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Color, Shape and Texture feature extraction for Content Based Image Retrieval System: A Study

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Abstract: Content based image retrieval system is the most interested topic for researchers in these the three visual features are considered as color, shape and texture, these terms are refers as content in a content based image retrieval system. Although the visual features are not give accurate result but colour, shape and texture are used because they are easier to assimilate into mathematical calculation. Color, shape and texture are most widely used contents for content based image retrieval system. The goal of content based image retrieval system is that to retrieve query image from large database. Color shape and texture extracted feature for given query image and measure the similarity from database image and retrieve the similar images as a query image extraction features.

Keywords: Content Based Image Retrieval System.

I. INTRODUCTION

The content based image retrieval system is always compared with a textual search based image retrieval system but content based image retrieval system gives accurate result for retrieving database image as compared to textual based image retrieval system. The image containing large several types of visual content information which are difficult to extract and combine. There are different local and global extraction methods for color, shape and texture. The global methods consider complete image for global extraction feature with global color histogram and global histogram intersection and local extraction methods contains a portion of image for local image extraction feature with local color histogram [1].There are mostly three properties usually considered- color, shape, and texture.

Figure demonstrates a few illustration of content based image retrieval process. Neighbourhood elements can be focuses, additionally edges or small picture portions. Normally, a few estimations are taken from a district fixated on a nearby element and changed over into descriptors. The descriptor examines then utilized for different applications. There are several feature extraction methods and learning algorithms for content based image retrieval.

CBIR system consists of following three extraction methods [1]:-Color Feature Extraction, Shape Feature Extraction and Texture Feature Extraction.

Fig1 shows the architecture diagram of CBIR engine. CBIR engine retrieves similar images from large database system in which color shape and texture feature extraction methods are gives accurate result for retrieving image as a query image.

The query image is given by user is the input for image retrieval engine and output is similar images retrieved by the CBIR engine.

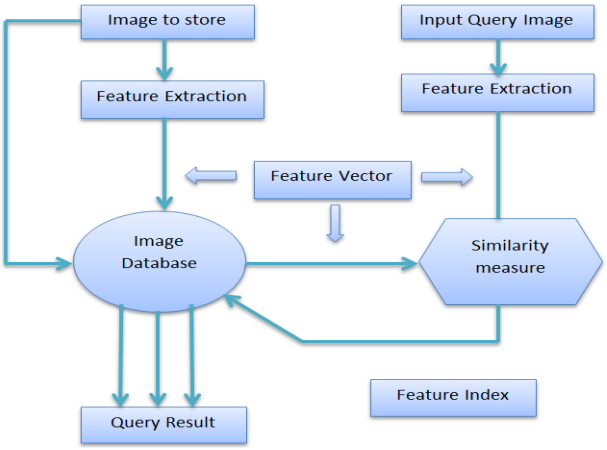

Fig 1 Content Based Image Retrieval Engine [2]

Feature extraction is done by three visual contents extraction methods, several image feature extraction methods are used for the color, shape and texture feature. The image database contains dataset of different types of images which having different types of color, shape and texture features and we have to extract that feature and stored that feature extraction matrix with that particular image and match that matrix with query image features matrix, when similarity measures match with database image then retrieve the particular image.

II. COLOR FEATURE EXTRACTION

Color space represents the color in the form of intensity value. We can specify, visualize and create the color by using color space method. There are different color feature extraction methods.

Color feature extraction methods:
a. Histogram Intersection Method[2]:
Histogram Intersection (HI) considers global color

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features. The duos of color histograms X and Y with k bins for each, HI is defined as,In Histogram Intersection method, the number of bins makes impact on performance. The large no of bins represent the image in very complex manner it increases the computational complexity.

b. Zernike Chromaticity Distribution Moments[2]:
It is derived from chromaticity space. This method gives fixed length and computation effective representation of an image which contains the color content of an image but, their size is invariant under rotation and flipping.

c. Color Histogram[2]:
Color histogram represents the image from different perspective. The image in which color bins of frequency distribution are represented by color histogram and it counts the pixels which are similar and store it. Color histogram analyzes every statistical color frequency in an image. The change occurred in the translation, rotation and angle of view these problems are solved by color histogram and also it focuses on individual parts of an image. The computation of local color histogram is easy and it is resistant to minor variations in the image so for indexing and retrieval of image database it is very important.

TABLEI COMPARISON BETWEEN DIFFERENT COLOR MODELS [3]

Models	Advantages	Disadvantages
RGB	1) Transformation is not required to display information on the screen, due to this reason it considered as the base color space for various applications. 2)It is used in video display because of its additive property	1) It is not useful for object specification and recognition of colors. 2) It is complex to determine specific color.
CMY(K)	It is commonly used for production printer color	It is subtractive model so inks are not give result as color.
HSV	HSV colors define easily by human perception not like CMY or RGB.	Hue points are sensitive to derivations because of the angular nature of the feature.

TABLE II RANK ORDER EVALUATION FOR TESTED COLOR SPACES [4]

Color space / No of Bins	Hsv 27	Hsv 166	rgb 27	rgb 64	rgb 125	lab 175
Average ranking	3,56	1,89	3,33	4,22	2,44	5,56

HSV color space is very effective and it retrieves the most similar images.

III.SHAPE FEATURE EXTRACTION [5]

Shape is main source of information which is used for object recognition. Without shape visual content object cannot be recognize properly. Image is incomplete without recognizing shape. The two objects cannot have exact same shape but by using various algorithms we can recognize similar shape easily. The main problem to recognize shape that the setting location the object shows different shape from different location, so it is measure problem to recognize the actual shape of the object.

Shape feature extraction methods:
a. Binary image algorithm[5]:
Binary image algorithm convert image into two color format i.e. black and white color format, then trace exterior boundary region of image and by applying shape factor shape of the image is recognized. Shape is calculated by shape factor, values of shape factor are considered as shown in table1.

$$\text{SHAPE FACTOR} = \frac{Area}{(Diameter)^2}$$

TABLE III SHAPE FACTOR

Sr. No.	Shape	Shape Factor
1	Circle	$0.7 \leq SF \leq 0.8$
2	Square	$0.484 \leq SF \leq 0.55$
3	Rectangle	$0.25 \leq SF \leq 0.3$
4	Triangle	$0.445 \leq SF \leq 0.483$
5	Oval	$0.32 \leq SF \leq 0.34$
6	Diamond	$0.36 \leq SF \leq 0.38$

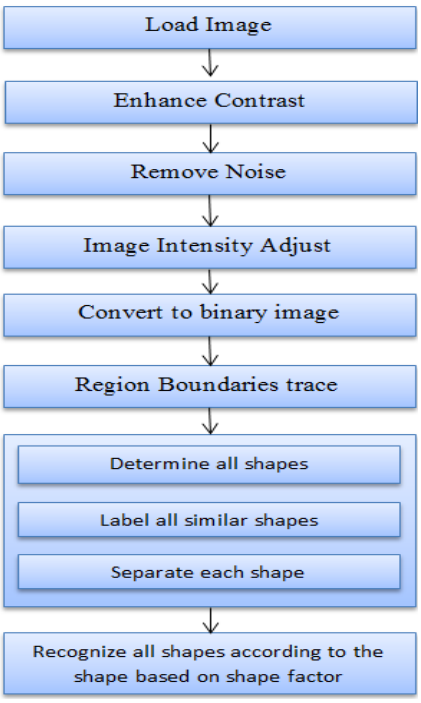

Fig. 3: Shape recognition algorithm [5].

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In these shape recognition algorithm when input is given as an image then load that image, contrast of the image is enhanced and image is converted into black and white format i.e. the image is converted into binary format. All boundary regions are traced and determine all shapes by applying shape factor then label all images and separate each shape from each other.

b. Horizontal and vertical segmentation[6]:
In an horizontal segmentation image is divided into horizontal segments and trace the coordinate points and determine the shape of object due to that sitting location problem of object cannot be occurred same as in an vertical segmentation image is divided into vertical segments and trace the coordinate axis points of the image according to the coordinate axis shape of the object accurately recognized.

Chain code method calculate the boundary of binary image, Area of an object represents the number of pixels resides within closed boundary of binary image and Horizontal and Vertical Distances are represented by calculating the distance between boundary lines.

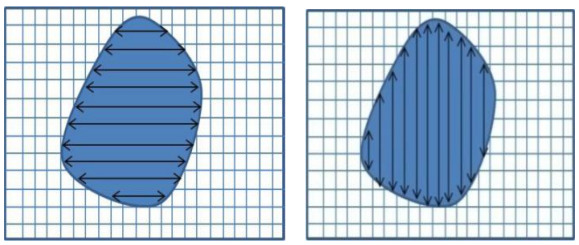

Fig 6: Horizontal and vertical distance calculation [6]

TABLE IV COMPARISON OF ACCURACY FOR DIFFERENT SHAPE EXTRACTION METHODS [6]

Descriptor	Accuracy (J48)	Accuracy (5NN)
Chain Method	50.8%	53.2%
Vertical Distance	51.2%	46.2%
Horizontal Distance	49.0%	52.6%
Area	57.4%	54.2%
Chain Method +Area	65.8%	67.8%
Chain Method +Area + Horizontal Distance	72.3%	69.7%
Chain Method +Area + Vertical Distance	62.5%	62.5%

Results in above table shows the combination of chain method, area and horizontal distance.

IV. TEXTURE FEATURE EXTRACTION

Texture contains significant information about the basic arrangement of the surface that is clouds, leaves, bricks, fabric etc. It also defines surface with environment relationship. Texture feature also describes the physical composition of surface. There are different methods of texture feature extraction

Texture feature extraction methods:
a. The Grey Level Co-occurrence Matrix[7] :
The Grey Level Co-occurrence Matrix Is Statistical approach. Texture features are calculated from the statistical distribution. This method is a technique of extracting subsequent order statistical texture features. The elements of matrix represent the relative frequency. This method describes texture by creating statistics of the dispersal of intensity values as well as location and orientation of similar valued pixel [4].
Formula to calculate grey level co-occurrence for single pixel-

$$M_{CO} = \sum_{x=1}^{K}\sum_{y=1}^{K} \begin{cases} 1, \text{if } I(x,y) = i \text{ and } I(x+d_x, y+d_y) = j \\ 0, \text{Otherwise} \end{cases} \leq$$

b. Edge Detection[7]:
Edge detection method determine the texture complexity by using the edge pixels in specified region, the edgeless per unit area is calculated as

$$F_{edgeness} = \frac{|\{p \mid Mag(p) > T\}|}{N}$$

Where,
N= region with N pixels.
Mag(p)= gradient magnitude.
Dir(p)=gradient direction.

c. Laws Texture Energy Measures[7]:
For detecting various types of textures it uses local masks. To compute the energy of texture it uses convolution masks of 5×5 which is represented by a nine element vector for each pixel

V. CONCLUSION

Here we are studied some content based image retrieval methods in which we are studied some algorithms.

Table II shows the color space, no of bins and average ranking. For smaller histogram it gives best result. HSV color space is very effective and it retrieves the most similar images. It increases the search speed of the system[4]. HSV color space is close to human visual perception and hue component is more dominant than saturation and value component so for color feature extraction HSV is best than other color spaces [6].

Results in table IV shows the combination of chain method, area and horizontal distance has maximum accuracy level compared to other methods for each algorithm [6] so, for shape feature extraction Horizontal and Vertical Segmentation method is finest.

The Grey Level Co-occurrence Matrix method describes texture by creating statistics of the dispersal of intensity values as well as location and orientation of similar valued pixel [6], so for texture feature extraction this method gives best result than other methods.

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