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Content-based image retrieval using Mix histogram

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ABSTRACT

This paper presents a new method to extract image low-level features, namely mix histogram (MH), for content-based image retrieval. Since color and edge orientation features are important visual information which help the human visual system percept and discriminate different images, this method extracts and integrates color and edge orientation information in order to measure similarity between different images. Traditional color histograms merely focus on the global distribution of color in the image and therefore fail to extract other visual features. The MH is attempting to overcome this problem by extracting edge orientations as well as color feature. The unique characteristic of the MH is that it takes into consideration both color and edge orientation information in an effective manner. Experimental results show that it outperforms many existing methods which were originally developed for image retrieval purposes.

Keywords: image retrieval, color, edge orientation, CBIR

1. INTRODUCTION

By the advent of internet, the amount of digital information began to grow exponentially. As a result, It led to an enormous increase in the volume of digital image data. Image databases have since been and are growing larger and larger. Therefore, there is a growing need for automatic and efficient content-based image retrieval (CBIR) systems. The purpose of these systems is to automatically find similar images to a given image. In a typical CBIR system, in order to measure similarity between images, their feature vectors are compared to each other based on some distance metrics. When a query image comes in, its feature vector will be compared to those in the database and the most similar images will be retrieved. A typical CBIR system diagram can be seen in Figure. 1. CBIR systems often use low-level features (e.g. color, texture and shape) to represent visual features of the image.

Color plays a pivotal role in visual perceptual processes and hence has gained an increasing attention for image retrieval purposes. Color histograms are among common color feature extractors widely used in CBIR systems since they are computationally efficient, easy to implement and invariant to rotation and small changes in viewing position. But it does not take into account the spatial information. Several approaches try to incorporate spatial information such as color coherent vector [1] and color correlograms [2]. Some color feature extractors are also proposed in [3, 4].

Texture is one of the most important visual features of an image widely used in image retrieval applications. There is not yet a clear definition of texture. It is used to characterize roughness or coarseness of object surface. Several approaches have been proposed for texture analysis, such as Markov random field (MRF) [5], Gabor filtering [6, 7], gray co-occurrence matrices [8], the Tamura texture feature [9] and wavelet decomposition [10, 11] and so on.

Shape features are also among important visual features which play a crucial role in recognizing objects and are widely used in content-based image retrieval systems. Some typical shape descriptors include Fourier transforms coefficients, edge curvature and arc length [12, 13].

Some approaches combine multiple features to improve performance [14, 15]. In [16], the texton co-occurrence matrix (TCM) is proposed to use spatial correlation of textons. The multi-texton histogram (MTH) [17] takes the advantages of the co-occurrence matrix and color histograms to utilize both color and texture features. Integrative co-occurrence matrices [12] is another approach that uses color and texture features.

Researchers have recently turned to machine learning techniques for image retrieval applications. One of the most popular methods is to combine CBIR systems with deep learning to take advantage of semantic information of the image as well as visual information [18-20]. In such methods, the outputs of different layers in the Convolutional Neural