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A Novel Approach of Content Based Image Retrieval and Classification using Fuzzy Maps

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Abstract: *Content Based Image Retrieval has numerous applications in variety of areas like medicine, video imaging, GIS etc., many works proposed on these applications are computationally intensive. This paper presents different Content Based Image Retrieval methods and in particular about fuzzy based methods.*

Keywords: *Synthesized image features, Image Recognition, Content Based Image Retrieval, descriptors, feature vectors.*

1. INTRODUCTION

The word Content Based Image Retrieval was originated in 1992, used by Kato T to describe experiments into automatic retrieval of images from different data sets. From that point of time it is used to describe the process of retrieving required images from a large collection[1] on the basis of synthetical image features.

In Content Based Image Retrieval Systems the image databases are marked with descriptors derived from the visual content of the images. In many cases CBIR techniques [2][3][4]are used to extract images which are visually similar to a specified target image.

Images are classified as Intensity images, Indexed images and Binary images. Intensity image represents image as a matrix where each element has a value corresponding to how bright or dark the pixel at the corresponding position.

In an indexed image the image matrix values do not determine the pixel colors directly. Here we use two matrices to represent an indexed image. The first matrix has the same size as the image. The second matrix is known as color map and its size vary from the first one. In binary images the image format stores an image as a matrix but can color a pixel black or white .As usual it assigns a 0 for black and a 1 for white as the color code.

In general the content of an image can be characterized by many visual properties [5] such as features. Image recognition and classification methodologies can classified as..

1. Structural Pattern recognition:

In this process primary components of patterns are extracted. The relations between them are explained with Graphs or decision trees.

2. Statistical Pattern recognition:

Here the features are algorithmically extracted using different template matching procedures.

3. Fuzzy Logic technique:

Fuzzy systems are structural numerical estimators. They narrate the system closely related to the real world and articulate If-Then rules as a tool of expert knowledge.

4. Neural Network Approach:

This approach involves testing the applicability of different learning methods.

2 MATERIAL AND METHODS

The results of applying Fuzzy Hamming Distance as a similarity measure between the color histograms of two images. The Fuzzy Hamming Distance is suitable for this application because it can take into account not only the number of different colors but also the magnitude of this difference. Constantin Vertan, Nozha Boujemaa propose to revisit the use of color image content as an image descriptor through the introduction of fuzziness [6], which naturally arises due to the imprecision of the pixel color values and human perception. In 2000 they proposed the use of both fuzzy color histograms and their corresponding fuzzy distances for the retrieval of color images within various databases [7][8]. Again in 2000 Stefano Berretti, Alberto

Del Bimbo, and PietroPala, proposes retrieval by shape similarity using local descriptors and effective indexing. Shapes are partitioned into tokens in correspondence with their protrusions, and each token is modelled according to a set of perceptually salient attributes. Shape indexing is obtained by arranging shape tokens into a suitably modified M-tree index structure.

T he efficient management of the rapidly expanding visual information became an urgent problem. In 1996, Greg Pass RaminZabih described for comparing images called histogram refinement, which imposes additional constraints on histogram based matching. Histogram refinement splits the pixels in a given bucket into several classes, based upon some local property. Within a given bucket, only pixels in the same class are compared. Here describe a split histogram called a color coherence vector (CCV), which partitions each histogram bucket based on partial coherence. After that Chad Carson, Serge Belongie, Hay it Greenspan, and Jitendra Malik Retrieved images from large and varied collections using image content as a key is a challenging and important problem.

Two distinct distance functions model respectively, token and shape perceptual similarity Arnold W.M. Smeulders, Marce l Worring, Simone Santini, Amarnath Gupta, and Ramesh Jain, starts discussing In 2000 the working conditions of content-based retrieval: patterns of use, types of pictures, the role of semantics, and the sensory gap. Subsequent sections discuss computational steps for image retrieval systems. Step one of the review is image processing for retrieval sorted by color, texture, and local geometry [9][10][11].

For a region-based image retrieval system, performance depends critically on the accuracy of object segmentation. Yixin Chen James Z Wang proposed a soft computing approach, unified feature matching, which greatly increases the robustness of the retrieval system against segmentation related uncertainties. In the retrieval system, an image is represented by a set of segmented regions each of which is characterized by a fuzzy feature (fuzzy set) reflecting color, texture, and shape properties. Ju Han and KaiKuang Ma, in 2002 presents a new color histogram representation, called fuzzy color histogram , by considering the color similarity of each pixel's color associated to all the histogram bins through fuzzy-set membership function. A novel and fast approach for computing the membership values based on fuzzy c -means algorithm is introduced. The FCH is further exploited in the application of image indexing and retrieval. Experimental results clearly show that FCH yields better retrieval results than CCH. Minakshi Banerjee, Malay K. Kundu in 2003 discussed the common problem in content based image retrieval (CBIR) is selection of features. Image characterization with lesser number of features involving lower computational cost is always desirable. Edge is a strong feature for characterizing an image so a robust technique is presented for extracting edge map of an image which is followed by computation of global feature (like fuzzy compactness) using gray level as well as shape information of the edge map. Giridhar et al referred geometric moment invariants [12] to detect images. Unlike other existing techniques it does not require pre segmentation for the computation of features. This algorithm is also computationally attractive as it computes different features with limited number of selected pixels. DeokHwanKim ,ChinWanChung in 2003 propose a new content-based image retrieval method using adaptive classification and cluster merging to find multiple clusters of a complex image query. When the measures of a retrieval method are invariant under linear transformations, the method can achieve the same retrieval quality regardless of the shapes of clusters of a query.

3. ARCHITECTURE OF CONTENT BASED IMAGE RETRIEVAL SYSTEM

CBIR process architecture contains different stages listed as below.

1. Image Acquisition: Digital images can be acquired from the collection of data sets.
2. Image Preprocessing: The image is first processed in order to extract the features which defines its contents. It involves normalization, filtering, segmentation and object identification.
3. Feature Extraction: Shape, color, texture are described the content of the low and high level features. Visual information [14]is extracted from the image and saves as feature vectors.
4. Matching: The saved information of images is computed and the feature vectors are matched with the feature vectors of query image which helps to measure the similarity property.
5. Output retrieved images: This stage is used to search previously maintained data to find the matched images.
6. User Interface: it checks for the display of outputs, their ordering, the type of user interaction etc..

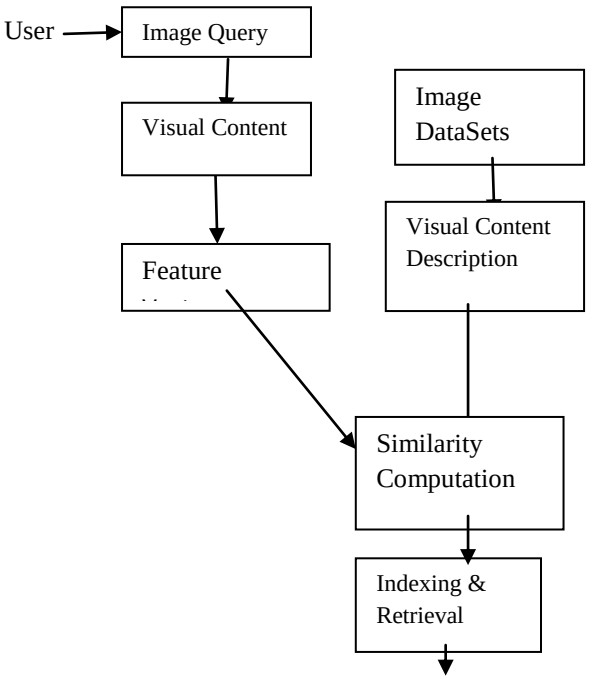

Fig 1. Flow chart of CBIR

3. PROPOSED METHOD

The proposed method uses self-organizing maps (SOM) and fuzzy clustering procedures to retrieve images. We used three selected descriptors namely color, texture and shape. Let C be the set of color features S be the set of shape features. Let R be the resultant feature vector after concatenating C and S. The average of all the respective features over the entire database is used to normalize the individual feature components. Let the normalized vectors [13] be C' and S'. The final matching score for the Euclidean Distance and point pattern matching technique is based on the number of matched pairs found in the two sets.

4. RESULTS

Good number of standard images was used for testing. Precision is defined as the fraction of retrieved images that are truly relevant to the query image and recall is defined as the fraction of relevant images that are actually retrieved. The performance metrics used during evaluation is the precision-recall measure and retrieval time. All the test images were tested through MATLAB on Pentium machines.

SOM based approach is compared with other existing methods and it is proved that the proposed method is the improved one. The image retrieval taken for the proposed method is 1.26 sec where as the existing system took 1.67 sec.

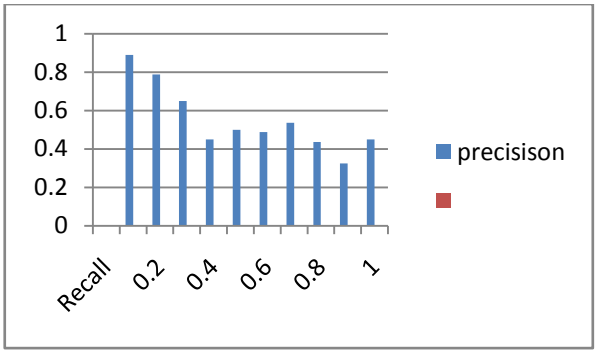

Fig 2. *Graph showing Precision of Proposed method*

5. CONCLUSION

This paper uses SOM based fuzzy maps to extract images A similarity measure that combines spatial distance, direction distance and Euclidean distance is used. Several experiments were performed to analyze the performance of the proposed system. The results proved that the combination method is efficient in terms of precision, recall and speed of image retrieval.

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