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AN ADEQUATE METHOD FOR COLOR IMAGE RETRIEVAL BASED ON TEXTURE

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Abstract - The goal of this paper is to review techniques for content-based image retrieval by using low level feature such as texture. The reviewed techniques are Gray-level co-occurrence matrix, Color co-occurrence matrix, Local binary pattern and Ultra local binary pattern; all these approaches are studied and compared their performance. It is found that U-LBP is superior than above mentioned methods and the retrieval accuracy is measured in terms of Mean Square Error (MSE), Peak Signal to Noise Ratio (PSNR), Precision and Average Precision.

Index Terms - Content-based Image Retrieval (CBIR), Color Image, Shape, Texture, LBP, ULBP, MSE, PSNR.

MOTIVATION

Due to the increase of online users on the Internet, the amount of collections of digital images have been grown continuously, for example, in web applications that allows adding images and digital albums. Also it is important to note that the images are worldwide used. A tempt of television, old photographs and games has contributed to this growth as well. Images are increasingly used to convey information, whether one local information, weather, advertising, etc. In this circumstance, it is necessary to develop the appropriate systems to manage effectively all these collections. Another problem was the complication of image data, and these data can be interpreted in various ways, thus raising the question of how to work in order to manipulate these data and represent or establish policies to its content. This motivated the development of the image retrieval area whose goal is try to solve those problems.

I. INTRODUCTION

An image retrieval method is used for browsing, searching and retrieving digital images from a large database. Users are not satisfied with the traditional information retrieval techniques, as the network and development of multimedia technologies are becoming more popular in these days. So nowadays the content based image retrieval method is becoming a popular method for exact image retrieval [1, 2, 4]. In this paper the techniques of content based image retrieval for color image using texture is discussed, analyzed and compared.

A. Content-based image retrieval (CBIR)

Now a day's many image retrieval systems have been developed. Researchers paying attention on Content based image retrieval technique. In CBIR system, image retrieval is based on similarities in their lower level features like textures, colors, shapes, etc [3]. CBIR is the computer vision application to the difficulty in finding of images from large databases [2]. Content Based Image Retrieval (CBIR) is techniques that allow accessing the digital images from a large collection of image databases by using the image features. Image retrieval approaches are based on the computation of the similarity between the users query and images [6].

The basic challenge in CBIR is to develop the methods which is increases the retrieval accuracy and reducing the retrieval timing [3]. Hence we studied a method in which texture feature is used for efficient image retrieval. A typical Content based Image Retrieval system is given below which representing the elementary principle used in CBIR [4].

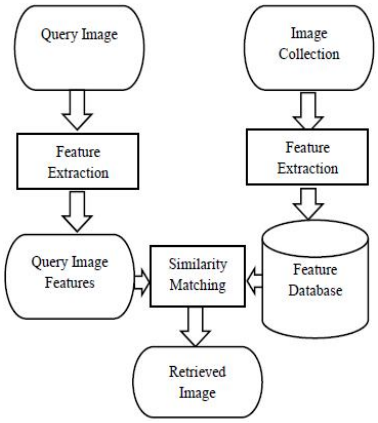


Fig.1: Typical Content Based Image Retrieval System [4]

The process of CBIR includes following stages:

1. **Image acquisition:** this process is to acquire a digital image.
2. **Image Database:** It includes collection of n number of images depends on the user range and choice.
3. **Image Preprocessing:** this technique is used to improve the image that increases the chances for success of the other processes. The image is first processed in order to extract the features, which describe its contents. The processing involves filtering, normalization, segmentation, and object identification. Like, image segmentation is the process of dividing an image into multiple parts.

The output of this stage is a set of significant regions and objects.

4. **Feature Extraction:** Features such as shape, texture, color, etc. are used to describe the content of the image. The features further can be classified as low-level and high-level features. In this step visual information is extracts from the image and saves them as features vectors in a features database .For each pixel, the image description is found in the form of feature value (or a set of value called a feature vector) by using the feature extraction .These feature vectors are used to compare the query with the other images and retrieval.
5. **Similarity Matching:** The information about each image is stored in its feature vectors for computation process and these feature vectors are matched with the feature vectors of query image (the image to search in the image database whether the same image is present or not or how many are similar kind images are exist or not) which helps in measuring the similarity. This step involves the matching of the above stated features to produce a result that is visually similar with the use of similarity measure method called as Distance method.
6. **Resultant Retrieved Images:** It used to search the previously maintained information to find the matched images from database. The output will be the similar images having same or very closest features as that of the query image.
7. **User interface and feedback** which control the display of the outcomes, their ranking, the type of user interaction with possibility of refining the search through some automatic or manual preferences scheme etc.[8]

B. Texture

A texture feature is used in large scale for image retrieval. Texture is depends on the distribution of intensity over the image and is not defined for a separate pixel [9]. Various techniques for texture analysis have been investigated in the field of computer vision and pattern recognition. The texture extraction techniques can be classified into two categories: statistical and structural. Statistical approaches use intensity distribution of image to extract statistical parameters representing texture of image. Commonly used statistical methods include Fourier power spectra, Co-occurrence matrices, Shift-invariant principal component analysis (SPCA), Tamura feature, Wold decomposition, Markov random field, Fractal model, and Multi-resolution filtering techniques such as Gabor and wavelet transform [7, 8].

Structural methods, including morphological operator and adjacency graph, describe texture by identifying structural primitives and their placement rules. They tend to be most effective when applied to textures that are very regular [8].

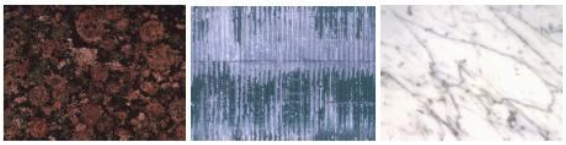


Fig.2 Example of textures [8]

B. Applications of CBIR systems

(1) To search a particular image on the web.
(2) Various types of professionals like police force for picture Recognition in crime prevention.
(3) Medicine diagnosis
(4) Architectural and engineering design
(5) Fashion and publishing
(6) Geographical information and remote sensing systems
(7) Home entertainment [8,10]

II. MATHEMATICAL MODELLING

i) Gray-level Co-occurrence Matrix Method (GLCM)

The gray-level co-occurrence matrix can reveal certain properties about the spatial distribution of the gray levels in the texture image [10]. For example, if most of the entries in the GLCM are concentrated along the diagonal, the texture is coarse with respect to the specified offset. You can also derive several statistical measures from the GLCM.

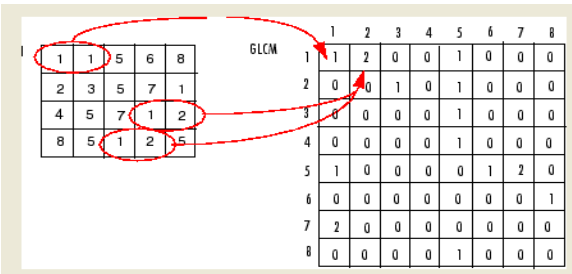


Fig.3 Process Used to Create the GLCM

To illustrate, the above figure shows how gray co-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 and 3. Gray co-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.

ii) Color Co-occurrence Matrix (CCM)

The texture feature extraction plays important role in image analysis. Color co-occurrence matrix gives

spatial information about color images which ignores the intensity information for the image. Color correlogram for content-based image retrieval (CBIR) characterizes not only the color distribution of pixels, but also the spatial correlation of pairs of colors [5]. Color not only reflects the material of surface, but also varies considerably with the change of illumination, the orientation of the surface and the viewing geometry of the camera.

iii) Local Binary Pattern (LBP)

Local binary pattern is a type of visual descriptor used for classification in computer vision. LBP is the particular case of the Texture Spectrum model. It has since been found to be a powerful feature for texture classification; it has further been determined that when LBP is combined with the Histogram of oriented gradients (HOG) descriptor, it improves the detection performance considerably on some datasets.

iv) Ultra LBP (U-LBP)

Local Binary Pattern is a simple yet powerful method for image feature extraction in pattern recognition and image processing. However, the LBP operator of each pixel mainly depends on its neighboring pixels and emphasizes on local information too much. From the practical viewpoint, the information is quite limited if we consider the LBP operator in isolation, especially for a large image. To deal with this issue, ultra LBP (U-LBP) is used, which consider the relationship among different LBP operators.

III. EXPERIMENTAL RESULTS

i) Precision comparisons

Precision (%)				
Query image type	**Gray level co-occurrence matrix method**	**Color image retrieval method based on texture (color co-occurrence matrix)**	**Local Binary pattern (LBP)**	**Ultra LBP (U-LBP)**
Food	74.55	87.86	81.19	85.96
Flowers	70.18	77.08	78.09	81.26
Buses	81.16	89.31	90.00	93.53
Textures	82.99	85.65	89.39	93.23
People	81.40	89.14	89.93	93.90
Elephants	80.18	83.43	91.04	97.34
Beaches	82.98	92.96	89.65	91.64

ii) Average precision

Average Precision {%}				
Query image type	**Gray level co-occurrence matrix method**	**Color image retrieval method based on texture (color co-occurrence matrix)**	**Local Binary pattern (LBP)**	**Ultra LBP (U-LBP)**
MSE	108.3	105.9	105.1	104
PSNR	27.9	28.03	28.08	30
Average Precision	80.2	86.49	87.18	90.98

Gray level co-occurrence matrix method

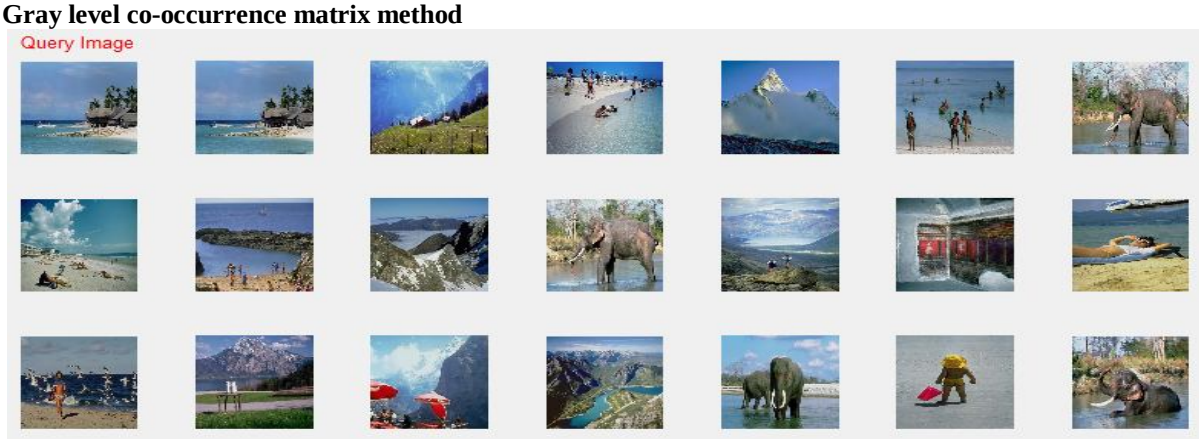


Fig: Retrieval Results Using GLCM

Color co-occurrence matrix

Fig: Retrieval Results Using CCM

Local Binary pattern

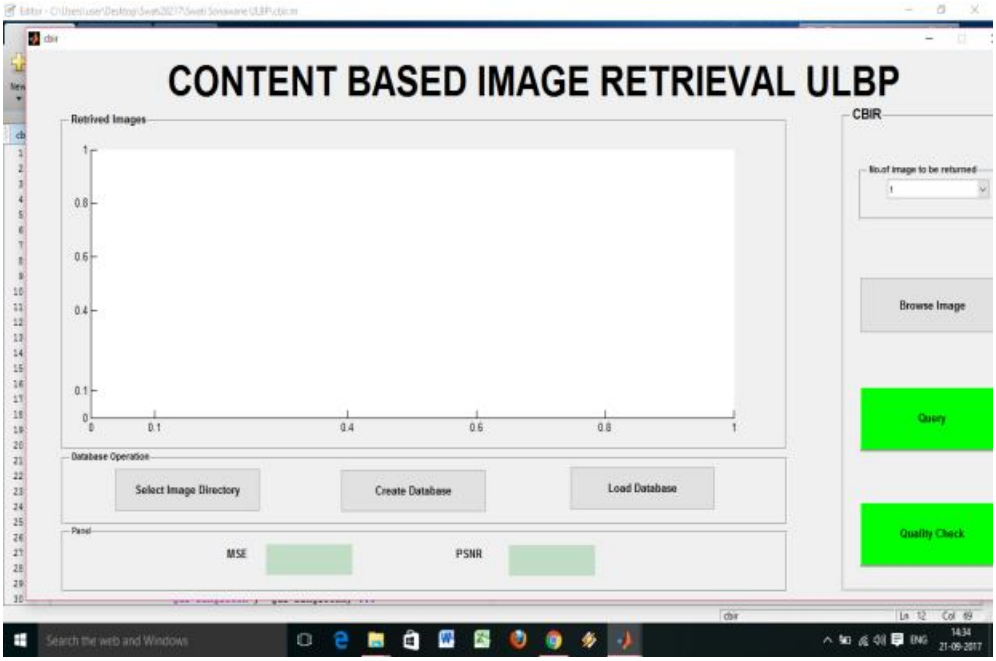
Fig: Retrieval Results Using LBP

Ultra-local Binary pattern

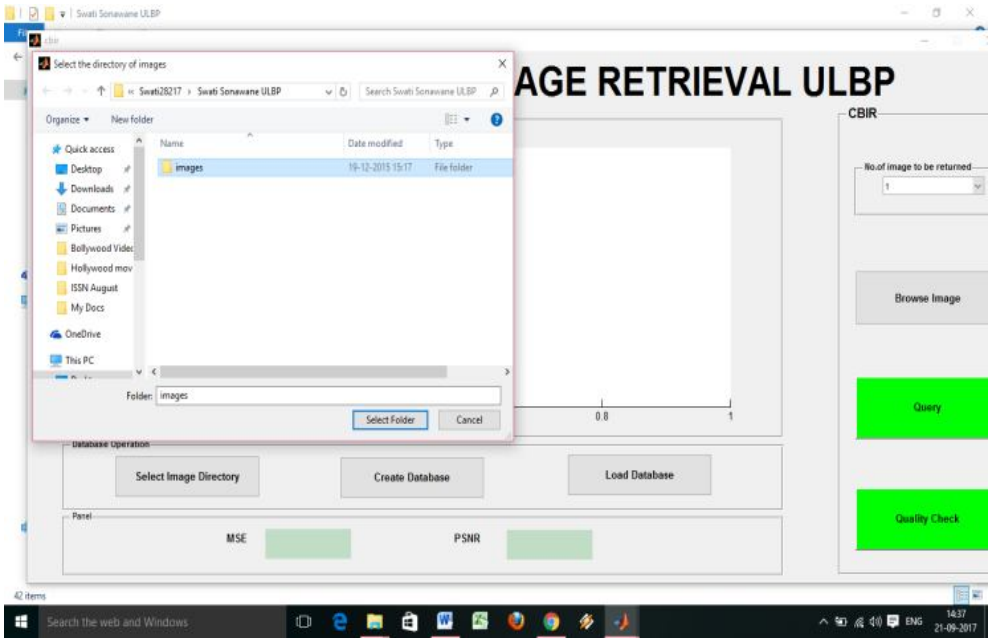
Fig: Retrieval Results Using U-LBP

Execution steps for image retrieval are given as,

1. Run MATLAB file and you will see the below GUI window.

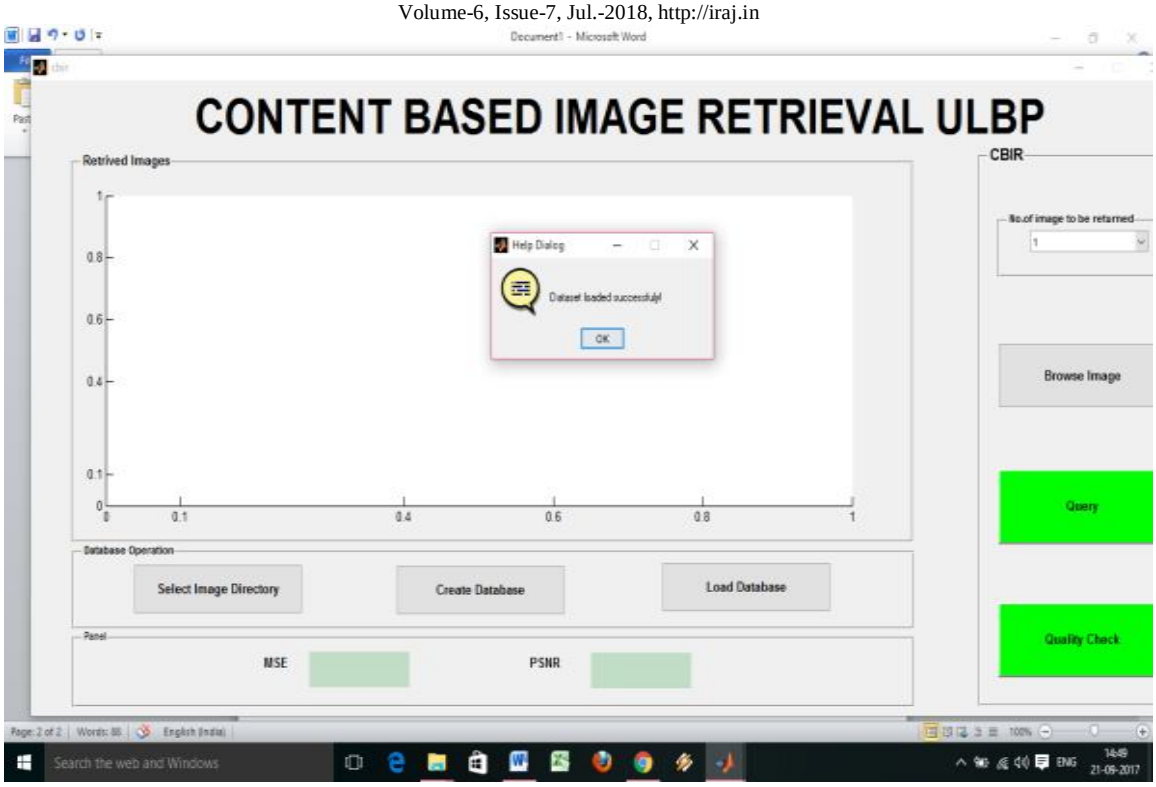


2. Push button - 'Select image directory' used to select "images" folder. Basically selection of image directory gives you access to image database for which you are applying algorithm.



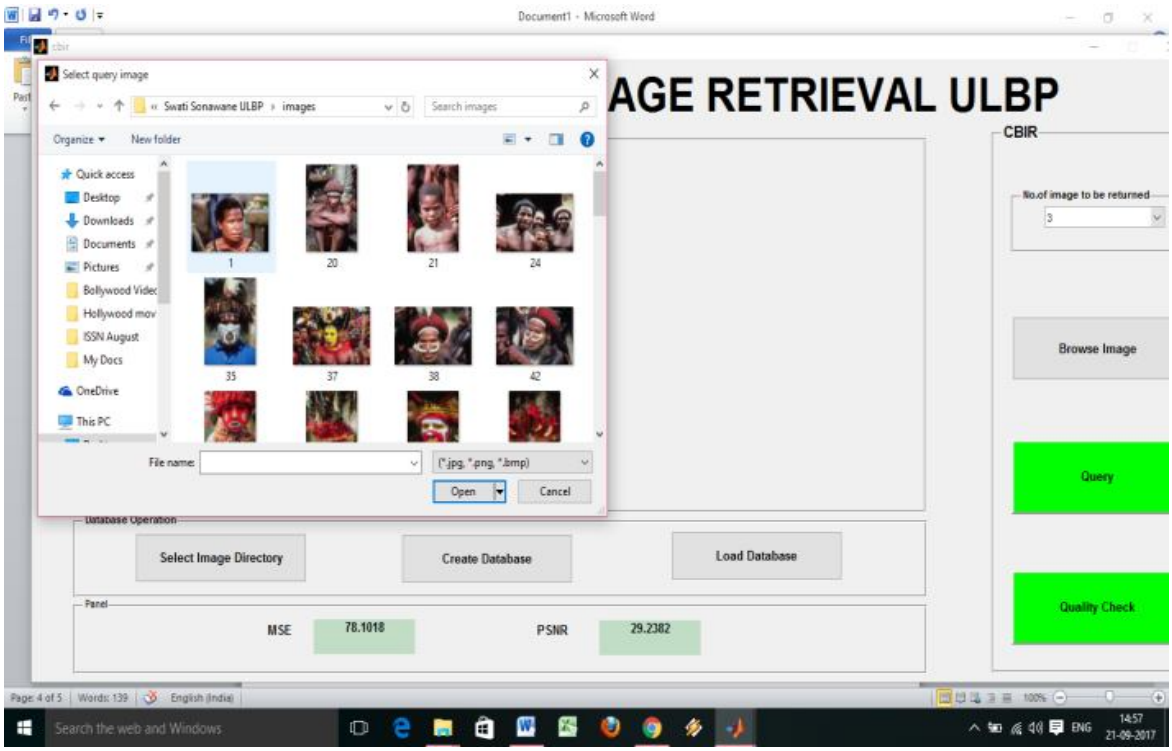
3. Push button - 'Create Database' by pressing this button you will calculate all principle components for each image. Hence it will take 2-3 hours to create PCA (Principle Component Analysis) database. This database is created in terms of 'dataset.m' file.
If you have already created 'dataset.m' files for you in your code folder then you don't need to create Database at every time.

4. Push button - 'Load database' is used to load the database file i.e 'dataset.m' file.

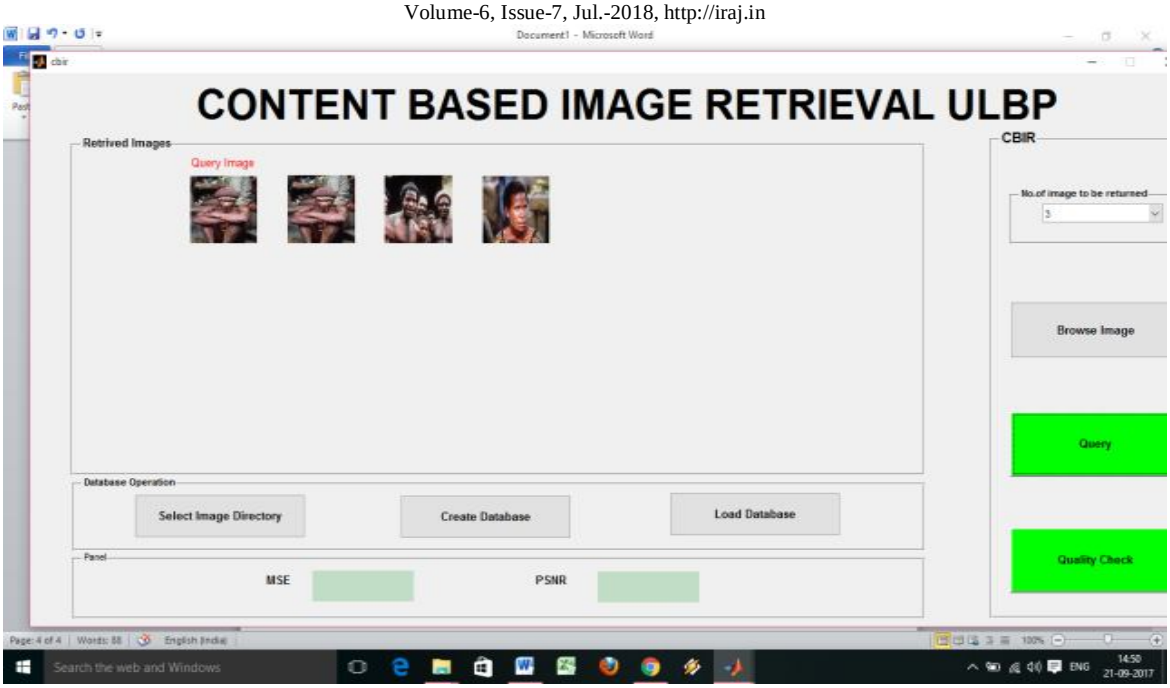


5. Drag button in GUI is used to select number of images to be returned.

6. Push button - 'Browse Image' is used to select query image from 'images' folder. This button is used to select image for which you want to find resembling images.



7. Push button – 'Query' is used to get output resembling images compared to query image. Remember that first image would be exactly same as query image (perfect match)



8. Push button - 'Quality check' is used to see quality parameters.

CONCLUSION

Image feature - Texture is studied for classification of a color image for image retrieval. Ultra LBP have faster retrieval speed than other methods mentioned in literature. We have differentiated different texture retrieval methods based on MSE, PSNR, Precision and Average Precision and we found that as per our experimentation, average precision for Ultra LBP method is 90.98, which is better than average precision of Gray-level Co-occurrence Matrix, Color Co-occurrence Matrix and Local Binary Pattern Method.

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