Chapter 107
Radial Moments for Image Retrieval

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ABSTRACT

Images have always been considered an effective medium for presenting visual data in numerous applications ranging from industry to academia. Consequently, managing and indexing of images become essential in order to retrieve relevant images effectively and efficiently. Therefore, the proposed chapter aims to elaborate one of the advanced concepts of image processing, i.e., Content Based Image Retrieval (CBIR) and image feature extraction using advanced methods known as radial moments. In this chapter, various radial moments are discussed with their properties. Besides, performance measures and various similarity measures are elaborated in depth. The performance of radial moments is evaluated through an extensive set of experiments on benchmark databases such as Kimia-99, MPEG-7, COIL-100, etc.

INTRODUCTION

Images have always been considered an effective medium for presenting visual data in numerous applications ranging from industry to academia. With the development in technology, a large amount of images are being generated everyday. Therefore, managing and indexing of images become essential in order to retrieve relevant images effectively and efficiently. Early work on image retrieval can be traced back to 1970s. In 1979, a conference was held regarding database techniques for pictorial applications (Blaser, 1979). Since then, the research pertaining to image database management has influenced several researchers (Chang and Fu, 1979; Chang and Fu, 1980; Chang and Kunii, 1981; Chang et al., 1988). In traditional systems, textual annotations of images were used to describe images. Afterwards, the images were searched using text based approach from traditional database management system such as SQL query. A comprehensive survey of text based retrieval can be found in (Chang and Hsu, 1988; Chang et al. 1988). In text based image retrieval, images are organized by semantic hierarchies to facilitate navigation and browsing using standard keyword queries. However, the textual annotation of images is a cumbersome task, which requires intensive manual labor for large image databases. Apart from that,

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the use of keywords become unwieldy, which do not meet human visual perception. Consequently, it is intricate for the traditional text based methods to support wide range of image databases and task dependent queries. Humans are capable of identifying an extensive range of objects irrespective of their size and orientation. A widespread research has been pursuing to develop an automated system to imitate this basic capability of human visual perception. In 1992, the National Science Foundation of United States organized a workshop on visual information management system (Jain, 1991) to discover new trends in image database management systems. It was discussed that a more efficient and spontaneous way to represent and index visual information would be based on attributes that are inherent in images themselves. In other words, the representation and indexing of images should be based on their actual visual content rather than textual annotations. Since then, the research on content based image retrieval (CBIR) has been developing rapidly (Cawkill, 1993; Dowe, 1993; Jain et al., 1995; Mejdoub et al., 2009, Arnold et al., 2000; Lew, 2006). CBIR has several applications such as medical imaging, trademark matching, digital library, computer aided design, military services, crime prevention, target detection, architectural and engineering design, geographic information, chromosome identification, surveillance tasks, etc.

CBIR uses visual contents, which can be general or domain specific as shown in Figure 1. General visual content includes image perceptual low level features such as color, texture, and shape. On the other hand, domain specific visual content such as human faces, iris, etc., is application dependent and may require domain knowledge. In our research work, we focus on general visual content such as color, texture, and shape. Among them low level shape perceptual feature provides a persuasive notion to object individuality, which meets human visual perception. Besides, shape feature signifies the geometrical information that remains unaffected when translation, scale, and rotation transformation effects are eliminated from an object. Hence in our research work, we pay attention to shape based image retrieval. However, shape description and representation is a challenging task. This is due to the projection of a real-world 3D object on to a 2D plane, by which the information about one dimension of an object is lost. As a consequence, the projected object only provides partial information of real object. Moreover, shape is often corrupted with noise, distortion, partial occlusion, compression, etc. A good shape representation must be compact and retain essential characteristics of the shape. In addition, invariance to rotation, scale, and translation is a crucial requirement because such transforms are consistent with human perception.

Figure 1. Description of image visual contents and location of the research subject