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A Review Paper on a Genetic Algorithm Applied to Content-Based Image Retrieval for Natural Scenes Classification

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Abstract— The Content-Based Image Retrieval (CBIR) techniques use different techniques retrieve self-content descriptors over the image data set being studied according to the type of the image. The reason of study of CBIR consists in classifying images avoiding the use of manual labels related to understanding of the image by the human being vision. In this work provide a new CBIR procedure which works with local texture analysis, and which is developed in a non-supervised fashion, clustering the local achieved descriptors and classifying them with the use of a K-means algorithm supported by the genetic algorithm. This method has been deployed in LabVIEW software, programming each part of the procedure in order to implement it in hardware. The results are very promising, reaching up to 90% of recall for natural scene classification.

Keywords— Natural scene CBIR, Genetic Algorithms, K-Means, LabVIEW.

I. INTRODUCTION

Retrieval of information consists on the process of converting a query application into a set of meaningful references. The first studies on retrieval of information applied to images began in the late 80s. Since then, the possibilities arising from this type of application on data bases has dean the attention of several studies [1]. The first techniques were not, on the whole, intended to study visual features, but on metadata extracted from the properties of the images, such as labels or the name of these images. These techniques were named label type. In other words, the images were localized and characterized using an approach based on texts with label management systems organized in traditional data bases. At the beginning of 1990, as a result of the internet improvements and new digital camera technologies, the creation of digital image data bases of immense volume has soared [2]. It is also related to the massive use of digital cameras among people. Also, at the beginning, the difficulties that faced the retrieval of information, based on texts, increased and rendered unsatisfactory results. Although the techniques have improved, they have reached a limit that is reflected on their poor results [3]. This is due to the use of labels that not always describe all the details of the images being processed. In this way, the necessity to classify or search images lead to the apparition of (*Content-Based Image Retrieval*) techniques (CBIR). Additionally, the research on extraction methods, organization and indexation of visual information and their use on business application have been steadily increasing on the last years [1]. Currently, CBIR systems draw upon several disciplines to perform the image classification. On one hand, its is required an intelligent stage to identify the images and on the other hand, another stage to classify them into groups or subcategories [4]. Genetic Algorithms (GA) are a class of techniques that can be used to complete the identification stage. There are several GA applications for the information retrieval. All of them emphasize users feedback. This last case corresponds to a mathematical GA that individually transforms a set of image attributes and that treats them as dynamical properties. It also uses operations modelled according to the Darwinian principle of evolution. In this way, it contemplates the reproduction and surviving of individuals as the solution of the fittest. Each of these mathematical operations currently consists of an attribute matrix that resembles the model of the chromosome chain and that is associated to a fitness function. As a result, the fittest individuals are stored to compare the extracted data from the images and formulate a decision. This paper presents the development and implementation of a CBIR system oriented to natural scenery images classification. The implementation was carried out with Lab VIEW and is intended to operate in FPGA hardware. The manuscript begins presenting the state of the art and the methodology used to extract the attributes of the digital images by means of statistical descriptors. Latter, it is analysed the process to group the images by means of the *K*-means algorithm. Finally, the results are presented and the conclusions and perspectives are formulated.

II. CONTENT BASED IMAGE RETRIEVAL

In early days because of very large image collections the manual annotation approach was more difficult. In order to overcome these difficulties Content Based Image Retrieval (CBIR) was introduced. Content-based image retrieval (CBIR) is the application of computer vision to the image retrieval problem. In this approach instead of being manually annotated by textual keywords, images would be indexed using their own visual contents .The visual contents may be colour, texture and shape. This approach is said to be a general framework of image retrieval .There are three fundamental bases for Content Based Image Retrieval which are visual feature extraction, multidimensional indexing and

retrieval system design. The colour aspect can be achieved by the techniques like averaging and histograms. The texture aspect can be achieved by using transforms or vector major areas of application are Art collections, Medical diagnosis, Crime prevention, Military, Intellectual property, Architectural and engineering design and Geographical information and Remote sensing systems.

2.1 Retrieval Based on Colour

Several methods for retrieving images on the basis of colour similarity are being used. Each image added to the database is analysed and a colour histogram is computed which shows the proportion of pixels of each colour within the image. Then this colour histogram for each image is stored in the database. During the search time, the user can either specify the desired proportion of each colour (75% olive green and 25% red, for example), or submit a reference image from which a colour histogram is calculated. The matching process then retrieves those images whose colour histograms match those of the query most closely.

2.2 Retrieval Based on Structure

The ability to match on texture similarity can often be useful in distinguishing between areas of images with similar colour. A variety of techniques has been used for measuring texture similarity in which the best established rely on comparing values of what are known as second order statistics calculated from query and stored images. Essentially, these calculate the relative brightness of selected pairs of pixels from each image. From these it is possible to calculate measures of image texture such as the degree of contrast, coarseness, directionality and regularity, or periodicity, directionality and randomness. Alternative methods of texture analysis for retrieval include the use of Gabor filters and fractals. Texture queries can be formulated in a similar manner to colour queries, by selecting examples of desired textures from a palette, or by supplying an example query image. A recent extension of the technique is the texture thesaurus, which retrieves textured regions in images on the basis of similarity to automatically-derived code words representing important classes of texture within the collection.

2.3 Retrieval Based on Shape

The ability to retrieve by shape is perhaps the most obvious requirement at the primitive level. Unlike texture, shape is a fairly well-defined concept and there is considerable evidence that natural objects are primarily recognized by their shape. A number of features characteristic of object shape (but independent of size or orientation) are computed for every object identified within each stored image. Queries are then answered by computing the same set of features for the query image, and retrieving those stored images whose features most closely match those of the query. Two main types of shape feature are commonly used global features such as aspect ratio, circularity and moment invariants and local features such as sets of consecutive boundary segments. Alternative methods proposed for shape matching have included elastic deformation of templates, comparison of directional histograms of edges extracted from the image, and shocks, skeletal representations of object shape that can be compared using graph matching techniques. Queries to shape retrieval systems are formulated either by identifying an example image to act as the query, or as a user-drawn sketch. Shape matching of three-dimensional objects is a more challenging task particularly where only a single 2-D view of the object in question is available.

2.4 Retrieval Based on Other Features

One of the oldest-established means of accessing pictorial data is retrieval by its position within an image. Accessing data by spatial location is an essential aspect of geographical information systems, and efficient methods to achieve this have been around for many years. Similar techniques have been applied to image collections, allowing users to search for images containing objects in defined spatial relationships with each other. Improved algorithms for spatial retrieval are still being proposed. Spatial indexing is seldom useful on its own, though it has proved to be effective in combination with other factors such as colour and shape. Several other types of image feature have been proposed as a basis for CBIR. Most of these rely on complex transformations of pixel intensities which have no obvious counterpart in any human description of an image. Most such techniques aim to extract features which reflect some aspect of image similarity which a human subject can perceive, even if he or she finds it difficult to describe. The well-researched technique of this kind uses the wavelet transform to model an image at several different resolutions. Promising retrieval results have been reported by matching wavelet features computed from query and stored images. Another method giving interesting results is retrieval by appearance. The advantage of all these techniques is that they can describe an image at varying levels of detail (useful in natural scenes where the objects of interest may appear in a variety of guises), and avoid the need to segment the image into regions of interest before shape descriptors can be computed. Despite recent advances in techniques for image segmentation, this remains a troublesome problem Quantization .The shape aspect can be achieved by using gradient operators or morphological operators.

2.5 Segmentation

Segmentation is very important to image retrieval. Segmentation extracts the boundaries from a large number of images without occupying human time and effort. The user defines where the object of interest is, and then the algorithm groups regions into meaningful objects. Reliable segmentation is especially critical for characterizing shapes within images, without this shape estimates are meaningless. The normalized cut segmentation method is also extended to textured image segmentation by using cues of contour and texture differences.

Fig.1 Segmented image

Image Retrieval Architecture: There are three databases in this system architecture. The image collection database contains the raw images for visual display purpose. During different stages of image retrieval, different image resolutions may be needed . The visual feature database stores the visual features extracted from the images using techniques. This is the information needed to support content-based image retrieval. The text annotation database contains the key words and free-text descriptions of the images. The retrieval engine module includes a query interface sub-module and a query-processing sub-module. The interface collects the information need from the users and displays back the retrieval results to the users in a meaningful way. The query-processing sub-module manipulates the user query into the best processing procedures. There are two major characteristics of this system architecture:

- Multidiscipline and Inter-discipline nature.
- Interactive nature between human and computer

The two methods, which are used for image retrieval, are:

- Text based image retrieval
- Content based image retrieval

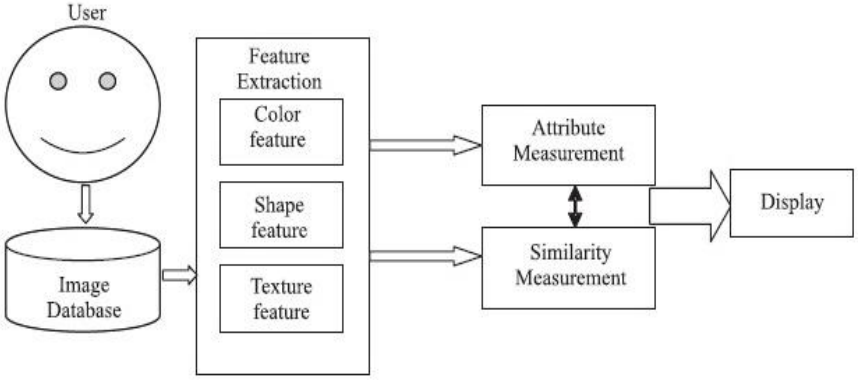

Figure 2. CBIR architecture .

Table I Comparison Between TBIR and CBIR:

TBIR	CBIR
In text based, user entered the query in the form of text to search an image from image database and the system will return images similar to the query entered by the user. It is also known as annotations based image retrieval (ABIR) **Advantages:** - Easy to implement - Fast retrieval - Web image search **Disadvantages**: - Annotation of each image requires domain experts - It is necessary to use unique keyword for each image,so this is a very complex task. - Annotation for each and every image in a large database is impossible - Sometimes, Text descriptions are incomplete	Content-based means that the search analyses the contents of the image not the metadata such as keywords, labels or tags associated with the images. It is also known as query by image content (QBIC) and content-based visual information retrieval (CBVIR) **Advantages:** - Features such as colour, texture, shape and spatial are retrieved automatically - Similarities of the images are based on distance between the features - No need of domain experts - Description of image in text form doesn't required **Disadvantages:** - High semantic gap between low level features and high level features

III. CONCLUSIONS

In this paper implemented a CBIR technique modified with a GA. A consequence of the previous is the improvement of the performance using LabVIEW, which brings more training and recovering velocity. This improvement outperforms the implementation with MatLab. It is important to note that this CBIR modification, based on [1], was made looking for equilibrium between processing time and efficiency while managing large amount of images. All modules and routines were manually programmed with LabVIEW, and they were directly compiled in ordinary PCs.

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