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An Efficient Method for Landscape Image Classification and Matching Based on MPEG-7 Descriptors

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Abstract

In this thesis, an efficient approach for landscape image classification and matching system based on the MPEG-7 (Moving Picture Expert group) color and shape descriptor. Image classification is the task of deciding whether an image landscape or not. These classifications use the dominant color descriptor method for finding the dominant color in the image. In DCD we examine whole image pixel values. The pixel value contains Red, Green and Blue color values in the RGB color model. After calculating all pixels values we can say that which color has maximum value in image by performing some arithmetic operations. So this color is called dominant color and based on this color, we classify some landscape images.

After DCD, we use shape and color structure for image matching with database images. Shape descriptor calculate some key points of image like number of objects in image, maximum object size and active pixels in binary image. Based on these key points, we match the database and store the resulted image. Now we apply CSD method on the resulted images from the shape descriptor and again perform matching to get the final result.

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Keywords: *MPEG-7, Image Processing, Shape Descriptor, Object Analysis, Dominant Color Descriptor, Color Descriptors.*

I. INTRODUCTION

The MPEG-7 descriptors [3] define and classification of a set of image like landscape images, cityscape and other type which describe various aspects of visual contents [9], [10] of the images. These allow the localization of the required multimedia content and compression. Low-level descriptors include color, texture, and shape descriptors, which describe different features of visual content of the image object like landscape. We use the DCD, CSD and shape based segmentation method for image classification and image matching.

II. MPEG-7 COLOR DESCRIPTOR

The previous MPEG standards was called MPEG-1 and MPEG-2 concentrated as a image compression, while MPEG-4 moved to a higher level of abstraction in coding objects and using content-specific techniques for coding content. The next version of MPEG is MPEG-7 [5] has moved to an even higher level of abstraction of multimedia data. Color is the main visual feature, along with texture, shape and motion, towards content localization. The colors in an image should be presented relating to its perception, coherency and spatial distribution.

MPEG-7 defines seven color descriptorsare following:

- Color Space
- Color Quantization
- Dominant Color
- Color Structure
- Scalable Color
- Color Layout
- Group of Frames/Group of Pictures Color

In this paper we use only two MPEG-7 descriptor for landscape image classification and matching are showing below.

- *Dominant Color:*

This descriptor provides a compact description [4], [5], [6] of the representative colors of any type of image or image region. Its main applications are classification of images based on single or several color values. In its basic form, the dominant color descriptor consist of the number of dominant colors (N), and for each dominant color its value as a vector of color components (c_i) and the percentage of pixels (p_i) in the image region in the cluster corresponding to c_i. Two additional fields, spatial coherency (s) and color variance (v_i), provide further characteristics of the color distribution in the spatial and color space domains [9].

- *Color Structure:*

The Color Structure Descriptor is also based on color histograms [7], but aims to identifying structure of color distributions. The color structure descriptor is adopting the Hue-Min-Max-Difference (HMMD) color space. It is very good for find matching of between two color images that have similar or dis-similar pattern.

- *Shape Descriptor*

Shape description techniques [8] can be broadly categorized into two types, boundary based and region based. Boundary based methods use only the contour or border of the object shape and completely ignore its interior part of shape. Hence, these methods are also called external methods. The region based techniques take into account internal details like holes besides the boundary details. Recognition of a shape by its boundary is the process of comparing and recognizing shapes by analyzing the shapes boundaries but the local structural organization is always hard to describe.
Generally we know that shape recognition has two major parts, shape representation and shape matching. The objective of shape descriptors is to measure geometric attributes of an object that can be used for quantifying shapes, matching shapes, and recognizing objects.

III. PROCEDURE FOR LANDSCAPE IMAGE CLASSIFICATION

- *Classification and Matching Method Description*

In this work first we classify the landscape image then find the matching with predefined landscape images database. Figure 6.1 shows two block diagram of my work. First block uses dominant color descriptor to classify a landscape image and second block is combination of shape and color structure descriptor to determine the matching.

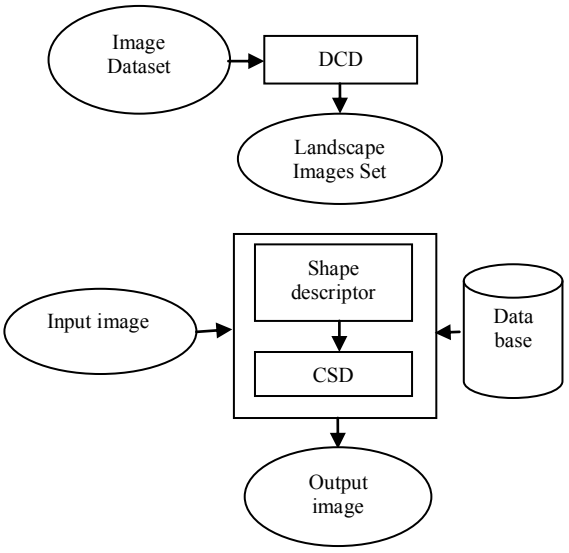


Fig. 1

I have taken a query images set and in proposed method have following computation are carried, which is divided into three main steps:

Input: - Get query images.

Output: - Find similar type of landscape image and it match with database.

1. Take RGB color query images and find the percentage of all colors in an image then calculate the maximum value of color that is called dominant color. On the basis of this dominant color value, classify the image whether it is landscape or not.

Process:-

[r, c] = Size (Query_image)
For 1: r
For 1: c
C_value = Impixel (Query_image)
If (C_value_G > C_value_R) && (C_value_G > C_value_B)
NP_G = NP_G +1
End
End
End
Show (NP_G)
For i = 1: r
For j= 1: c
S_D (i, j) = Query_image(i,j,2)
End
End
Show (Sum(S_D))

2. In boundary based shape block is done to achieve number of object, active pixels in binary image and maximum object size. We store similar resulted images that have been found by this step.

Process:-

Q_{image} = *Query_image*
BG_{image} = *Morphologically structure image*
$Image1 = Q_{image} - BG_{image}$
Image2= Create binary image (Image1)
Image3 = BW connect component (image2)
Show(Number of objects)
Show(Maximum object)
Show(binary image size)

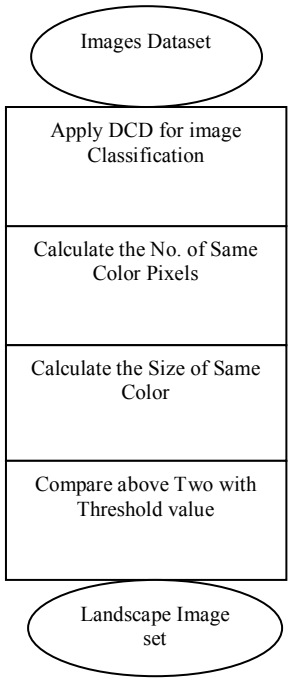
3. In the last block of our approach is color structure descriptor that determine the generalized histogram and the structure of image. Now matching is performed with landscape database to show the image belongs to database or not.

Process:-

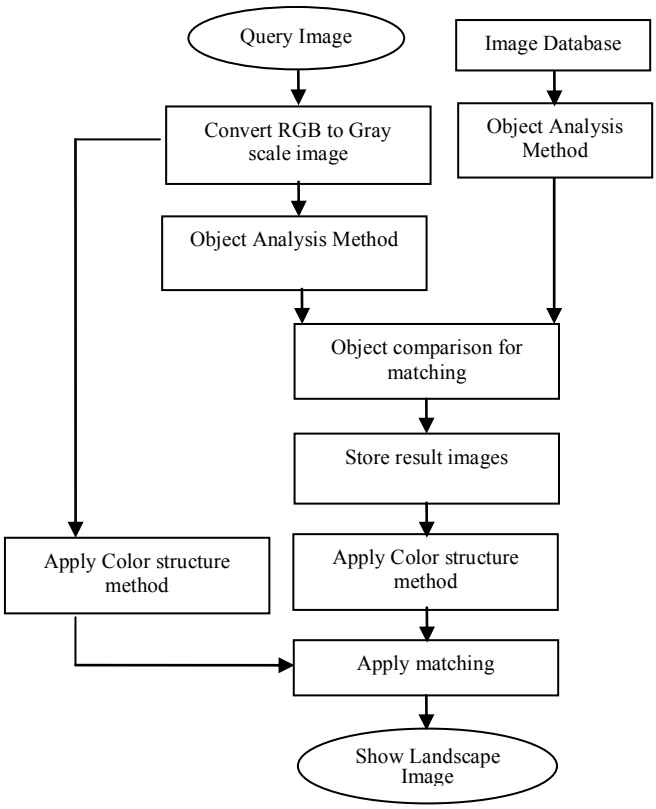
Q_{image1} = *Query_image 1*
Q_{image2} = *Query_image 2*
$C\_hist1 = hist\ (Q_{image1})$
$C\_hist2 = hist\ (Q_{image2})$
C_simila = similarity (C_hist1, C_hist2)
$C\_structure = isequal\ (Q_{image1}, Q_{image2})$

- *Classification and Matching Method Flowchart*

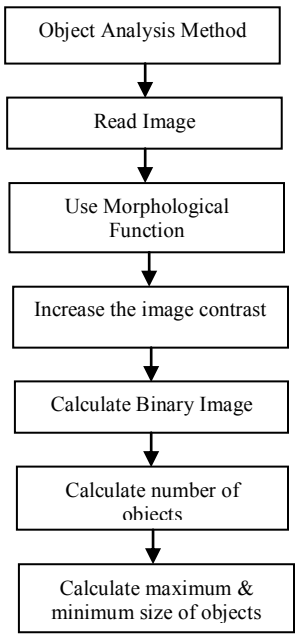
1. In this flowchart we use dominant color descriptor for landscape image classification.



2. The landscape image matching algorithm based on object analysis and color component structure.



3. The object analysis algorithm that matching the objects between query and database image. It is based on boundary based segmentation method.



- *Proposed Algorithm*

Step 1:- Read an image from query dataset (QDS_{image}).

Step 2:- Apply dominant color method and counting the pixels of same color and total value of particular color.

$$NP\_G = DCD(Q_{image}) \quad and \quad CV\_G = DCD(Q_{image})$$

Step 3:- On the basis of color that have maximum number of particular color pixel and particular color value, we classified the landscape images .

$$[C\_L, C\_NL] = Cluster\ of\ Image\ (images)$$

Step 4:- Now we get two clusters, landscape and not landscape images clusters for further analysis.

Step 5:- Read an query image from the $C\_L(Query_{image})$.

Step 6:- In this step we converts RGB images to intensity image by eliminating the hue and saturation information while retaining the luminance.

$$Gray\ value\ of\ the\ pixel = 0.2989 * R + 0.5870 * G + 0.1140 * B$$

Equation 1 represent the gray value of the particular pixels also we can say that a Gray value of the pixel is a weighted sum of the R, G, and B color components.

Step 7:- Find foreground (objects) of the gray image for object analysis.

a. Create structure element of the gray image.

b. Perform some operations on both gray image and SE for extracting objects image.

$$Q_{image} = Query\_image$$
$$BG_{image} = Morphologically\ structure\ image$$
$$Image1 = Q_{image} - BG_{image}$$

Step 8:- In this step, we increase the intensity of a low contrast grayscale image because after subtraction, the image has a uniform background but is now a bit too dark.

Step 9:- Find out binary image of the above corresponding image.

a. Find image threshold value: Computes a global threshold value that can be used to convert an intensity image to a binary image. Value is a normalized intensity value that lies in the range [0, 1]. The gray thresh function uses Otsu's method, which chooses the threshold to minimize the intra class variance of the black and white pixels.
b. Apply threshold value on the gray image and get the binary image this process is called binarization.

Step 10:- Morphology is the study of the shape and form of objects. Morphological image analysis can be used to perform Image filtering operations, such as removal of small objects or noise from an image and object extraction.

a. Removes all small objects from binary image.
b. Find number of objects in binary image (N_Obj).

Step 11:- Now we are calculating the number of pixels in the binary image (npibry) and also finding the number of maximum pixels in the objects (nmxpi).

Step 12:- In this step we perform matching of above result with respect to image database.

$$True/False = Matching\{ N\_Obj(Q_{image}) , N\_Obj(D_{image})\}$$
$$True/False = Matching\{ N\_Px\_Bny (Q_{image}) , N\_Px\_Bny(D_{image})\}$$
$$True/False = Matching\{ NM\_Px\_Obj(Q_{image}) , NM\_Px\_Obj(D_{image})\}$$

if all three conditions are true than we perform next step otherwise show matching is not done.

Step 13:- We create an array which stores the similar images having same number of objects, same the number of pixels in the image and the number of maximum pixels in the objects.

Step 14:- Now we are using the color structure method on the query image then calculate the following.

a. Scanning the image by an 8x8 structure element.
b. Determine the histogram of query image.
c. Determine the structure of the query image.

$$Q_{image1} = Query\_image\ 1\ and\ C\_hist_1 = Hist\ (Q_{image1})$$

Step 15:- Again apply color structure method on the resulted image that has been stored in array, created in step 13.

$$Q_{imageR} = Query\_image\ R\ and\ C\_hist_R = Hist\ (Q_{imageR})$$

Step 16:- Matching is performed on the resulting images and query image.

$$C\_simila = Similarity\_Matching\ (C\_hist_1, C\_hist_R)$$
$$C\_structure = Isequal\_structure\ (Q_{image1}, Q_{imageR})$$

In above algorithm after executing the 3rd steps, we get the classification of landscape images based on color descriptor. On those resulted images, we perform matching based on shape and color structure that gives matching result in final step.

IV. RESULT AND ANALYSIS

In the evaluation of image retrieval systems, it also has calculated landscape image retrieval system. In this algorithm we are regarded as the two most important aspects and therefore both of them should be considered at the same time. In order to verify the retrieval effect of algorithm proposed in this paper, a great number of experiments on an image database are performed. The database holds 125 landscape color image which is composed of flower, tree, architecture of earth and lands. We are showing a table that show connected objects with maximum and minimum size of objects.

Some images are following that come from database.

Fig. 2

Table 1 show the comparison between images based on number of green color pixels and total value of green color in image.

IMAGES	NO. PIXELS IN GREEN COLOR	TOTAL GREEN COLOR VALUE
SCOTLAND	328	8359
LANDSCAPEIM1	14478	37563
LANDSCAPEIM2	4794	45790
NATURAL	2	20312
LANDSCAPEIM3	16205	40063
FLOWER	2507	5781
BUILDING	2718	21685

Fig 3 show the comparison analysis of different-2 images when apply DCD algorithm.

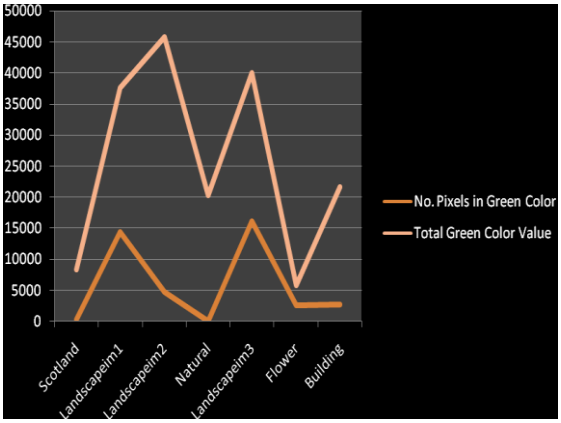


Fig. 3

Now we are showing the result of shape and color structure descriptor of some query images is given below in table 2.

Images	No. of objects	The number of pixels in the binary image	Maximum size of object
Scotland	65	2824	534
Landscapeim1	248	7111	863
Landscapeim2	165	11981	5280
Natural	309	1593	5065
Landscapeim3	115	4971	1342
Flower	51	4028	1127
Building	73	15105	6905

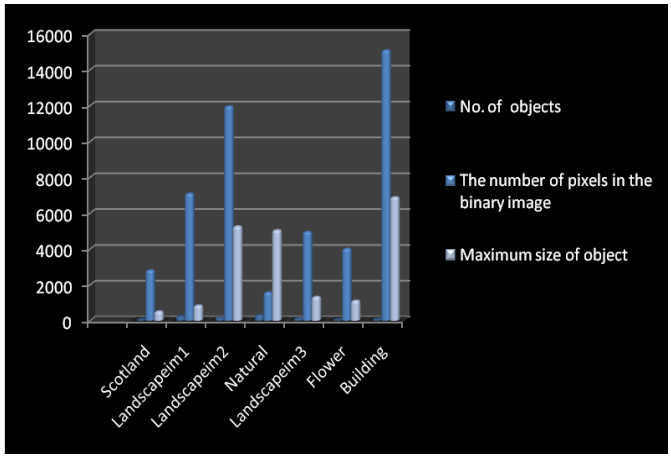


Fig. 4

Above Fig 4 represents the shape analysis of some images, for example Scotland, Landscape1, Landscape2, Natural etc and also produce the comparison between images. In above figure, three keys (No. of objects, the number of pixels in the binary image, Maximum size of object) apply on landscape images and get the similar images.

V. CONCLUSION AND FUTURE WORK

In our work, we propose an approach of landscape image classification and matching based on dominant color descriptor, color structure and contour shape descriptor. In DCD we find out dominant color of image on the basis of selecting same color pixels and overall particular color value. This step is called classification of the landscape image and then we use CSD and shape descriptor for image matching from pre-defined database.

Shape descriptor describes the shape of objects, size of the objects etc. for image objects matching and after we apply CSD for color and image structure matching. We can say that my approach is hybrid because this is adopting the key feature of DCD, CSD and contour shape.

It depends strongly on the quality and accuracy of the image classification and matching which allow deciding if an image is landscape or not.

In future we add some concept like DCT, movement invariant, MPEG-11 etc. for better image classification because it take very less time for color searching.

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