Chapter XI
Intuitive Image Database Navigation by Hue–Sphere Browsing
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ABSTRACT

Efficient and effective techniques for managing and browsing large image databases are increasingly sought after. This chapter presents a simple yet efficient and effective approach to navigating image datasets. Based on the concept of a globe as visualisation and navigation medium, thumbnails are projected onto the surface of a sphere based on their colour. Navigation is performed by rotating and tilting the globe as well as zooming into an area of interest. Experiments based on a medium size image database demonstrate the usefulness of the presented approach.

INTRODUCTION

Efficient and effective ways for managing and browsing large image databases are increasingly sought after. This is due to the sheer explosion of availability of digital images in the last few years. Nowadays, the sizes of home user’s image collections are already typically in the 1,000s while professional image providers overlook databases in excess of 1,000,000 images. Common tools display images in a 1-dimensional linear format where only a limited number of thumbnail images are visible on screen at any one time, thus requiring the user to search back and forth through thumbnail pages to view all images and locate the relevant ones. Obviously, this constitutes a time consuming, impractical and exhaustive
way of searching for images, especially in larger catalogues. Furthermore, the order in which the pictures are displayed is based on attributes like file names and does not reflect the actual image contents and hence cannot be used to speed up the search.

Recently, several approaches have been introduced which provide a more intuitive interface to browsing and navigating through image collections (Ruszala & Schaefer, 2004). The basic idea behind most of these is to place images which are visually similar, as established through the calculation of image similarity metrics based on features derived from image content, also close to each other on the visualisation screen, a principle that has been shown to decrease the time it takes to localise images of interest (Rodden et al., 1999). One of the first approaches was the application of multidimensional scaling (MDS) (Kruskal & Wish, 1978) used to project images being represented by high dimensional feature vectors to a 2-dimensional visualisation plane (Rubner, Guibas, & Tomasi, 1997). In the PicSOM system (Laaksonen et al., 2000) tree-structured self organising maps are employed to provide both image browsing and retrieval capabilities. In (Krishnamachari & Abdel-Mottaleb, 1999) a hierarchical tree is employed to cluster images of similar concepts while the application of virtual reality ideas and equipment to provide the user with an interactive browsing experience was introduced in (Nakazato & Huang, 2001).

In this chapter we present a simple and fast approach to image database navigation. All images are projected onto a spherical globe; navigation through the image collection is performed by rotation of the sphere and zooming in and out (Schaefer & Ruszala, 2005). The use of a spherical object is not a coincidence, rather it stems directly from the type of features that are used for navigation. We utilise the median hue and median brightness (in HSV colour space) to calculate a pair of co-ordinates for each image in the database. As hue describes a circular quantity ($0^\circ$=$360^\circ$) whereas brightness is not, a sphere is a natural choice of geometrical body to encapsulate the combination of these two. The proposed method hence provides an effective, intuitive and efficient interface for image database navigation as is demonstrated on a medium sized image collection (Schaefer & Stich, 2004).

**RELATED WORK**

Several approaches which provide a more intuitive interface for image database navigation, compared to the traditional linear display of thumbnails, have been recently introduced in the literature. Rubner et al. were among the first (Rubner, Guibas, & Tomasi, 1997) and suggested the application of multidimensional scaling (MDS) (Kruskal & Wish, 1978) to calculate the locations of images and displaying them in a global 2-dimensional view on a single screen. Using this method, all images in a database are (initially) shown simultaneously; their locations are dependent on their visual similarity (based on features such as colour, texture or shape descriptors) compared to all other images features in the database. If two images are very similar in content they will also be located close to each other on the screen and vice versa. The user can browse the database easily from a top-down hierarchical point of view in an intuitive way.

The main disadvantage of the MDS approach is its computational complexity. First a full distance matrix for the complete database, i.e. all pairwise distances between any two images in the collection, needs to be calculated. MDS itself is then an iterative process which successively re-arranges the locations of each image minimising the distances between images on screen and their actual (feature-based)
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