2010

Accelerating Image Retrieval Using Binary Haar Wavelet Transform on the Color and Edge Directivity Descriptor

Chatzichristofis, Savvas A.
Institute of Electrical and Electronics Engineers (IEEE), United States

http://hdl.handle.net/11728/10160

Downloaded from HEPHAESTUS Repository, Neapolis University institutional repository
Accelerating Image Retrieval using Binary Haar Wavelet Transform on the Color and Edge Directivity Descriptor

Savvas A. Chatzichristofis1 Yiannis S. Boutalis1,2 Avi Arampatzis1
1Department of Electrical & Computer Engineering, Democritus University of Thrace, Xanthi, Greece
2Department of Electrical, Electronic and Communication Engineering, Chair of Automatic Control, University of Erlangen-Nuremberg, Germany
{schatzic, ybout, avi}@ee.duth.gr

Abstract—In this paper, a new accelerating technique for content-based image retrieval is proposed, suitable for the Color and Edge Directivity Descriptor (CEDD). To date, the experimental results presented in the literature have shown that the CEDD demonstrates high rates of successful retrieval in benchmark image databases. Although its storage requirements are minimal, only 54 bytes per image, the time required for the retrieval procedure may be practically too long when searching on large databases. The proposed technique utilizes the Binary Haar Wavelet Transform in order to extract from the CEDD a smaller and more efficient descriptor, with a size of less than 2 bytes per image, speeding up retrieval from large image databases. This descriptor describes the CEDD, but not necessarily the image from which it is extracted. The effectiveness of the proposed method is demonstrated through experiments performed with a known benchmark database.

Keywords—CEDD; Image Retrieval; Large Scale Databases

I. INTRODUCTION

As the use of computers, internet and cameras is getting more popular by the minute, efficient content-based image retrieval is more essential than ever. Any technology that, in principle, helps to organize digital image archives by their visual content is defined as Content based image retrieval (CBIR). By this definition, anything ranging from an image similarity function to a robust image annotation engine falls under the purview of CBIR [1].

Online image repositories such as Flickr contain hundreds of millions of images and are growing quickly [2]. The requirements of the modern retrieval systems are not limited to the achievement of good retrieval results, but extend to their ability for quick results. The majority of the internet users would compromise the partial reduction of the results accuracy in order to save time from searching.

The image retrieval, as well as text retrieval, may be described by the similarity search paradigm [3]. Efficient approaches that allow application on generic similarity search problems still need to be investigated [4]. A promising direction to address this issue is the approximate similarity search paradigm [5], [6], [7], [8]. Approximate similarity search provides an improvement in similarity search performance at the price of some imprecision in the results. An interesting approach of approximate similarity search was proposed in [4]. The idea at the basis of this technique is that when two objects are very close one to each other they ‘see’ the world around them in the same way.

In order to achieve image retrieval from large scale databases, the representation of images by Latent Dirichlet Allocation (LDA) [9] models for content-based image retrieval is studied in [2]. Image representations are learned in an unsupervised fashion, and each image is modeled as a mixture of its depicted topics or object parts.

The present paper proposes a different approach for searching in large databases. First of all, in order to ensure quality of the results, the Color and Edge Directivity Descriptor (CEDD), proposed in [10], [11], is utilized. The size of this descriptor is 54 bytes/image. Subsequently, the Binary Haar Wavelet Transform [12] applied on the CEDD, is used for the extraction of a second descriptor. This second descriptor, which describes the CEDD content with less than 2 bytes, is employed during the retrieval procedure instead of the image. In this way, reduced retrieval times are achieved.

Details concerning the CEDD and the Binary Haar Wavelet Transform are given in Sections 2 and 3, respectively.

During the search process, an image query is entered and the system returns images with a similar content. Initially, the similarity/distance between the query and each image in the database is calculated with the proposed descriptor, and only if the distance is smaller than a predefined threshold, the comparison of their CEDDs is performed. The entire retrieval procedure is described in Section 4. In order to estimate the appropriate threshold value, efficient techniques, described in Section 5, were used. The experimental results are presented in Section 6, and the conclusions of this study are drawn in Section 7.

II. THE COLOR AND EDGE DIRECTIVITY DESCRIPTOR

The descriptors, which include more than one features in a compact histogram, can be regarded that they belong to the family of Compact Composite Descriptors. A typical example of CCD is the CEDD descriptor. The structure of CEDD consists of 6 texture areas. In particular, each texture