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Flower Image Retrieval Based on Itty Model

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***Abstract*—Content based Image Retrieval is a growing topic under image processing. The main purpose of CBIR System is to help users to retrieve revelent images based on their contents using several feature extraction technique such as color, texture and shape using saliency map. In this paper various extracting methods are discussed, analyzed and compared. To extract the color feature from the image the color moment will be used. To extract texture feature, the image will be in gray-scale and Gabor filter is performed on it. To extract Shape feature Zernike moment and Fourier Descriptor are used.**

***Index Terms*—CBIR, Flower Image Retrieval, Feature extraction, Saliency Map**

I. INTRODUCTION

Information retrieval (IR) is finding material (usually documents or Images) of an unstructured nature (usually text) that satisfies an information need from within large collections (usually stored on computers).More specially, when the retrieved information is a collection of images, this field of knowledge is call Image Retrieval [1].

Image retrieval is a computer system for searching, browsing and retrieving digital images from database collection. This area of research is very active research since the 1970s [2]. Due to rapid advancement of information technology image retrieval for digital image has drastically [3]. That's why image retrieval has become important research topic nowadays by researchers.

The main aim of an image database is to store and retrieve an image or image sequences that are relevant to a query. Image retrieval systems categorized as image retrieval research and development and it has two approaches text-based information retrieval (TBIR) and content based image retrieval (CBIR).Text-based concept is by mean of image annotation information given for the images, or the keyword actions used for searching such images are the technique used for image retrieval process [3].

The saliency map combines information from each of the feature maps into a global measure where points corresponding to one location in a feature map project to single units in the saliency map. Saliency at a given location is determined by the degree of difference between that location and its surround [25].

In image retrieval research, researchers are moving from keyword based, to content based then towards semantic based image retrieval and the main problem encountered in the content based image retrieval research is the semantic gap between the low-level feature representing and high-level semantics in the images [3].

A. Keyword Based Image Retrieval

In the 1970s, the Keyword Based Image Retrieval system used keyword as descriptors to index an image [1]. In Fig.1General Framework of keyword based image retrieval is show.

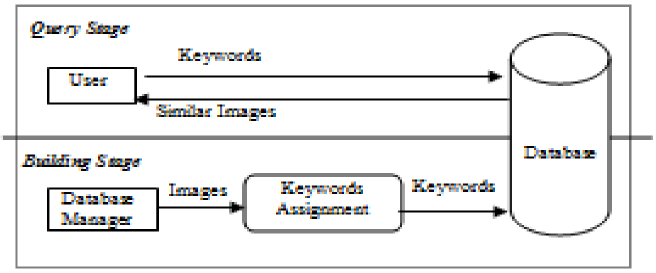

Fig.1 General Framework of Keyword Based Image Retrieval [2].

In this method images are stored in the database then they are examined manually and assigned keywords that are most appropriate to describe their contents. The Keyword which stored in the database, are stored as the part of the attributes associated to the image. During query stage, the image retrieval system will accept from the user one or many keywords which constitute the search criteria. A keyword matching process is then performed to retrieve images associated with the keywords that match the search criteria.

B. Content Based Image Retrieval

Content-based image retrieval plays a central role in the application areas such as multimedia database system in recent years. The work focused on using low-level features like color, texture and shape for image representation. In CBIR each image that is stored in the database has its features extracted and compared to the features of the query image [8].it divided in two steps.

1. Feature Extraction:
   In this step, process is to extract the image feature to a distinguishable extent[8].
2. Matching:
   The second step involves matching these features to yield a result that is visually similar [8].

The major aim of the CBIR system is to construct meaningful description of physical attributes from images to facilitate efficient and effective retrieval [3].

Fig.2 has shown the block diagram of the content based image retrieval.

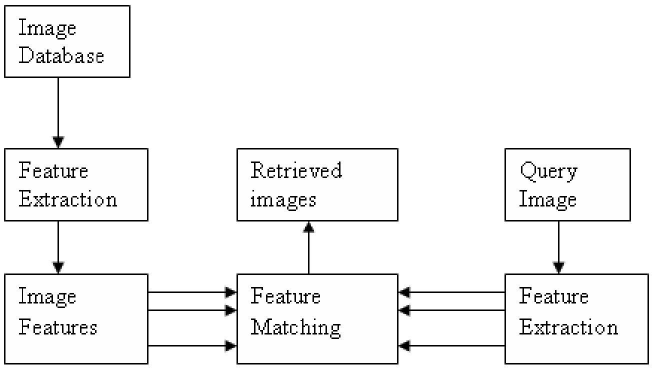

Fig.2 Block Diagram of Content Based Image Retrieval [8]

II. FEATURE EXTRACTION TECHNIQUES

Visual feature extraction is the basis of any content-based image retrieval technique. In this two features are include as text-based feature and visual feature. Visual feature can be further classified as low-level features and high-level features [1].Content based indexing low-level feature like color, shape and texture are used for indexing and retrieving images.All those features are describe below.

A. COLOR

The color is important feature that construct feasible the establishing of images. Color is a property that depends on the contemplation of light to the eye and processing of that information by brain [4].color are defined in three dimensional color spaces such as RGB, HSV, and HSB. A color has three values per pixel and they measure intensity and chrominance of light, The actual information stored in the digital image data is the brightness information in each spectral band, Quantization in term of color histograms refer to the process of reducing the number of bins by taking colors that are very similar to each other and putting them in same bins[4].

Many methods can be used for the description of color features. They are Color Histogram, Color Moment Conventional Color Histogram, Invariant Color Histogram, Fuzzy Color Histogram, Geometric Moment, Average RGB, Color Moment, Color Correlogram, and Color Coherence Vector.

I. COLOR HITOGRAM

The main method of representing color information of images in CBIR is through color histograms. A color histogram is a type of bar graph, where each bar represents a particular color of a color space being used. The most common form of the histogram is obtained by splitting the range of the data into equally sized bins. then for each bins, the number the color of the pixels in an image that fall into each bin are counted and normalized to total points, which gives as the probability of a pixel falling into that bin[1].

A color histogram for a given image is defined as a vector [5]:

$$H=\{H[1],H[2],H[3],H[4],\ldots\ldots.H[i],\ldots\ldots H[n]\}$$

Where i represents the color bin in the color histogram and $H[i]$ represents the number of pixels of color i in the image, and n is the total number of bins used in the color histogram [5]. Every pixel in an image must be assigning a bin of a color histogram of that image. In order to compare images of different sizes, color histograms should be normalized [5]. The normalized color histogram is defined as: H'

$$H' = \{H'[1],H'[2],H'[3],H'[4],\ldots\ldots H'[i],\ldots\ldots H'[n]\}$$

Where, $H'= H[i]/p$, p is the total number of pixels of image. However, color histogram has its own drawbacks. If two images have exactly the same color proportion but the colors are scattered differently, then we can't retrieve correct images [5].

II. CONVENTIONAL COLOR HISTOGRAM

The approach used for the CBIR system is depend on the conventional color histogram(CCH),which contains occurrence of each color obtained counting all image pixels having that color. Each pixel is associated to a specific histogram bin only on the basis of its own color, and color similarity across different bins or color dissimilarity in the same bin are not taken into account [8].All the pixel in the image can be described by three component in a certain color space those are RGB and HSV[8].

Quantization in term of color histograms refers to the process of reducing the number of bins by taking colors that are very similar to each other putting them in same bin[8].256 is the maximum number of bins one can obtain using the histogram function.[8].

CCH is sensitive to noisy interferences such as illumination changes and quantization errors. it does not take into consideration color similarity across different bins and cannot handle translation and rotation[8].to solve this problem invariant color histogram is used.

III. INVARIANT COLOR HISTOGRAM

Color histograms have been widely used for object recognition. Though in practice these histograms often vary slowly under changes in viewpoint, it is clear that the color histogram generated from an image surface is intimately tied up with the geometry of that surface, and the viewing position [8].The Invariant Color Histogram is developed to create a color histogram with using color gradient and its invariant under any mapping of the surface which is *locally* affine and so that a very wide class of viewpoint changes [8].

IV. FUZZY COLOR HISTOGRAM

The classic histogram is a global statical feature, which describes the intensity distribution for a given image. The main advantage is that it is fast to manipulate, store and compare and insensitive to rotation and scale [8].

In the fuzzy color histogram color space is divided into a number of bins and then counting the number of pixels of image that related to each bin. The number of region that the color space is divided into quite large and thus the colors represented by near region have relatively small differences and due to this color problem arise. Image which are similar to each other but have small difference contain noise will produce histograms with dissimilar adjacent bins and vice versa due to the small distance that the regions are separated from each other [8].

L*a*b* color space into a single histogram by means of a fuzzy expert system. The a* and b* components are considered to have more weight than L* as it is mostly the combination of the two which provides the color information of an image [8]. The L*a*b* color space was selected because it is a perceptually uniform color space which approximates the way that humans perceive color. In L*a*b*, L* stands for luminance, a* represents relative greenness-redness and b* represents relative blueness-yellowness [8]. All colors and grey levels can be expressed throughout a combination of the three components. However, L* does not contribute in providing any unique color but for shades of colors, white, black and grey. Thus, the L* component receives a lower weight with respect to the other two components of the triplet [8].

V. AVERAGE RGB

Average RGB is used to filter out images with larger distance at first stage when multiple feature queries are involved [7]. It uses a small number of data to represent the feature vector and it also uses less computation as compared to others that’s why this feature is used. However, the accuracies of query result could be significantly impact if this feature is not combined with other features [7].

B. TEXTURE

The texture is a low-level features for image search and retrieval application same as color and shape. There is no unique definition for texture; however, an encapsulating scientific definition stated as, “Texture is an attribute representing the spatial arrangement of the grey level s of the pixels in a region of image” [17].Texture representation methods are classified into two main categories:1) structural and 2)statistical. Structural methods, including morphological operator and adjacency graph, describe texture by indentifying structural primaries and their rules[4].statistical methods, including Tamura feature, shift-invariant principal component analysis(SPCA),Fourier power spectra,Wold decomposition,co-occurrence matrices[4].The common Technique are used for texture feature extraction such as Discrete Wavelet Transform, Gabor -filter, co-occurrence matrices, Ranklet Transform, Haar Discrete Wavelet Transforms, Fourier Transform, discrete cosine transform, Hadamard Transform, Gaussian Pyramid, Laplacian Pyramid, Gabor Filter.

I. DISCRETE WAVELET TRANSFORM

Discrete Wavelet Transform (DWT) is applied on derived CBDIP and CBVLC. The simplest wavelet form among the wavelets, Haar wavelet is used here[15].Four sub bands of 3 level decomposition are shown in Fig.3.Figure shows the DWT process on CBDIP and CBVLC images for which steps are given below[15].

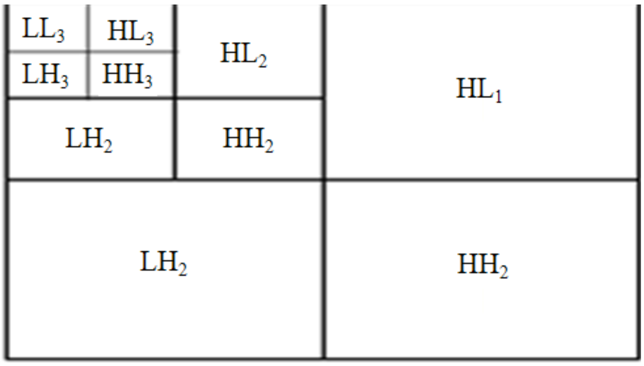

Fig.3 of Level decomposition [15].

For each CBDIP and CBVLC Image [15]:

Step 1: Decompose the image into 4 sub bands LL, LH, HL and HH using Haar Wavelet. As per the wavelet procedure, the original image fits intothe LL sub band and the remaining sub bands acts as detail matrices[15].

Step 2: Calculate Mean (μ) and Standard Deviation (σ) for the 4 sub bands as following Equation [15]:

$$\mu_m^n = \frac{1}{N_{mn}} \sum_{(i,j)\in W_m^n} W_m^n(i,j)$$

$$\sigma_m^n = \sqrt{\frac{1}{N_{mn}} \sum_{(i,j)\in W_m^n} (W_m^n(i,j) - \mu_m^n)^2}$$

Where, n and m denote decomposition level and sub band orientation respectively, N_{mn} is the number of coefficient in the mn_{th} sub band , W_m^n (i, j) the intensity of a pixel (i,j) in the sub band image and are the mean and standard deviation of absolute values of coefficients in the mn_{th} sub band respectively [15]:

Step 3: Repeat step 1 and step 2 till the decomposition Level reaches 3. (At each level, decomposition takes places only on LL sub band).For level 1 decomposition, three high band images$W_1HL(i,j)$, $W_1LH(i,j)$ and $W_1HH(i,j)$ denotes horizontal, vertical and diagonal orientations Respectively and the original image fits into $W_1LL(i,j)$.similarly sub bands are depicted at each level of decomposition [15].

II. GABOR WAVELET TRANSFORM

Gabor wavelet transform is the technique used for multichannel, multi-resolution analysis of the image which represents image variations at different scales. Gabor filters are a group of wavelets obtained from the appropriate dilation and rotation of Gabor function: a Gaussian modulated sinusoid [18]. Gabor filter having many of methods or techniques for image texture retrieval which is good in content based image retrieval application because of many reason. Being well suited for image signal expression and representation in both space and frequency domains.

- Presenting high similarity with human visual system as stated above.
- Offering the capacity for edge and straight line detection with variable orientations and scales.
- Not being sensitive to lighting conditions of the image [18].

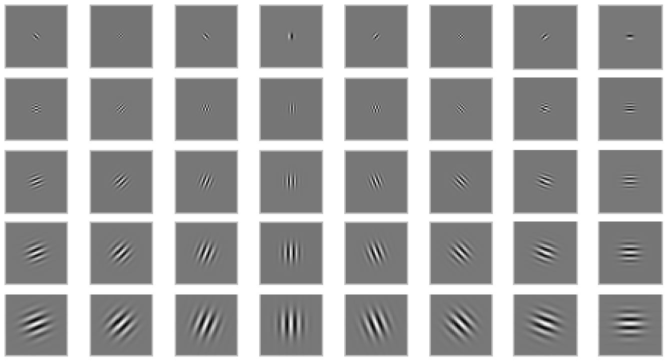

Fig. 4. A set of real impulse responses: multiscale, multi-orientation Gabor wavelet filters [18]

Gabor wavelet representation is suffer from some weaknesses such as their costly computational complexity. It has non invariance to rotation as well as the non orthogonal property of the Gabor filters that implies redundancy in the filtered images [18].

III. LOCAL BINARY PATTERN

The original version of the local binary pattern operator works in a 3 × 3 pixel block of an image. The pixels in this block are threshold by its center pixel value, multiplied by powers of two and then summed to obtain a label for the center pixel. As the neighborhood consists of 8 pixels, a total of 28 = 256 different labels can be obtained depending on the relative gray values of the center and the pixels in the neighborhood.

LBP (local binary pattern) is an operator which describes the image texture feature based on gray level. It represents the local texture by the grey levels' quantitative relation between any pixel and its surrounding pixels. Setting a sampling radius R and sampling point numbers P, creating a cirque centered at the core pixel with radius R, and uniform sampling P pixels on the circle.

IV. GAUSSIAN PYRAMID

To extract features and remove noise form image, the Gaussian pyramid is used. It is also used to decompose images into information at multiple scales. The Gaussian pyramid consists of low-pass filtered, down-sampled version of the previous level of the pyramid, where the base level is defined as the original image. Fig. 6 shows the decomposition of an image into its Gaussian Pyramid representation [12].

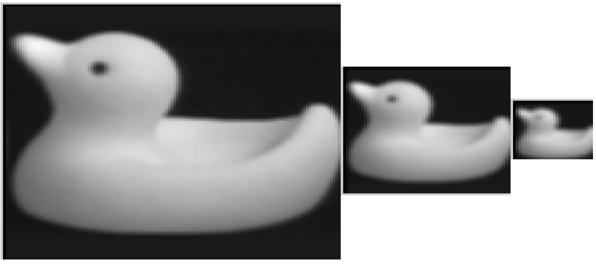

Fig.5. Gaussian pyramid decomposition

V. LAPLACIAN PYRAMID

The Laplacian Pyramid is describe as the decomposition of the original image into a hierarchy of images. Fig. 7 shows the decomposition of an image into its Laplacian Pyramid representation. The original image is at the upper left corner. The images immediately below and to the right of the original image are the coarse and detail signal respectively resulting from the first level of decomposition of the original image. The images adjacent to and below the coarse signal of the first level of decomposition are the detail and coarse signals respectively of the second level of decomposition [12].

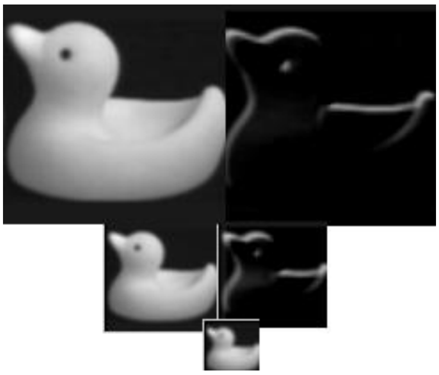

Fig.6. Laplacian Pyramid Decomposition

C. SHAPE

Shape is one of the most important visual feature in image retrieval processes. For describe image content the basic feature Shape is used. When a 3-D real world object is projected onto a 2-D image plane, one dimension of object information is lost that's why Representation and description of Shape is a difficult task. As a result, the extracted image is only partially represents the projected object. For making the problem more difficult, shape is often corrupted with noise, defects, arbitrary distortion and occlusion. As a result, shape properties play an important role in content based image database systems devised by computer vision researchers [20].

The reason for choosing shape feature for describing an object is because of its inherent properties such as identifiability, affine invariance, and reliability and occlusion invariance, thus shape of the object has proved to be a promising feature based on which several image classification and retrieval operations can be performed [20].For describing the Shape of image the shape descriptor are required. The shape descriptor is classified into two major class namely Contour-based shape representation and description techniques and Region-based shape representation and description techniques. In the Counter-based shape techniques it uses only shape boundary information. In the Region based techniques it takes whole shape under consideration. There are some shape Descriptor methods like Geometric Moments Geometric Moments, Zernike Moments, Fourier Descriptor, Grid Method and Shape Matrix

I. ZERNIKE MOMENTS

Teague has proposed the use of orthogonal moments to recover the image from moments based on the theory of orthogonal polynomials, and has introduced Zernike moments [20]. Zernike moments are allows independent moment invariants to be develop an arbitrarily high order. The complex Zernike moments are derived from Zernike polynomials [14]:

$$V_{nm}(x,y)=V_{nm}(\rho\cos\theta,\rho\sin\theta)=R_{nm}(\rho)\exp(jm\theta)$$

And

$$R_{nm}(\rho)=\sum_{s=0}^{(n-|m|)/2}(-1)^s\frac{(n-s)!}{s!\left(\frac{(n+|m|)}{2}-s\right)!\left(\frac{(n-|m|)}{2}-s\right)!}\rho^{n-2s}$$

Where *n* and *m* are subject to *n*-|*m*| = even, |*m*|≤*n*. Zernike polynomials are become complete when set of complex valued function added over the unit disk, i.e., *x*2 + *y*2 = 1.Then the complex Zernike moments of order *n* with repetition *m* are defined as [20]:

$$A_{nm}=\frac{n+1}{\pi}\sum_x\sum_y f(x,y)V^*_{nm}(x,y),x^2+y^2\le 1$$

Zernike moments are as same as to the Fourier transform, to expand a signal into series of orthogonal basis. The number of Moments truncated from the expansion is called the precision of shape representation. Basis functions of Zernike moments take the unit disk as their domain. Before calculating moments unit disk must be specified. Zernike moments descriptors do not need to know boundary information, making it suitable for more complex shape representation [20]. To overcomes the drawback of geometric moments in which higher order moments are difficult to construct, Zernike moments descriptors are constructed to arbitrary order.

II. GRID DESCRIPTORS

In grid shape representation, a shape is projected onto a grid of fixed size, 16×16 grid cells for example [20]. If grid cells are assigned the value 1 then they are covered by the shape and if value 0 is assigned to grid cells then they are outside the shape. A shape number consisting of a binary sequence is created by scanning the grid in left-right and top bottom order, and this binary sequence is used as shape descriptors to index the shape [20]. To achieve scale, rotation and translation invariance for comparison of two shape using Grid Descriptor, several normalized process have to be done. To achieve this first find out the major axis. To achieve Rotation normalization the shape will be turning on so that the major axis is parallel with *x*-axis. To avoid multi normalization results for mirrored shape and flipped shape, the centroid of the rotated shape may be restricted to the lower-left part, or a mirror and a flip operation on the shape number are applied in the matching stage [20]. To achieve Scale normalization Shape has to be resized so that the length of the major axis is equal to the grid width, after that shift the shape to the upper-left of the grid. In the set of Grid descriptor, the distance between two grid descriptors is simply the number of elements having different values. For example, the grid descriptors for the two shapes in Fig. 7 (a) and (b) are 001111000 011111111 111111111 111111111 111110011 001100011 and 001100000 011100000 111100000 111100000 011111100 000111000 respectively, and the distance between the two shapes will be 27 [20].

For example, the two shapes in Fig. 7 (c) and (d) are perceptually similar, but are very different under grid representation, for the major axis of shape (c) is horizontal while the major axis of shape (d) will be vertical [20].

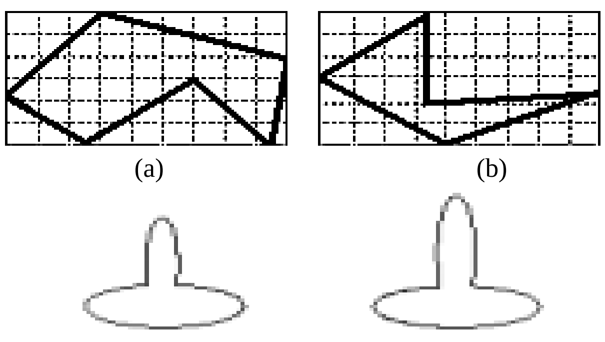

Fig.7 Grid representation of shape

D ARCHITECTURE OF ITTY MODEL

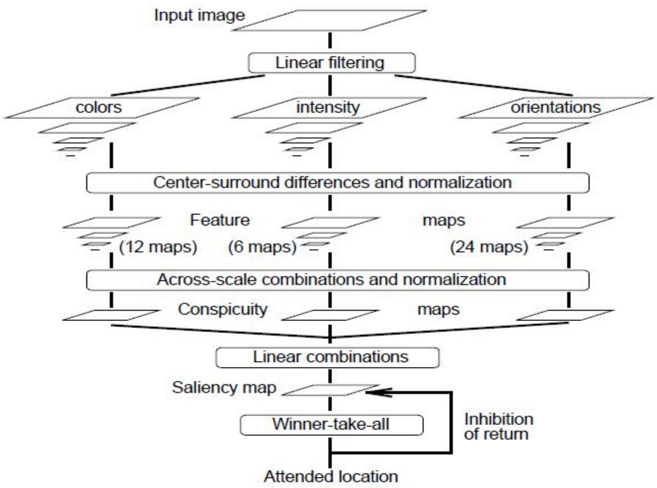

FIG.8 ARCHITECTURE OF ITTY MODEL

According to the model, Linear filtering of an input image is done then after various feature such as color, intensity and orientation of the linear filtered input image is extracted. After extracted this feature from the input image center surround difference and normalization is apply to that image which give as a total 42 map(12 for color ,6 for intensity and 24 for orientation) which is call as conspicuity map. At the end of this all process saliency map is generated for the given input image which is the output of the Itty model.

E PROPOSED METHEDOLOGY

Image Retrieval system having various technique used for image retrieval. In this thesis we explained all the method which is used previously. The main used of these methods are in feature extraction from the images. Image retrieval system used low level feature to retrieve image from database using applying Improved Itti Model to get better saliency Map. Here we propose a new method which the combination of all the three features which improves the performance of retrieve image.

In our base paper, only color and texture feature without saliency map having the precision ratio of 0.610 and using the combination of color and texture feature, apply basic itty model to get saliency map which having a precision ration of 0.743.Using the improved itty model precision ratio is increased up to 0.854.

- **Precision and Recall**

The performance of Image retrieval system was measured by precision and recall. Precision is measured by the ratio of number of retrieved relevant images to the total number of retrieved images. Here a precision is denoting by **P** and its equation is:

$$P = \frac{Number\ of\ relevant\ image\ retrieved}{Total\ number\ of\ image\ retrieved}$$

Recall is measured by the ratio of the relevant images retrieved to total number of relevant images the in database. A Recall is denoting with **R** and its equation is:

$$R = \frac{Number\ of\ relevant\ image\ retrieved}{Total\ number\ of\ relevant\ image\ in\ database}$$

For example, if database have 1000 images in it, amongst them there are 100 images of Flower. Now we can query an image of rose flower. In this with using image retrieval can retrieve 75 images of rose flower and from that can get 60 relevant images to our query image. Here a precision is ratio of 60to 75, and recall is ratio of 65 to 100. In this proposed method we will work on only for Precision.

CONCLUSION

This paper proposes a new CBIR method that uses the combination of color, shape and texture. Many researches have been done to develop some algorithm that solve some problems and achieve the accuracy when retrieving images. All these technique given in this paper are good to individual. We get different result using the different techniques of color, texture and shape than previous one. With this paper it is conclude that by using combination of all different methods can get better result.

F PROPOSED FOLWGRAGH

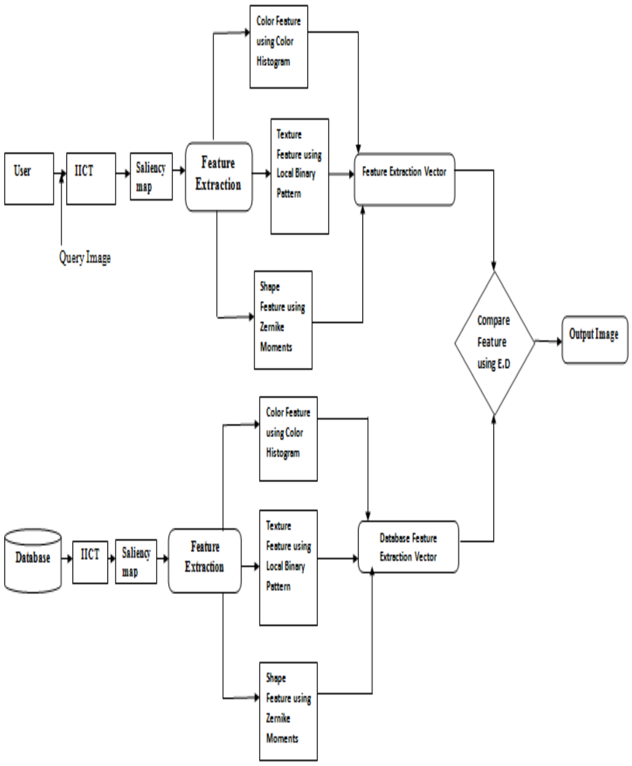

Fig 9 Flow graph of proposed method

G PROPOSED ALGORITHM STEP

Proposed Algorithm for Image Retrieval system

Step 1: Apply improved Itty model to image to get saliency map.

Step 2: Apply feature Extraction on saliency map.

Step 3: Store extracted feature or parameters of all images in database.

Step 4: User will give query image, apply improved itty model and convert it into saliency map.

Step 5: Feature extraction of query image.

Step 6: Extract Color Texture and Shape feature using Color Histogram, Local Binary Pattern and Zernike Moment.

Step 7: Compare saliency map of both images.

Step 8: Retrieve images by similarity measurement using Euclidean Distance.

H EXPERIMENTAL RESULT

After implementation of proposed method, output is generated based on the precision ratio of the images of different class of database. Following are some snapshots to show results of different -different flower categories.

Fig 10 Result of class daffodil flower category

In Figure shows the generated output for the one of the flower category class using color histogram algorithm. This output is generated based on the given input image.

Fig 11 Result of class snowdrop flower category

Fig shows the output based on the input image of snowdrop flower category using the local binary pattern method of texture.

Method	CT	ICT	IICT	Proposed Algo
Avg Precision	0.610	0.743	0.835	0.854

Fig 12 Result of class lily valley flower category

Fig shows the output based on the input image of snowdrop flower category using the Zernike moment of shape method.

I *RESULT ANALYSIS*

After doing the implementation of the proposed method, the comparison of the result is to be analyzed. The result analysis is done by comparing precision of every class of flower category of the database. The following are the comparison table for showing difference between proposed method and existing method.

Comparison Table:

Categories	Zernike Moments	LBP	Color Histogram	Proposed algo
1	0.63	0.61	0.53	0.74
2	0.62	0.63	0.59	0.78
3	0.61	0.59	0.53	0.68
4	0.64	0.71	0.58	0.78
5	0.61	0.68	0.64	0.76
6	0.57	0.62	0.71	0.77
7	0.59	0.57	0.67	0.75
8	0.63	0.62	0.63	0.79
9	0.61	0.58	0.62	0.76
10	0.59	0.61	0.58	0.74
11	0.63	0.51	0.51	0.71
12	0.62	0.63	0.59	0.68
13	0.61	0.59	0.53	0.75
14	0.64	0.61	0.58	0.78
15	0.61	0.68	0.64	0.79
16	0.67	0.53	0.71	0.83
17	0.59	0.57	0.57	0.72

Table 1 Comparison table for proposed methods

Table 2 Existing method Result

CONCLUSION

In Content based Image Retrieval (CBIR), images are retrieved by their visual content such as color, texture and shapes. CBIR is used to effectively retrieve required images from large collection of images called database. This report proposes a new Image Retrieval method that uses the combination of color, Texture and shape feature using apply Improved Itty model to get saliency map of image using color histogram, texture using LBP and shape Zernike moment respectively. Previously this type of combinations has been done but in that there are some problems for image retrieval and can't get better results with precision.

After the implementation of proposed method with three feature color, texture and shape using color histogram and Zernike moment results are compare and analysis. Using this comparison it is conclude that proposed method is better than existing.

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