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Image retrieval using interactive genetic algorithm

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Abstract:Image retrieval based on colour and textureis a wide area of research scope.It is hard to retrieve certain images from all available ones. An interactive image retrieval system, which firstly uses histogram feature and then HSV (Hue, Saturation,Value) colour space, in which the work of colour feature extraction, the process is as follows: quantifying the colour spacein non-equal intervals, constructing one-dimension featurevector for query and all database images and then finding distance between them.Texture feature extraction is obtained by using gray-level co-occurrence matrix (GLCM) andcolour co-variance matrix (CCM) where manhattan distance is calculated and then colourglcm and colourccm is evaluated by using the normalised form of Euclidean distance. Finally,in genetic algorithm, considere the fitness function and combinecolourglcm and colourccm. Through this experiment, the results obtained from the method of genetic algorithm are better compared to the HSV colour space.

I. INTRODUCTION:

Now a days image retrieval has increased very tremendously in many application areas such as biomedicine, military, commerce, entertainment, journalism and education. Content-based image retrieval (CBIR), is called as query by image content (QBIC).Content-based image retrieval(CBIR) is the retrieval of image that purely based on visual features, likecolour, texture,features and shape."Content-based" means that the search analyses and the contents of the image rather than the information which provided in data such as keywords, tags, or descriptions associated with the image. The term "content" is refer as colours, shapes, textures, or any other information that can be derived from the image itself. Content-based image retrieval is opposed to traditional concept-based approaches.

We cannot obtain a good solution for accuracy and efficiency if we consider single feature in case of image retrieval.There are two types of dimensional features in image retrieval.They are High dimensional feature and Low dimensional feature High-dimensional feature used to reduced the query efficiency and low-dimensional feature used to reduced the query accuracy so, it isconsidered as a better way by using multi features for image retrieval. Human eye is able in perceiving the image which is a combination of primary parts (color, texture, shape). Therefore, our approach is oriented used to find out some of the possibilities to create a robust low-level descriptors is by combination of these primary parts of image,colour and texture are the most important visual features.

II. LITERATURE:

Researchers have proposed different methods to improve the system of image retrieval. Very first they have introduced keyword based image retrieval then they have introduced content based image retrieval. In keyword based image retrieval, images are indexed using keywords, which means keywords are stored in database. During query stage, user will input keyword or keywords which constitute the search criteria. A keyword matchprocessing is then performed to retrieve images associated with the keywords that used as retrieval keys during search and retrieval. Before images are being stored in the database, they are examined manually and assigned keywords that are most appropriate to describe their contents. Then these keywords match the search criteria.

In content based image retrieval, images are indexed using its features like colour feature, texture feature and shape feature. Before images are being stored in the database, they are examined and features are extracted from the images. Parameters of these features are stored in database. During query stage, user will input image which constitute the search criteria. Features matching process is then performed to retrieve images associated with the features that match the search criteria. Images are widely used nowadays. It has the advantage of visual representation and it is usually adopted to express other mediums. With the rapid development of computers and networks, the storage and transmission of a large number of images become possible. Instead of text retrieval, image retrieval is wildly required in recent decades. Content-based image retrieval (CBIR) is regarded as one of the most effective ways of accessing visual data. The most commonly used low-level features include those reflecting color, texture, shape, and salient points in an image .Because of the robustness, effectiveness, implementation simplicity and low storage requirements advantages, colour has been the most effective feature and almost all CBIR systems employ colours. HSV or CIE Lab and LUV spaces are used to represent colour instead of the RGB space as they are much better with respect to human perception. Generally, the distribution of colour was represented by colour histograms and formed the images' feature vectors. Shape, texture and spatial features etc. were adopted to improve the colour based CBIR as different 9 images may have similar or identical colour histograms and images taken under different ambient lighting may produce different histograms. The texture feature is another wildly used feature in CBIR, which intended to capture the granularity and repetitive patterns of surfaces within an image. In the MPEG-7 standard, a set of colour and texture descriptors including histogram-based descriptors, images .The most practical CBIR system constructed is based on the colour, shape, texture and other low-level features.

Guiying Li defined texture is a repeated pattern of information or arrangement of the structure with regular intervals. In a general sense, texture refers to surface characteristics and appearance of an object given by the size, shape, density, arrangement, proportion of its elementary parts. A basic stage to collect such features through texture analysis process is called as texture feature extraction. Due to the signification of texture information, texture feature extraction is a key function in various image processing applications like remote sensing, medical imaging and content based image retrieval. Neville discussed texture features can be extracted using several methods such as statistical, structural, model-based and transform information. Some previous research works compared texture analysis methods; Dulyakarn compared each texture image and Fourier spectra, in the classification. Maillard performed comparison works between GLCM, semi-variogram, and Fourier spectra at the same purpose. Bharati et al. (2004) studied comparison work of GLCM, wavelet texture analysis, and multivariate statistical analysis based on PCA (Principle Component Analysis). In those works, GLCM is suggested as the effective texture analysis schemes. Monika Sharma e discussed GLCM is applicable for different texture feature analysis. Statistical methods use second order statistics to model the relationships between pixels within the region by constructing Spatial Gray Level Dependency (SGLD) matrices. A SGLD matrix is the joint probability occurrence of gray levels i and j for two pixels with a defined spatial relationship in an image. The spatial relationship is defined in terms of distance, d and angle.

In 1973, Haralick introduced the co-occurrence matrix and texture features which are the most popular second order statistical features today. Haralick proposed two steps for texture feature extraction. First step is computing the co-occurrence matrix and the second step is calculating texture feature based on the co-occurrence matrix. This technique is useful in wide range of image analysis applications from biomedical to remote sensing techniques.Haralick extracted 10 thirteen texture features from GLCM for an image. The important texture features for classifying the image into water body and non-water body are Energy (E), Entropy (Ent), Contrast (Con), Inverse Difference Moment (IDM) and Directional Moment (DM). 104 Andrea Baraldi and Flavio Parmiggiani (1995) discussed the five statistical parameter energy, entropy, contrast, IDM and DM, which are considered the most relevant among the 14 originally texture features proposed by Haralick et al. (1973). The complexity of the algorithm also reduced by using these texture features.

III. PROPOSED METHODOLOGY:

3.1 Feature extraction of HSV color:

HSV means HUE, SATURATION and VALUE.Hue is attribute of a visual sensation.Saturation is a colorfulness of a stimulus relative to its brightness.and Value is about brightness of image.The color space is widely used in computer graphics, visualization in scientific computing and other fields. In this space, hue is used to distinguish colors, saturation is the percentage of white light added to a pure color and value is which refers to the perceived light intensity. The advantage of HSV color space is that it is closer to human conceptualunderstanding of colors and has the abilityto separate chromatic and achromatic components.

3.2 Non-interval quantization:

Because of a wide range of each component, if we directly calculate the characteristics for retrieval, then computation is very difficult to ensure the rapid retrieval. It is essential to quantify HSV space components refer to reduce the computation and improve efficiency. At the same time, the human eye to distinguish the colors is limited, do not need to calculate all segments. Unequal interval quantization according the human color perception has been applied on H, S ,V components. Based on the color model of substantial analysis, we

divide color into eight parts. Saturation and intensity is divided into three parts separately in accordance with the human eyes to distinguish. In accordance with the different colors and subjective color perception quantification, quantified hue(H), saturation(S) and value(V) are showed as equation (3). In accordance with the quantization level above, the H, S, V three-dimensional feature vector for different values with different weight to form one-dimensional feature vector named

$$G = Q_S Q_V H + Q_V S + V \quad (1)$$

Where Q_S is quantified series of S, Q_V is quantified series of V.

Here we set QS= QV=4, then
G = 16H + 4S +V-- (2)

$$H=\begin{cases}0 \text{ if } h\in[316,20]\\1 \text{ if } h\in[21,40]\\2 \text{ if } h\in[41,75]\\3 \text{ if } h\in[76,155]\\4 \text{ if } h\in[156,190]\\5 \text{ if } h\in[191,270]\\6 \text{ if } h\in[271,295]\\7 \text{ if } h\in[296,315]\end{cases} \quad S=\begin{cases}0 \text{ if } s\in[0,0.2)\\1 \text{ if } s\in[0.2,0.7)\\2 \text{ if } s\in[0.7,1)\end{cases} \quad V=\begin{cases}0 \text{ if } v\in[0,0.2)\\1 \text{ if } v\in[0.2,0.7)\\2 \text{ if } v\in[0.7,1)\end{cases}$$

(3) (2)

In this way, three-component vector of HSV form one-dimensional vector, which quantize the whole color space for the 72 kinds of main colors. So we can handle 72 bins of one-dimensional histogram. This quantification can be effective in reducing the images by the effects of light intensity, but also reducing the computational time and complexity.

IV. TEXTURE FEATURE EXTRACTION:

4.1. Texture feature extraction based on GLCM:

GLCM creates a matrix with the directions and distances between pixels, and then extracts meaningful statistics from the matrix as texture features. GLCM texture features commonly used are shown in the following:

The GLCM expresses the texture feature according to the correlation of the couple pixels gray-level at different positions. It quantificationally describes there texture feature. In this paper,we can see four features is there are energy(E), contrast(I), entropy(S), inverse difference(H) are given as follows:

$$E=\sum_x \sum_y p(x,y)^2 \text{---------------------------------}(4)$$

It is a gray-scale image texture measure of homogeneity changing, reflecting the distribution of image gray-scale uniformity of weight and texture.

$$I=\sum \sum (x-y)^2 p(x,y) \text{-----------------------------}(5)$$

Contrast is the main diagonal near the moment of inertia, which measure the value of the matrix is distributed and images of local changes in number, reflecting the image clarity and texture of shadow depth. Contrast is large means texture is deeper.

$$S= -\sum_x \sum_y p(x,y) \log p(x,y) \text{---------------------}(6)$$

Entropy used to measuresthe image texture randomness, when the space co-occurrence matrix for all values are equal, then we can say that its a minimum value; on the other hand, we can seen the value of co-occurrence matrix is very uneven, then the value is greater. Therefore, the maximum entropy implied by its image gray distribution is random.

$$H=\sum_x \sum_y \frac{1}{1+(x-y)^2} p(x,y) \text{--------------------}(7)$$

It is used to measures the local changes in image texture number. Its value are large and illustrated that image texture in between the different regions of the lack of change and partial very evenly. Herep(x, y) is the gray-level value at thecoordinate (x, y) .

To create a GLCM, use the grayco-matrixfunction. The function creates a gray-level co-occurrence matrix (GLCM) by calculating how often a pixel with the intensity (gray-level) value i occurs in a specific spatial relationship to a pixel with the value j. By default, the spatial relationship is defined as the pixel of interest and the pixel to its immediate right (horizontally adjacent), but you can specify other spatial relationships between the two pixels. Each element (i,j) in the resultant glcm is simply the sum of the number of times that the pixel with value i occurred in the specified spatial relationship to a pixel with value j in the input image. Because the processing required to calculate a GLCM for the full dynamic range of an image is prohibitive, gray comatrix scales the input image. By default from 256 to eight. The number of gray levels determines the size of the GLCM. To c, graycomatrix uses scaling to reduce the number of intensity values in grayscale image control the number of gray levels in the GLCM and the scaling of intensity values, using the NumLevels and the GrayLimits parameters of the graycomatrix function.To illustrate, the following figure shows how grayco-matrix calculates the first three values in a GLCM. In the output GLCM, element (1,1) contains the value 1 because there is only one instance in the input image where two horizontally adjacent pixels have the values 1 and 1, respectively. glcm(1,2) contains the value 2 because there are two instances where two horizontally adjacent pixels have the values 1 and 2. Element (1,3) in the GLCM has the value 0 because there are no instances of two horizontally adjacent pixels with the values 1.Grayco-matrix continues processing the input image, scanning the image for other pixel pairs(i,j) and recording the sums in the corresponding elements of the GLCM.

Figure 1: GLCM

GLCM creates a matrix with the directions and distances between pixels, and then extracts meaningful statistics from the matrix as texture features. GLCM expresses the texture feature.

V. ALGORITHM:

[1] Take a query image, convert it to a grayimage .
[2] Convert rgbcolours in query image to hsv and then decompose them by applying three levels of discrete wavelet transform using haar wavelet.
[3] Form one-dimensional vector from three-component vector of hsv, which quantize the whole colour space for the 72 kinds of main colours.
[4] Pick one database image, convert it into a gray image and perform steps [2, 3].
[5] Now, find the difference of absolute values of one-dimensional vectors obtained from query and database images.
[6] Perform the steps[4,5] for all database images and then sort the results in an ascending order.
[7] Compute gray level co-occurrence matrix from the query imagewhich contains statistical information about pixels that having similar gray level valuesand calculate the statistic features energy, contrast, entropy and inverse difference.
[8] Repeat the steps[7] for all the images that are present in the database, find the manhattan distance between of query and database images and sort the results in ascending order.
[9] Compute color covariance matrix from the query image which provides spatial correlation of pair of colors and calculate the statistic features energy, contrast, entropy and inverse difference for red, green, hue and value.
[10] Repeat the step[9] for all the images that are present in the database, find the manhattan distance between of query and database images and sort the results in ascending order.
[11] Evaluate thecolorglcm and colorccmsame as glcm and ccm, finally calculate distances for both colorglcm and color ccm. Sort the results in the ascending order.
[12] Evaluategenetic algorithm by considering the color, texture and fitness function, which gives the information about the better quality of all the proposed solutions.

VI. RESULTS AND ANALYSIS:

6.1 Introduction to GUI:

The graphical user interface (GUI), is a type of user interface that allows users to interact with electronic devices through graphical icons and visual indicators such as secondary notation, instead of text-based user interfaces, typed command labels or text navigation. GUIs were introduced in reaction to the perceived steep learning curve of command-line interfaces (CLIs), which require commands to be typed on a computer keyboard. The actions in a GUI are usually performed through direct manipulation of the graphical elements. Beyond computers, GUIs are used in many handheld mobile devices such as MP3 players, portable media players, gaming devices, smartphones and smaller household, office and industrial controls. The term GUI tends not to be applied to other lower-display resolution types of interfaces, such as video games(where head-up display (HUD) is preferred), or not including flat screens, like volumetric displays because the term is restricted to the scope of two-dimensional display screens able to describe generic information, in the tradition of the computer science research at the Xerox Palo Alto Research Center.

6.2 Advantages of graphical user interface:-

• Easiness for non-technical people: For non-technical people or for beginners good GUI's tends to make easiness in life.

For example with few clicks on buttons user can easily make his work done. Software in shops for calculation of products sold and inventory can be better managed by an even non-technical guy. Similarly listening songs in the car is easy for everyone.

• Drag and drop feature:- In most of the software, we have drag and drop functionality by which complex tasks are managed easily. Like dragging and dropping folders. And in mobile games, it is also nice to use. In much graphical software, drag and drop are awesome.

• Looks nicer than text interface:- In text interface, we have limited options to choose from and navigation is difficult. For non-educated people, text interface is difficult to understand and use. In GUI user can use any tool by detecting symbols or buttons.

• Hotkeys usage:- Sometimes we want a couple of functionality performed by single click then we use hotkeys. Like we see some buttons or mouse clicks/movements by which a couple of actions performed. This is very handy for speeding up tasks.

• User-friendly:- A user can easily navigate to the system without knowing a lot of details. Easy setup and ready to start working are awesome. Most of the software hides the complexity of actions from the users and display only required information is key to good interface.

• Disabled people:- In modern science, we can detect eyes movement and finger movement which is helpful for disabled people. Now, most of the software use this functionality to make life easier for disabled people. They can use software and websites easily with a few actions.

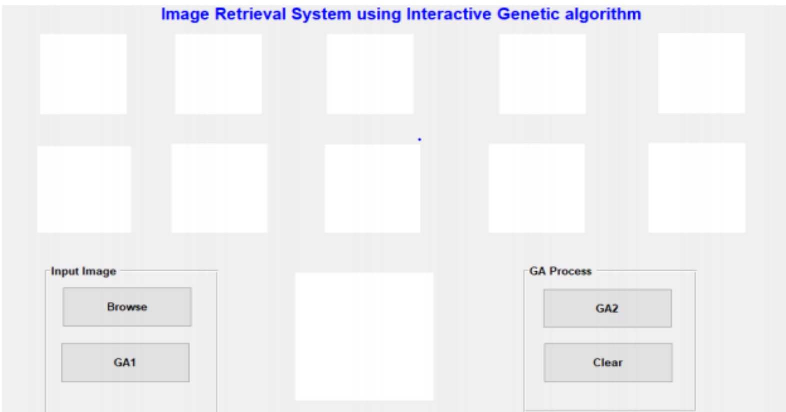

Figure 2: GUI used in our project

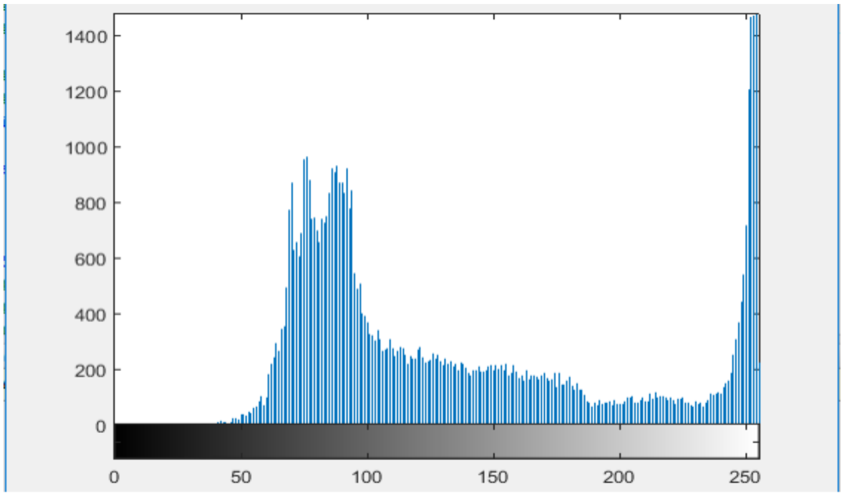

Figure 3: Histogram of a query image after converted into gray

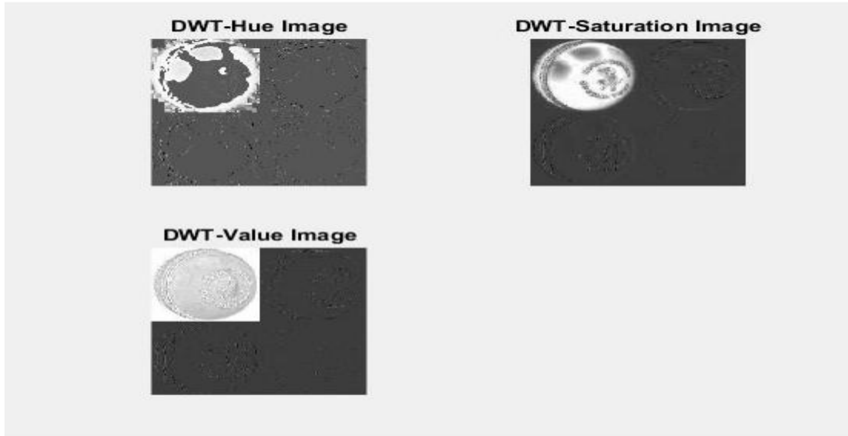

Figure 4: DWT images of Hue, Saturation and Value

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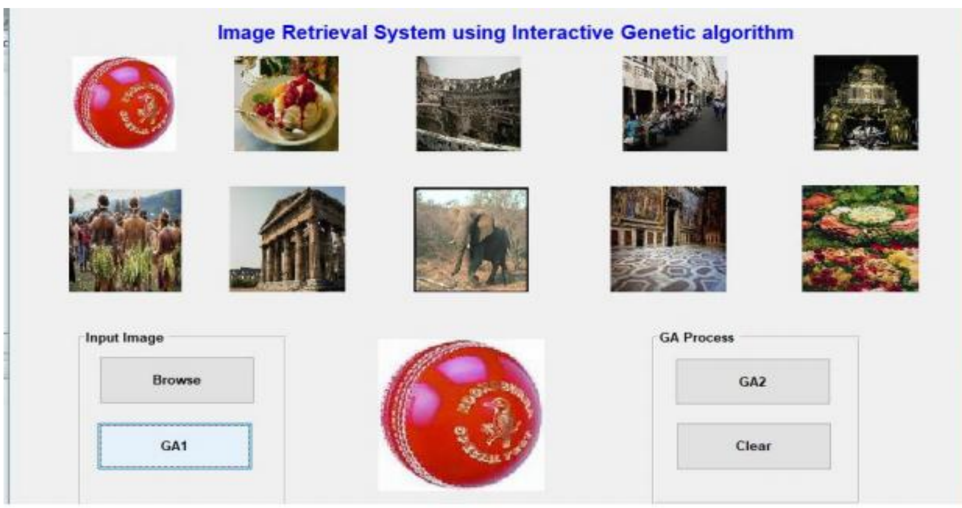

Figure 5: results of colour feature extracted images

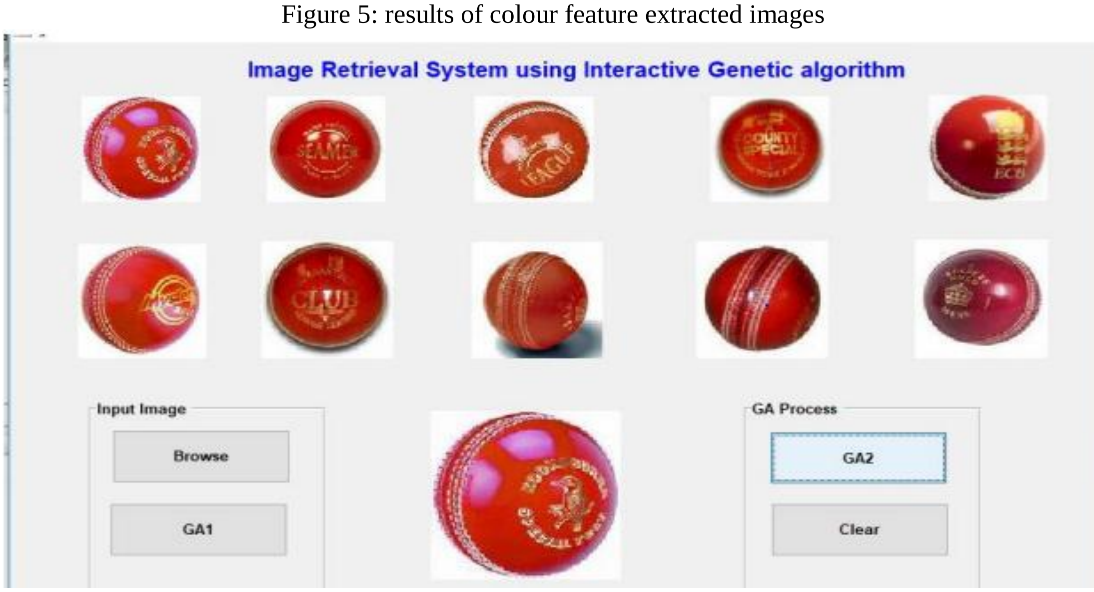

Figure 6: Results of Genetic algorithm

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VII. CONCLUSION:

This paper presents an approach for the image retrieval through the quantification of HSV colour space. Also, colourgray-level co-occurrence matrix and colourccm are evaluated using normalised Euclidean distance. In this paper, we proposed an algorithm named genetic algorithm, where the combination of texture feature from colourgray-level co-occurrence matrix and colour feature from colourccm is used for getting better results compared to the HSV colour space.

VIII. REFERENCES

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