

## Chapter 8

# Understanding Collections and Their Implicit Structures through Information Visualization

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### ABSTRACT

*This chapter discusses how various approaches to information visualization can be used to assist users in understanding large digital collections and discovering relationships among the entities involved explicitly or implicitly in their development including people, organizations, and documents. Our main postulate is that visualization schemes, such as fisheye views, starfield displays, or self-organizing maps, when integrated and coupled with semantic layouts of topic areas, can significantly facilitate the analysis and discovery of existing and potential relationships among a wide range of entities. A series of developments illustrates how users play a key role in determining advantages and limitations of information visualization schemes, as well as in finding opportunities for improvement and new application areas.*

### INTRODUCTION

Myriad relationships exist among people, objects, and practically among any entities or concepts. Many new connections are being created every instant and are somehow represented in the digital realm. Thus, for example, contact lists are being extended in social networks, hyperlinks are being

created between web pages, and documents are being written that cite various sources. These are examples of explicit relationships that are forged by users or authors. Also, there are a very large number of relationships that may not be evident, and that only exist by virtue of the characteristics of entities, their activities, location or other attributes. Thus, for instance, friends of friends in a

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social network are indirectly related, users from the same geographical area could be grouped together, papers on the same topic or written by authors from the same institutions or countries can also be considered to be connected in some implicit way.

In order to deal with the volume, complexity and dynamism of this expanding information universe, it has become crucial for people to understand how large collections of digital entities are organized and how their elements are inter-related. Relationships determine structures that can be of interest for various users or perspectives. For example, books grouped according to their publisher may be of interest for booksellers and for librarians, but not necessarily for library patrons, who may be interested in hierarchical, general-to-specific views of the books' subjects. Similarly, roads that connect towns on a map and their travel times may be of interest for tourists, but manufacturers planning product distribution or government officials making budgetary or tax decisions may be more interested in various demographic layers and groupings of the same geographical locations.

Information visualization schemes play a key role in providing graphical representations of large collections and of the relationships among their elements. These visualization schemes, coupled with appropriate control mechanisms for parameters such as scale, attributes on display, or evolution over time, have an enormous potential to become user interfaces that will help users understand not only the attributes of large number of digital objects and their explicit inter-relationships, but also the implicit structures that result from considering multiple perspectives and implicit relationships. In this chapter, we focus on such information visualization schemes. In particular, we discuss the design and applications of user interfaces we have developed for supporting user activities that rely on the analysis and comprehension of very large data sets.

The main emphasis of the chapter is on the potential of three existing techniques for information visualization, namely *starfield displays*, *fish-eye views*, and *self-organizing maps*, to help users in detecting and understanding relationships and structures among elements of large collections that are defined implicitly in terms of a number of relevant attributes. Though these techniques were originally devised or applied to the visualization of large collections and explicit relationships, we have worked on adaptations and applications for visualizing implicit relationships and structures.

The chapter is organized as follows: The following section introduces basic concepts and summarizes related work in areas such as applications and advances in starfield visualizations, fish-eye views and graphical representation of ontologies, digital repositories, and collaboration networks. The next section discusses our work that focuses on the visualization of digital collections, our experiences with actual users, and the evolution from the use of basic starfields to their enhancement with the introduction of fish-eye views. This will provide the basis for the core section on our current work, which integrates starfield visualizations, fish-eye views, and lightweight ontologies, as well as its applications to visualizing collaboration networks. Observations from actual use of this integrated visualization scheme are presented and discussed. We then discuss the broader implications of our approach and our findings, and close the chapter by providing conclusions that can be derived from our work.

## BACKGROUND

In this section we provide some basic definitions of the concepts involved in the chapter and we also review related work. We first refer to one of the structures we aim to visualize, namely collaboration networks. We also provide some background on ontologies, a notion we have used to classify and

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