International Journal of Cognitive Informatics and Natural Intelligence
Volume 15 • Issue 1 • January-March 2021

A Visual Saliency-Based Approach for Content-Based Image Retrieval

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ABSTRACT

During the past two decades an enormous amount of visual information has been generated; as a result, content-based image retrieval (CBIR) has received considerable attention. In CBIR the image is used as a query to find the most similar images. One of the biggest challenges in CBIR system is to fill up the "semantic gap," which is the gap between low-level visual features and the high-level semantic concepts of an image. In this paper, the authors have proposed a saliency-based CBIR system that utilizes the semantic information of image and users search intention. In the proposed model, firstly a significant region is identified with the help of method structured matrix decomposition (SMD) using high-level priors that highlight the prominent area of the image. After that, a two-dimensional principal component analysis (2DPCA) is used as a feature, which is compact and effectively used for fast recognition. Experiment results are validated on different image dataset having an extensive collection of semantic classifications.

KEYWORDS

Image Retrieval, Query-Based Image Retrieval, Region of Interest

INTRODUCTION

It is an era of searching on the internet. Nowadays searching is done using a digital media known as Multimedia Information Retrieval (MIR). The biggest challenge in today's era is to find the solution for the searching of digital information. The need of as Multimedia Information Retrieval system is required to search the image/video effectively and efficiently from the vast corpus of data available on the internet with the help of search engine. Searching on the web is done either in text query or by multimedia as a query. MIR deals with multimedia information like image/video which is further divided into branches such as Content Based Image Retrieval (CBIR), Michael S Lew et al. (2006). In early years, Myron Flickner et al. (1995) developed a content based retrieval system known as QBIC (Query by Image Content). In CBIR the image is used as a query to find the matched image from the database of image corpus on the web. Features of images are used for the matching of the images which are visually similar i.e., shape or texture or color or with the combination of these features.

DOI: 10.4018/IJCINI.2021010101

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There are various features frequently used in CBIR systems: Color, textures, shape etc. The color feature represents the visual appearance of an object. It is also invariant to many geometric transformations. Color histograms, color moments, color coherent vector (CCV), and color correlogram are the descriptors used to represent the color feature. Image texture defines the spatial arrangement of color or intensities. Image texture can be described in term of smoothness, coarseness, roughness. Recently, SIFT feature is also used as a local feature for image representation by David G Lowe (2004). Timo Ojala et al. (1996) proposed texture histograms feature by combing simple texture features. Shape is also used as one of the global feature. There are different shapes descriptors such as circularity, moment invariant, aspect ratio, boundary segments, eccentricity, orientation and Fourier descriptors are used in CBIR systems. Apart from using single feature, researchers have exploited the combinations of different features such as color and texture used by researchers Xiang-Yang Wang et al. (2014), color and shape by researchers Theo Gevers and Arnold WM Smeulders (2000) and color, texture and shape by researchers Xiang-Yang Wang et al. (2011). Combing features have improved the efficiency and accuracy of retrieval systems. However, combining features create the feature vector heavy and retrieval system more complex. So there is a need of feature that is compact and as well as efficient.

The majority of the works in CBIR have focused on narrow image fields which usually represent images related to a particular domain such as satellite images; medical images Arnold WM Smeulders et al. (2000). In domain-specific images, the images are restricted around a small semantic concept. On the other hand, broad domains represent images having a large set of semantic concepts such as natural images on the web Arnold WM Smeulders et al. (2000). These images also contain significant lack of consistency within them. Developing a system that can deal with the broad image domain is much more challenging. In general, in an image retrieval system, user visual attention is only focused in specific regions also known as objects of interest.

Most of the CBIR frameworks assume each picture as a whole semantic unit and assemble primitive components Ritendra Datta et al. (2009). The global features are computed from the entire image. Therefore, the retrieval precision such systems are low Ying Liu et al. (2007). In whole matching approaches, the complete image is used for matching. In such approach, a lot of irrelevant regions are also included because the features of the entire image area are integrated into one or several global feature vectors (e.g., color histograms). Many researchers proposed region-based approaches, to overcome the issues related to the global features and to extract the semantic information, P Manipoonchelvi and K Muneeswaran (2015). A region-based image retrieval (RBIR) framework contains different modules such as segmentation, feature extraction and similarity matching. The segmentation module extracts the various homogeneous regions from an image. There are different segmentation methods such as pixel-based, boundary based and region-based methods used in literature. The feature extraction module extracts either low-level features such as color, shape, and texture or high-level semantic features. The high-level semantic features are computed from the low-level features. The prior knowledge also plays an important role in extracting high-level semantic features.

Cheng-Chieh Chiang et al. (2009) proposed a method which allows the user to specify regions of interest as a query. Based on the color-size histogram irrelevant images are filtered out. An Earth Mover's Distance (EMD) based similarity measure is used to rank and matching the resulting candidate images. P Manipoonchelvi and K Muneeswaran (2015) proposed visual attention based method for significant region extraction. A color layout descriptor (CLD) is used to represent the regions. In their method, first the image is segmented into homogeneous color regions. Then for each region in the image, they compute visual descriptors such as color contrast, proximity to the centre of the image, size and nearness to image's boundary for each region in the image. Finally, on the basis of the visual metrics, the significance of each region is measured and identifies the central regions.

In a region-based approach, image is divided into different regions and visual features are computed on these regions. Region based feature have shown higher retrieval precision as compared to

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