a cluster area in the Network View, the corresponding metaphor process links that the cluster area contains are highlighted in Sankey Diagram. Fig. 1 (b) is the Sankey Diagram View. The view consists of five levels. The paper case level is represented on the far left, and the ‘Target, Intermediation, Representation, and Visual Variables & Visualization Technique’ levels show in order. Also, links in the Sankey Diagram demonstrate the overall flow of visual metaphor processes. Additionally, users can conduct two different interactions on the Sankey Diagram. First, when a user chooses a type of analysis offered by the tool, matched links are colored. Types of analysis consist of Target and Representation theme. The second interaction begins when the user clicks a node or a link, then all metaphor processes in the clicked components are filtered. It offers effective tracing of the metaphor process for users. The selected cases’ representation images are shown in Paper View (See Fig. 1 (c)).

4 CASE STUDY

4.1 Network View: Analysis of the Relationship between Intermediation and Representation

Fig. 2 is a magnified view of the Network View. Four significant clusters are detected. Various representations were used for ‘Timeline analysis’ and ‘Easy exploration of sentiment information’, especially geometry, landscape, plant, and natural phenomena (C1). For ‘Aspect-based sentiment analysis’, each aspect in the target uses food, celestial and cell for representation (C2). Opinion holders represent knitted patterns (or fiber), animals, or pictures for ‘Personalized sentiments and emotions’ (C3). Lastly, in ‘Sentiment analysis of argumentation’, compound (bubble) or building & structure is often used as a representation (C4).

4.2 Sankey Diagram View: Pattern of Visual Metaphor Process

In this case study, Sankey Diagram is utilized to analyze three intermediations (Timeline analysis, Easy exploration of sentiment

information, and Comparison of different sentiments) that often appear in sentiment visualization. When researchers use ‘Timeline analysis’ as intermediation in their sentiment visualization cases, they correspond ‘Timeline analysis’ with targets related to time (accumulate, continuity, etc.) and collect opinions and appraisals during the period. Researchers use ‘Process Metaphor’ as representation, they tend to use natural phenomena (blooming, tree/vine growing, and river flow) to show the opinion spreading process over time. Also, the researchers apply the creation and destruction of artifacts (sewing, bridge constructing, operating the time-space tunnel) to represent opinion and appraisal keywords during a specific period. Besides that, researchers arrange and stack several geometries (hexagon, colored dot, line) by each time stamp to show accumulation by time (See Appendix, Fig. 3). For ‘Easy exploration of sentiment information’, researchers tie more than two elements from the target and use parts in representations to replace targets. For example, some researchers use maps and geometries in their sentiment visualization cases (e.g. square (city) and line (pathway) on a map) to indicate opinion holders and sentiments. On the other hand, others use three-dimensional geometries (cube) to explore place-time-sentiment keywords (topics) (See Appendix, Fig. 4). Also, For ‘Comparison of different sentiments’, researchers use the sentiment and opinion holders as targets. In the distribution of reproductions, researchers utilize landscape (river), building and structure (bridge), and compounds (bubbles) to compare the differences in the amount of information, while they apply plants (appearance of petals) to compare the polarity of comments in original posts by opinion holders. The trend of comparing the amount of information or connectivity (relationship) by changing the visual variables (size (e.g. thickness of bridge) or color) of the representation and distinguishing the identity of the opinion holder was revealed (See Appendix, Fig. 5).

5 CONCLUSION

This study set out significant clusters of the relationship between intermediation and representation in the Network and helps to get an insight into the metaphor process by stages from the Sankey Diagram using the exploration tool. The exploration tool has significance in providing visual comprehension of what metaphors are usually used when analyzing sentiment data according to purposes. In the future, we would like to gather more metaphor cases from sentiment visualization to show more visual metaphor processes. We also want to research the relationships between ‘target and intermediation, representation and visual variables, and representation and visualization technique’ apart from the Network View that represents relationships between intermediation and representation. Furthermore, an advanced exploration tool development remains for further progress to show the pattern of connections between levels in metaphor processes.

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REFERENCES

- [1] P. Federico, F. Heimerl, S. Koch, and S. Miksch. A survey on visual approaches for analyzing scientific literature and patents. *IEEE transactions on visualization and computer graphics*, 23(9):2179–2198, 2016.
- [2] H. Ha, H. Joung, K. Moon, and K. Lee. Constructing a taxonomy for sentiment visualization analysis using visual metaphors. *Archives of Design Research*, 35(2):181–207, 2022.
- [3] S. Liu, X. Wang, C. Collins, W. Dou, F. Ouyang, M. El-Assady, L. Jiang, and D. A. Keim. Bridging text visualization and mining: A task-driven survey. *IEEE transactions on visualization and computer graphics*, 25(7):2482–2504, 2018.