Chapter 2
An Impact of Gaussian Mixtures in Image Retrieval System

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ABSTRACT

The difficulty of searching for patterns in data is still exploratory and, ever increasing image datasets with high intra-class variations has created a large scope for generalizing image classification problems. This chapter initiates the inclusivity of discrete latent variables leading to mixture of Gaussians capturing multimodal distributions from segmented regions. Further, these mixtures are analyzed in maximum likelihood framework to extract discriminatory features in compact and de-correlated feature space. Conversely, it is less evident in literature that combining these features with diverse distance measure techniques and neural network classifiers improves the classification performance. In this chapter, we study, explore and demonstrate the idea of subspace mixture models as hybrid intelligent technique for image retrieval systems.

INTRODUCTION

The advances in internet and image acquisition techniques has given away tremendous increase in digital image collections usually generated by scientific, educational, medical, industrial and other applications. The application potential of managing these large image databases has drawn substantial attention of researchers to develop various techniques to browse, store and retrieve images from large image archives. Earlier, text based techniques are generally used to organize images with semantic hierarchies to facilitate easy navigation and browsing (Blaser 1979). However, manually annotating images for wide spectrum of images is obviously a cumbersome and expensive task for large image datasets which is often subjective to human perception, context sensitive and incomplete (Chang and Hsu 1992). Since text-based methods failed to support a variety of task-dependent queries, content-based image retrieval (CBIR) was introduced as an effective alternate in the early 1980's (Ritendra et al. 2008).

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In CBIR, images are indexed by their visual content, such as color, texture & shapes. The problem of extracting/matching images has remained primarily statistical in nature, image retrieval systems employ pattern recognition methods to define the visual content with partial semantics (Gupta and Santini 1997). Many sophisticated algorithms designed to describe color, shape, and texture features, cannot adequately model image semantics and portray limitations while dealing broad content image databases (Mojsilovic and Rogowitz 2001). Extensive research on CBIR systems reveals low level contents with single and/or combination of multiple features often fail to describe the high level semantic concepts in user's mind (Zhou and Huang 2000). While this intrinsic difficulty in solving the core problem cannot be denied, we believe that the current state-of-the-art in CBIR holds enough promise and maturity to be useful for real-world applications, if aggressive attempts are made.

Few Existing Systems

Due to the advancements made in digital communication and the availability of image capturing devices (e.g. digital cameras and image scanners), the size of digital image collection is increasing rapidly. Usually, the keyword indexing-based retrieval systems are used to browse such images and a number of keyword-based general WWW search engines allow indicating that the media type must be images. Hot-Bot (http://hotbot.lycos.com/) and NBCi (http://www.nbci.com/) are examples of these. A number of other general search engines are more specifically for images, such as Yahoo!'s Picture Gallery (http://gallery.yahoo.com/) or the multimedia searcher of Lycos, but they are still only keyword-based. There are many special image collections on the web that can be searched with a number of alphanumerical keys e.g. ImageFinder (Guojun et al. 2007). ADL (Alexandria Digital Library) searches images with texture features which mainly focus on earth and social science applications (Manjunath et al. 1995). DEC Research Lab developed AltaVista Photofinder based on visual characteristics such as dominant colors, shapes and textures (Altavista). Berkeley Digital Library Project (BDLP) uses alphanumeric keys with content based search depending upon 13 color bins, six values with each bin and percentage of colors in each bin; all features are put into relational database (Chad et al. 1996). The features used for querying in Blobworld are the color, texture, location, and shape of regions (blobs) and of the background, Singular value decomposition (SVD) is used to project the histogram vectors onto a lower-dimensional subspace. The retrieved images are presented together with the segmented versions and the demo provides retrieval from a collection of 10000 corel stock photos (Serge et al. 1999). The ImageMiner system classifies landscapes, and body plans have been used to recognize animals and people (David et al. 1997). NETRA segments images in the database into homogeneous color regions later color, texture, shape, and spatial location features are extracted and finally SS-tree indexing is used to order the retrieval results (Wei et al. 1999).

BACKGROUND

The pattern recognition task of assigning an object to a class is referred to be a classification task. Over the past decade, significant attempts had been made to extract adequate features (patterns) and designing efficient classifiers to categorize object classes in an ever increasing datasets. The visual features such as Color (Wang et al. 2012), Shape (Safar et al. 2000), and Texture features (Ojala et al. 1994) are widely explored as image contents for image representation and retrieval. Global features failed to represent