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Chapter XI

Novel Indexing Method of Relations Between Salient Objects

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ABSTRACT

Since the last decade, images have been integrated into several application domains such as GIS, medicine, etc. This integration necessitates new managing methods particularly in image retrieval. Queries should be formulated using different types of features such as low-level features of images (histograms, color distribution, etc.), spatial and temporal relations between salient objects, semantic features, etc. In this chapter, we propose a novel method for identifying and indexing several types of relations between salient objects. Spatial relations are used here to show how our method can provide high expressive power to relations in comparison to the traditional methods.

INTRODUCTION

During the last decade, a lot of work has been done in information technology in order to integrate image retrieval in the standard data processing environments. Image retrieval is involved in several domains (Yoshitaka, 1999; Rui, 1999; Grosky, 1997;

Smeulders, 1998) such as GIS, medicine, surveillance, etc., where queries' criteria are based on different types of features such as metadata (Trayser, 2001; Sheth, 1998; Duncan, 2000), low-level features (Wu, 1995; Berchtold, 1997; Veltkamp, 2000), semantic features (Oria, 1997; Mechkour, 1995; Chu, 1998), etc.

Principally, relations between salient objects are very important. In medicine, for instance, the spatial data in surgical or radiation therapy of brain tumors is decisive because the location of a tumor has profound implications on a therapeutic decision (Chbeir, 2000, 2001). Hence, it is crucial to provide a precise and powerful system to express spatial relations.

In the literature, three major types of spatial relations are proposed (Egenhofer, 1989):

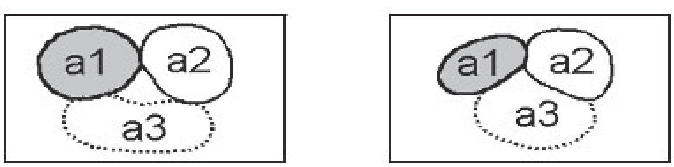
- *Metric relations* measure the distance between salient objects (Peuquet, 1986). For instance, the metric relation "far" between two objects A and B indicates that each pair of points A_i and B_j has a distance greater than a certain value d.
- *Directional relations* describe the order between two salient objects according to a direction, or the localization of a salient object inside images (El-kwae, 1999). In the literature, 14 directional relations are considered:
  - Strict: north, south, east, and west
  - Mixture: north-east, north-west, south-east and south-west
  - Positional: left, right, up, down, front and behind

  Directional relations are *rotation variant* and there is a need to have referential base. Furthermore, directional relations do not exist in certain configurations.
- *Topological relations* describe the intersection and the incidence between objects (Egenhofer, 1991, 1997). Egenhofer (1991) has identified six basic relations: *disjoint, meet, overlap, cover, contain* and *equal*. Topological relations present several characteristics that are *exclusive* to two objects (i.e., there is one and only one topological relation between two objects). Furthermore, topological relations have *absolute* value because of their constant existence between objects. Another interesting characteristic of topological relations is that they are transformation, translation, scaling and zooming *invariant*.

In spite of all the proposed work to represent complex visual situations, several shortcomings exist in the methods of spatial relation computations. For instance, Figure 1 shows two different spatial situations of three salient objects that are described by the same spatial relations in both cases: topological relations — a1 Touch a2, a1 Touch a3, a2 Touch a3; and directional relations — a1 Above a3, a2 Above a3, a1 Left a2.

The existing systems do not have the required expressive power to represent these situations. Thus, in this chapter, we address this issue and propose a novel method that

Figure 1. Two Different Spatial Situations



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