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Content Based Image Retrieval for Various Formats of Image

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ABSTRACT

The aim of this paper is to review the current state of the art in content-based image retrieval (CBIR), a technique for retrieving images on the basis of automatically-derived features such as color, texture, shape, histogram etc. A system in created in which various images of different formats are collected and then by using Feature Extraction, various features are extracted which helps to give the efficient matching results in less span of time. In Experiment analysis we have compared our technique with the previous methods and we checked the efficacy of our method and we also calculated true positive rate and false positive rate with the help of confusion matrix.

Keywords- Content Based Image Retrieval, Image Retrieval, Feature Extraction, and Confusion Matrix.

1. INTRODUCTION

Image retrieval is the task of retrieving digital images from a database. It is a computer system for browsing, searching and retrieving images from a large database of digital images. The goal of an image retrieval system is to retrieve a set of image from a collection of images such that this set meets the user's requirements. The user's requirements can be specified in terms of similarity to some other image or a sketch, or in terms of keywords. Content Based Image Retrieval (CBIR) attracted many researchers of various fields in effort to automate image data analysis and indexing. CBIR is like filter information Process and it is used to provide a high percentage of relevant images in response to the query image.[1]
A wide range of possible applications for CBIR technology has been identified. Some of these are listed below: [2]

- art galleries, museums, archaeology (typically paintings or objects in front of a homogeneous background)
- geographic information systems, weather forecast, aerial/astronomical images,
- medical imaging (2D/3D data) ,
- fashion/graphic design/advertising (typically objects in front of homogeneous or complex background),
- publishing (any image type for illustrating the text),
- trademark databases (icons, binary images, or images containing only few homogeneous colors),
- criminal investigations (e.g. fingerprint matching, copyright violation on the Internet, face recognition),
- picture archiving and retrieval, as well as database maintenance in general, e.g. removal of duplicates (very general image content),
- video archiving and access (very general video content),
- image search on the Internet (very general image content).

2. METHODOLOGY

Our system has been fully implemented (in matlab).

2.1 Dataset

We have created dataset of different format of images. To match an image from the database we need to fill the dataset.

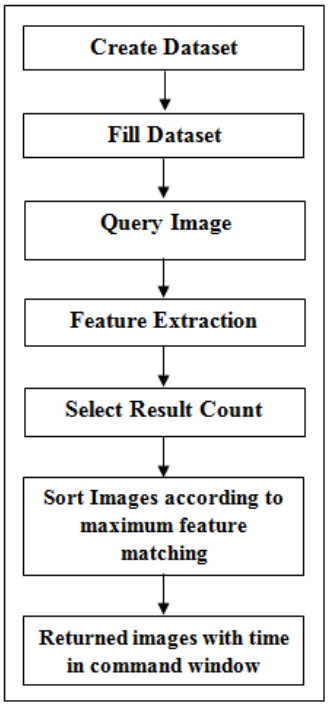

Figure 1: Indexing

2.2 Feature Extraction

For matching of color images we require some features so that the matching becomes easier. So, we extract 12 features and matching is done for each feature. The features are as following:

- Image texture- Texture is that innate property of all surfaces that describes visual patterns, each having properties of homogeneity. It contains important information about the structural arrangement of the surface, such as; clouds, leaves, bricks, fabric, etc. It also describes the relationship of the surface to the surrounding environment. In short, it is a feature that describes the distinctive physical composition of a surface. [3]
- Histogram Pattern- A color histogram represents the distribution of colors in an image, through a set of bins, where each histogram bin corresponds to a color in the quantized color space. A color histogram for a given image is represented by a vector:
  H = {H[0],H[1],H[2],H[3],……H[i],……,H[n]}
  Where i is 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 color histogram. [5]
- Size Matrix- The terms definition and picture size often cause confusion and misunderstandings, because, in practice, they have more than one meaning. One must discern between:[10]

  1) Graphic files on the computer (i.e. pictures from a digital camera)
  2) Hard copy files (i.e. a poster)

- Color contrast- The color histogram for an image is constructed by counting the number of pixels of each color. In other words color histogram defines as a distribution of colors in an image. For digital images, a color histogram represents the number of pixels that have colors in each of a fixed list of color ranges.[4]
- Angle- In particular, the techniques using functions of the curvilinear abscissa have proven to have many of the listed features, and Turning Angles have had a certain favor in the field of image retrieval. Although Turning Angles can give a high level of discrimination among the shapes and have some interesting properties that have been well described in literature, Turning Angles are very sensitive to small variations in the contour, and are not invariant for rotation.[6]
- Side lobes- The spiky features originate from the effects of side lobes in the autocorrelation function. The side lobes in the interference fringe envelope were suppressed with a process algorithm to significantly improve the longitudinal resolution. [7]
- RGB contrast- The RGB color model is an additive color model in which red, green, and blue light are added together in various ways to reproduce a broad array of colors. The name of the model comes from the initials of the

three additive primary colors, red, green, and blue. The main purpose of the RGB color model is for the sensing, representation, and display of images in electronic systems, such as televisions and computers, though it has also been used in conventional photography. [11]

- Shape- Shape may be defined as the characteristic surface configuration of an object; an outline or contour. It permits an object to be distinguished from its surroundings by its outline. Shape representations can be generally divided into two categories:[3]

  - Boundary-based, and
  - Region-based.

- Relativity- Relativity includes problems concerning the aboutness — thematic and iconographical concepts — of an image. These problems are difficult to address especially in automated image retrieval systems. Addressing relativity involves distinguishing Panofsky's factual and expressional meaning of images. [8]
- Wavelet transformation- Discrete wavelet transformation (DWT) is used to transform an image from spatial domain into frequency domain. The wavelet transform represents a function as a superposition of a family of basis functions called wavelets. Wavelet transforms extract information from signal at different scales by passing the signal through low pass and high pass filters. Wavelets provide multi-resolution capability and good energy compaction. [5]
- Normalized L2- SIFT histogram features are calculated for each ground truth image by using a codebook to quantize the SIFT descriptors extracted from the image. The histogram features thus range in length from 10 to 20 000 components. Three versions of the histogram features are considered:

  1)unnormalized SIFT histogram features which simply contain the codeword counts;
  2)L1 normalized SIFT histogram features where the components are normalized to sum to one;
  3)L2 normalized SIFT histogram features where the components are normalized so the feature vectors have length one.

  The best performance for the local descriptors results from using the L1 measure to compare L1 normalized histograms based on a codebook of 15000 words created using k-means clustering with the Euclidean distance and descriptors extracted using the saliency-based method**.** [9]

- Relative Deviation- The relative standard deviation (RSD or %RSD) is the absolute value of the coefficient of variation. It is often expressed as a percentage. A similar term that is sometimes used is the relative variance which is the square of the coefficient of variation. Also, the relative standard error is a measure of a statistical estimate's reliability obtained by dividing the standard error by the estimate; then multiplied by 100 to be expressed as a percentage.[12]

2.3 Result Count

By selecting the result count we will select the maximum number of images to be returned as result. The result count is set up to 20 i.e. we can have maximum of 20 images as output.

2.4 Sorting

The goal is to sort an array of elements using the bubble sort algorithm. The elements must have a total order and the index of the array can be of any discrete type. For languages where this is not possible, sort an array of integers.
The bubble sort is generally considered to be the simplest sorting algorithm. Because of its simplicity and ease of visualization, it is often taught in introductory computer science courses. Because of its abysmal O (n^2) performance, it is not used often for large (or even medium-sized) datasets. The bubble sort works by passing sequentially over a list, comparing each value to the one immediately after it. If the first value is greater than the second, their positions are switched. Over a number of passes, at most equal to the number of elements in the list, all of the values drift into their correct positions (large values "bubble" rapidly toward the end, pushing others down around them). Because each pass finds the maximum item and puts it at the end, the portion of the list to be sorted can be reduced at each pass. A Boolean variable is used to track whether any changes have been made in the current pass; when a pass completes without changing anything, the algorithm exits. [13]

2.5 Returned Images

After sorting, Best Matched images are retrieved from the given Dataset. It gives the best matched results in less time span and gives accurate results.

3.RESULTS AND COMPARISONS

Images of various formats are collected and then 12 features are extracted on the basis of which we are going to match the image with the database with the result count which ranges from 1 to 20. After that we will check the time of retrieval for different formats. Different format images appear in different windows.

3.1 JPG Results

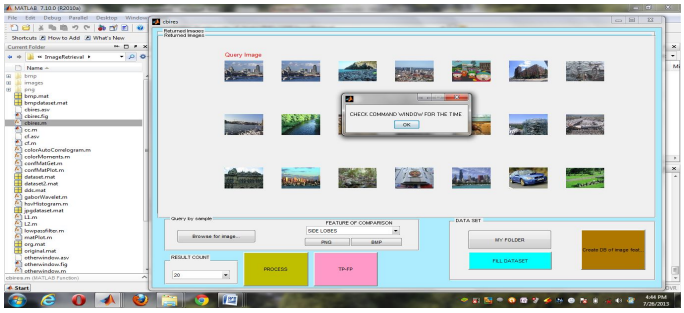

Figure 2: Returned jpg images

In this we upload the dataset for jpg images and then browse the query image. After that we choose the feature for matching and then the result count to get the required number of matched images. Images are sorted according to the similarity i.e. maximum matched image is in first place and so on. We can see the time of image retrieval in the command window.

3.2 PNG Results

For png images we select the query image by clicking on the png button. The after processing we will get the matched results in the other window. The first image is the same image as our query image.

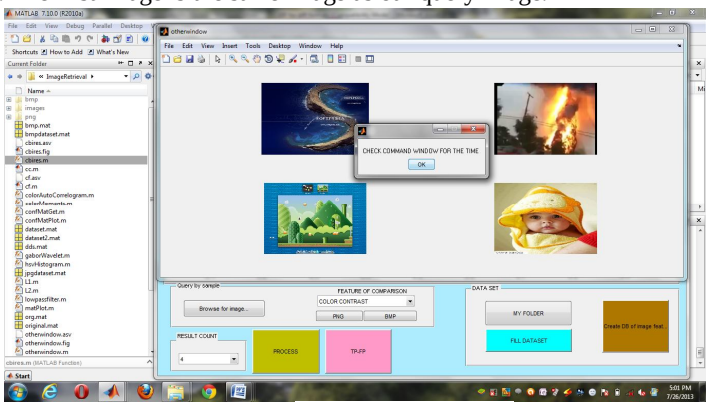

Figure 3: Returned png images

3.3 BMP Results

For bmp images we select the query image by clicking on the bmp button. The after processing we will get the matched results in the other window. The first image is the same image as our query image.

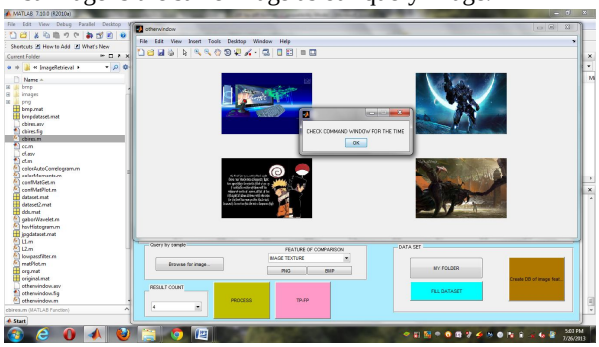

Figure 4: Returned bmp images

3.4 Comparison

We have compared our results with previous methods in order to check the efficacy of the system. The TP-Rate of our system is compared with wang database which proves that our system shows better TP rate than the previous techniques.

3.4.1 Performance Parameters

a) **TP Rate:** The True Positive (TP) rate is the proportion of examples which were classified as class x, among all examples which truly have class x, i.e. how much part of the class was captured. It is equivalent to Recall. In the confusion matrix, this is the diagonal element divided by the sum over the relevant row.

b) **FP Rate**: The False Positive (FP) rate is the proportion of examples which were classified as class x, but belong to a different class, among all examples which are not of class x. In the confusion matrix, this is the column sum of class x minus the diagonal element, divided by the rows sums of all other classes.

c) **Time:** The time taken to evaluate a feature depends on its collection frequency. those with high cf have correspondingly long lists of images for which similarity scores must be updated. Features are sorted according to their weights before evaluation. The evaluation time for 100 features typically varies between 0.01 and 0.30s.

d) **Accuracy:** The accuracy of a measurement system is the degree of closeness of measurements of a quantity to that quantity's actual (true) value. Accuracy is often the starting point for analyzing the quality of a predictive model, as well as an obvious criterion for prediction. Accuracy measures the ratio of correct predictions to the total number of cases evaluated. It may seem obvious that the ratio of correct predictions to cases should be a key metric.

3.4.2 Comparison of TP rate with Previous Methods

Category ID	Class	Proposed Method	Neha et. al.	Wang et. al.	Histogram based
1	Africa	0.9974	0.74	0.72	0.56
2	Beaches	0.9849	0.58	0.4	0.15
3	Buildings	0.9848	0.621	0.6	0.32
4	Buses	0.9967	0.57	0.5	0.27
5	Dinosaurs	0.9968	1	0.95	0.72

This table shows comparison of the TP rate of the feature of an image which gives the bet result of each category with the Previous Methods.

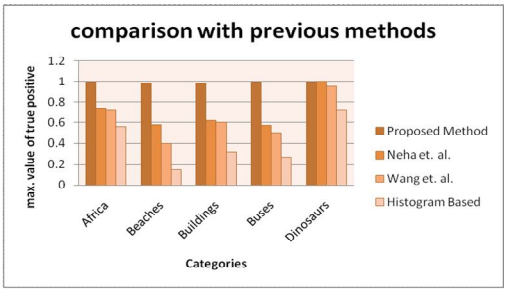

Figure 5: Comparison of TP-Rate with Previous Methods

The Graph shows the comparison of proposed method with previous methods. There are 5 category of images and TP rate is calculated for each category. From above graph we conclude that our method shows the best matched results as compared to previous models.

3.4.3 Comparison of TP rate of different formats

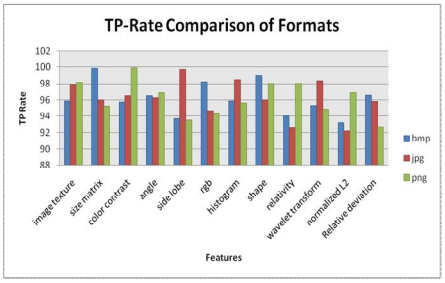

Figure 6: Comparison of TP-Rate of different formats

The graph shows the comparison of TP Rate of different format of images. TP rate for each feature is calculated for any random image from the database.

3.4.4 Comparison of FP rate of different formats

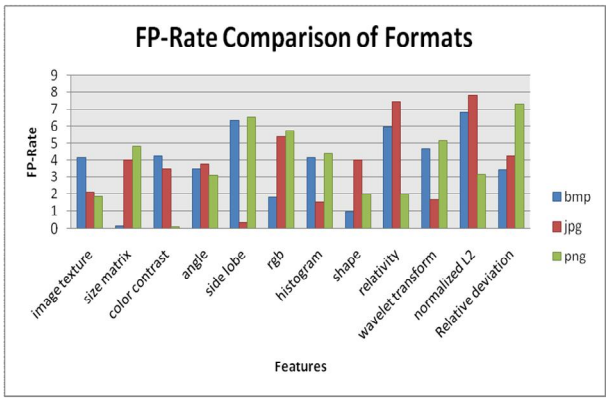

Figure 7: Comparison of FP-Rate with Previous Methods

The graph shows the comparison of FP Rate of different format of images. FP rate for each feature is calculated for any random image from the database.

3.4.5 Comparison of time

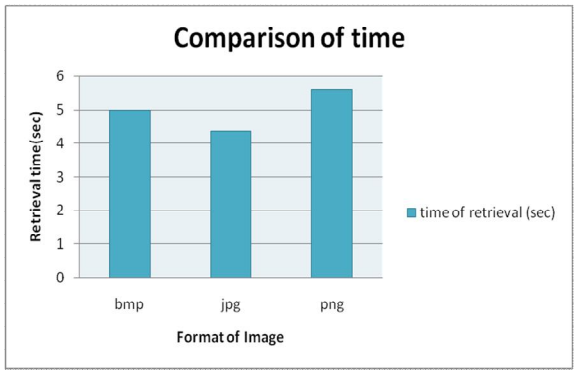

Figure 8: Comparison of time

This Graph shows the time taken to retrieve the matched images from database. Different formats take different time to retrieve the images.

3.4.6 Comparison of Accuracy

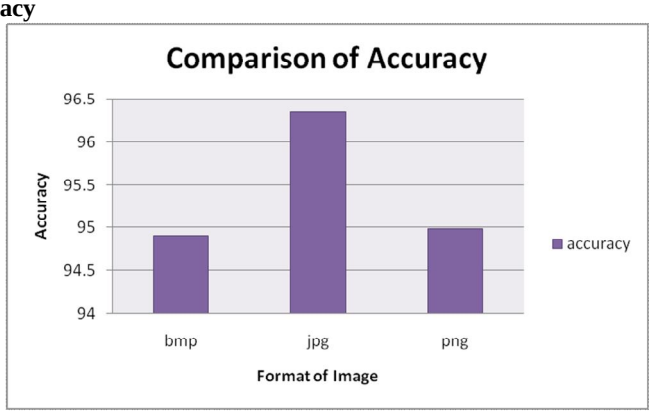

Figure 9: Comparison of Accuracy

This Graph shows the accuracy with which images are retrieved. The accuracy varies from image to image. We have calculated results for any random image from the database.

4. CONCLUSION

We have created database for different formats and concluded that it gives the better matching result than the previous methods. Further we have extracted various features on the basis of which we can match the images. The images are retrieved in less span of time and gives accurate output. We have created a confusion matrix from which we calculated the TP- rate and FP-rate for different features. The system gives the accuracy approximately up to 97% and accuracy varies from image to image.

5. FUTURE SCOPE

In future, researchers can increase their database. They can also work on other format of images like tiff, .gif etc. Further they can extract other features which help us for better matching the images. For Classification we can apply other methods like Naïve Bayes, Neural Network etc. For calculating difference between query image and database image researches can use other distance metrics such as Manhattan Distance etc. and sort the results using other sorting algorithms like Quick sort, Insertion sort etc.

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