Chapter 9
Highlighting in Visual Data Analytics

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ABSTRACT

Highlighting has been known as a basic viewing control mechanism in computer graphics and visualization for guiding users' attention in reading diagrams, images, graphs, and digital texts. Due to the rapid development of theory and practice in information visualization and visual analytics, the role of 'highlighting' in computer graphics has been extended from just acting as a viewing control to being part of an interaction control and a visual recommendation mechanism that is important in modern information visualization and visual analytics. In this chapter, the authors present a brief literature review. They try to assign the word 'highlighting' a contemporary definition and attempt to give a formal summarization and classification of the existing and potential 'highlighting' methods that are to be applied in Information Visualization, Visual Analytics, and Knowledge Visualization. We also propose a new three-layer model of 'highlighting' and discuss the responsibilities of each layer accordingly.

1. INTRODUCTION

Highlighting scheme has been widely applied in real-world applications. Highlighting is a very popular method in computer graphics. It is commonly used to guide users' attention and to reduce the human cognitive effort in reading graphical pictures. As a new applied discipline of computer graphics, Information Visualization has inherited this method as one of the major mechanisms for the viewing control. However, as the result of rapid development in visual computing, highlighting

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has expanded its role in the traditional computer graphics and formed its specific meaning and functionalities in Information Visualization and Visual Analytics.

Nevertheless, existing understanding of highlighting has stopped its potential functionality and performance in visual analytics. Upon that, inevitably, there are many implementation problems existing in current practices. This research is aimed to raise the attention and emphasis on Highlighting. Highlighting seems to have a simple concept but is more complicated and useful than what we usually think. To address these challenges, we redefine highlighting and refine the theory of highlighting in information visualization and try to distinguish it as a new mechanism of reducing human cognition process for visual analytics. Therefore, we have made an attempt to provide a formal summarization, classification and to further explore evaluation of the existing Highlighting approaches and techniques to date so that its usefulness can be maximized in Information Visualization (Huang & Liang, 2010). We describe the results of this attempt in more detail in this chapter.

2. THE CONTEMPORARY DEFINITION OF HIGHLIGHTING

Highlighting was considered as one of the most common terms in computer graphics. However, the literature shows that there is little agreement on the understanding of highlighting. In non-professional fields, the interpretation of highlighting is either limited to the specific scope of color and lighting, as self evidence of its name, or broadened to be the process of emphasizing information. In the research field, there is also a debate on the definition of highlighting which varies from one domain to another.

Specifically in the domain of information visualization, Becker and Cleveland in 1987 described highlighting as brushing special color to paint the object; in 1999, Liston et al. illustrated highlighting as the process of emphasizing related sets of information, through visual annotation, within a view or across multiple views; in 2003, MacEachren et al. referred highlighting as the indication method by using transient visual effects; in 2004, Seo and Shneiderman suggested the term highlighting for the visual link across multiple views; in 2005, Ware and Borrow further defined it as an effective way with pre-attentive visual cues. Recently, Ware and Borrow discussed highlighting methods from static to dynamic approaches (2004). Nevertheless, these definitions all confined highlighting as the basic techniques for viewing only. Hence, it also implies that the understanding of highlighting in the literature of visualization still remains in the lower level as a viewing control mechanism.

However, the need in processing and understanding large and complex datasets means that further development in visual computing should go beyond the current capacity of visualization tools for exploiting the meaningful information and maximizing the human's ability of interpreting. To response to these challenges, this chapter attempts to establish the highlighting as an essential component of visual computing to offer services for visual navigation and visual analytics.

To put forward the research of highlighting for visual analytics, the first step is to re-define the highlighting. Highlighting naturally is planted in visual thinking and visual communication. Only appropriate definition of highlighting will help researchers and practitioners would be able to design appropriate visualizations for users to extract meaningful information out of the visual processing. However, there are challenges in defining highlighting. The limitation of highlight-