# Comparative Study on Content Based Image Retrieval Based on Color, Texture (GLCM & CCM) Features

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**Abstract:** ***With the rapid development of multimedia and network technology, people can access a large number of multimedia information. For people who want to make full use of multimedia information resources, the primary question is how to query the multimedia information of interest. Text query can be applied to multimedia information retrieval, but it has inherent deficiencies. One hand, text annotation of multimedia information will spend a lot of manpower and resources and it is inefficient. On the other hand, annotated text is usually a person's perception of multimedia information. It is subject to impact of individual difference and state of human and environment, and the described results may be more one-sided. In addition, it is clearly incomplete to describe content-rich multimedia information with a small amount of text. Content Based Image Retrieval (CBIR) techniques appeared in 1990s. It solves the above problems well. It uses low-level features like color, texture and shape to describe image content, and breaks through the limitation of traditional text query technique. In this project we propose an image retrieval method based on multi-feature similarity score fusion using both GLCM and CCM. Single feature describes image content only from one point of view, which has a certain one-sided. Fusing multi-feature similarity score is expected to improve the system's retrieval performance. Here the retrieval results from color feature and texture feature are analyzed, and the method of fusing multi-feature similarity score is described. For the purpose of assigning the fusion weights of multi-feature similarity scores reasonably. For comparison, of different distance measurement methods and similarity measurements and also the texture features based on both GLCM and CCM methods are implemented. Finally the content based image retrieval based on color feature, texture feature and fusion of color-texture feature similarity score with equal weights.***

**Keywords:** CBIR, Feature extraction, color moment, wavelet texture feature, Gabor texture feature

## 1. Introduction

Now a day, people are interested in using digital images. So the size of the image database is increasing enormously. Lot of interest is paid to find images in the database. There is a great need for developing an efficient technique for finding the images. Hence, content based image retrieval (CBIR) has been a very active research topic in the last decade. CBIR usually indexes images by low level visual features such as color, texture and shape. The important task of CBIR is extraction of good visual features which represents a query image.

Color is one of the most reliable used low level visual features and is invariant to image size and orientation. The use of low level visual features is to retrieve relevant information from image databases. The MPEG-7 consists of number of histogram descriptors and dominant color descriptors [2]. MPEG-7 specifies seven color descriptors. It consists of color space, color quantization, dominant colors, scalable color histogram, color structure, color layout and GOF/GOP color. The dominant colors are used to reduce the quality of image content. In this paper, we will implement an effective representative color quantization algorithm and improve the similarity measure for DCD. The DCD contains two main components, they are

1. Representative colors and
2. Their percentages in the image or region.

Texture is another important visual feature that has been intensively studied in pattern recognition. It refers the surface properties of an object and their relationship to the surrounding environment. Texture consists of some basic primitives, and also describes the structural arrangement of a region and the relationship of the surrounding regions. Texture features can be classified into two categories, firstly spectral features such as Gabor filter and discrete wavelet transformation. Secondly, statistical features such as wold feature tamura feature and gray level co occurrence matrix representation.

Shape features can also provide powerful information for content based image retrieval. Humans can recognize objects solely from their shapes. The shape features are different from other elementary visual features, like color or texture features. The shape features[8] can be classified into two categories, firstly boundary based and secondly region based. Invariant moments are then used to record the shape features.

The some applications of the content based image retrieval are Fingerprint identification, crime prevention, biodiversity information systems, digital libraries, historical research, fashion and graphic design, publishing, advertising and medicine.

The basic difference between textual and visual information is the nature of retrieval process. The retrieval of textual information is based on discovering semantic similarity between textual entities. The visual information retrieval is based on discovering perceptual similarity.

## 2. Content Based Image Retrieval (CBIR)

Content Based Image Retrieval (CBIR) is the retrieval of images based on their visual features such as colour, texture, and shape. Content-based image retrieval systems have become a reliable tool for many image database applications. There are several advantages of image retrieval techniques compared to other simple retrieval approaches such as text based retrieval techniques. CBIR provides a solution for many types of image information management systems such as medical imagery, criminology, and satellite imagery. In this computer age, virtually all spheres of human life including commerce, government, academics, hospitals, crime prevention, surveillance, engineering, architecture, journalism, fashion and graphic design, and historical research use images for efficient services. A large collection of images is referred to as image database. An image database is a system where image data are integrated and stored. Image data include the raw images and information extracted from images by automated or computer assisted image analysis. Image retrieval based on content is extremely useful in a plethora of applications such as publishing and advertising, historical research, fashion and graphic design, architectural and engineering design, crime prevention, medical diagnosis, geographical information and remote sensing systems, etc.. A typical image retrieval application example is a design engineer who needs to search his organization database for design projects similar to that required by his clients, or the police seeking to confirm the face of a suspected criminal among faces in the database of renowned criminals. In the commerce department, before trademark is finally approved for use, there is need to find out if such or similar ones ever existed. In hospitals, some ailments require the medical practitioner to search and review similar X-rays or scanned images of a patient before proffering a solution. A typical CBIR uses the contents of an image to represent and access. CBIR systems extract features (color, texture, and shape) from images in the database based on the value of the image pixels. These features are smaller than the image size and stored in a database called feature database. Thus the feature database contains an abstraction (compact form) of the images in the image database; each image is represented by a compact representation of its contents (color, texture, shape, and spatial information) in the form of a fixed length real valued multi component feature vectors or signature. This is called offline feature extraction. The main advantage of using CBIR system is that the system uses image features instead of using the image itself. So, CBIR is cheap, fast, and efficient over image search methods. A key component of the CBIR system is feature extraction. A feature is a characteristic that can capture a certain visual property of the image. CBIR differs from classical information retrieval in that the image databases are essentially unstructured, since digitized images consist purely of arrays of pixel intensities, with no inherent meaning. One of the key issues with any kind of image processing is the need to extract useful information from the raw data (such as recognizing the presence of particular shapes or textures) before any kind of reasoning about the image's contents is possible. Early studies on CBIR used a single visual content such as color, texture, or shape to describe the image. The drawback of this method is that using one feature is not enough to describe the image since the image contains various visual characteristics.

## 3. Feature Extraction Method for Color

Color is the sensation caused by the light as it interacts with our eyes and brain. Color features are the fundamental characteristics of the content of images. Human eyes are sensitive to colors, and color features enable human to distinguish between objects in the images. Colors are used in image processing because they provide powerful descriptors that can be used to identify and extract objects from a scene. Color features provide sometimes powerful information about images, and they are very useful for image retrieval. Many methods can be used to describe color feature.

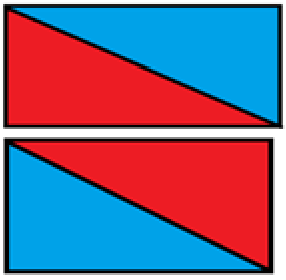


**Figure 1:** Two images having same color histogram

There are color histogram, color correlation, color moments, color structure descriptor (CSD), and scalable color descriptor (SCD). In this paper, we will use color moment method because it has the lowest feature vector dimension and lower computational complexity. To extract the color features from the content of an image, we need to select a color space and use its properties in the extraction. In common, colors are defined in three-dimensional color space. In digital image purposes, RGB color space is the most prevalent choice. The main drawback of the RGB color space is that it is perceptually non-uniform and device dependent system. The HSV color space is an intuitive system, which describes a specific color by its hue, saturation, and brightness values. This color system is very useful in interactive color selection and manipulation. The first-order (mean), the second (standard deviation), and the third-order (skewness) color moments have been proved to be efficient and effective in representing color distributions of images.

## 4. Feature Extraction Method for Texture

Here we have used two different approaches for texture extraction. First approach is using wavelets to extract texture Second approach is using gabor filter for texture extraction. Texture is nothing but some pattern on image which can be smooth, rough etc. There are many ways by which texture can be extracted.

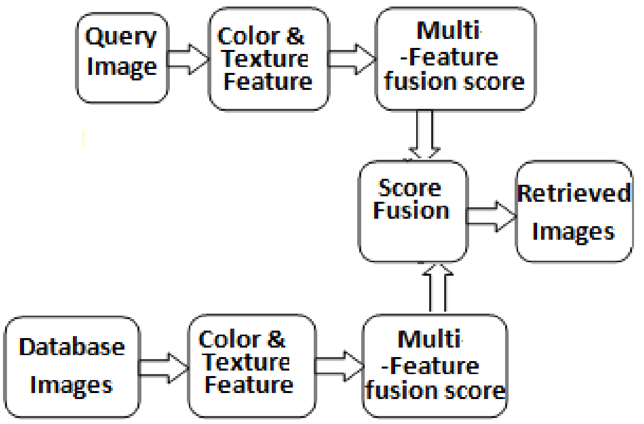
### 1) Extraction of texture using wavelet texture features

Textures can be modeled as quasi-periodic patterns with spatial/frequency representation. The wavelet transform transforms the image into a multi-scale representation with both spatial and frequency characteristics. This allows for effective multi-scale image analysis with lower computational cost. According to this transformation, a function, which can represent an image, a curve, signal etc, can be described in terms of a coarse level description in addition to others with details that range from broad to narrow scales

Unlike the usage of sine functions to represent signals in Fourier transforms, in wavelet transform, we use functions known as wavelets. Wavelets are finite in time, yet the average value of a wavelet is zero [9]. In a sense, a wavelet is a waveform that is bounded in both frequency and duration. While the Fourier transform converts a signal into a continuous series of sine waves, each of which is of constant frequency and amplitude and of infinite duration, most realworld signals (such as music or images) have a finite duration and abrupt changes in frequency. This accounts for the efficiency of wavelet transforms. This is because wavelet transforms convert a signal into a series of wavelets, whichcan be stored more efficiently due to finite time, and can be constructed with rough edges, thereby better approximating real-world signals [9].Examples of wavelets are Coiflet, Morlet, Mexican Hat, Haar and Daubechies.

### Extraction of Textures using Gabor filter

In image processing, a Gabor filter, named after Dennis Gabor, is a linear filter used for edge detection. Frequency and orientation representations of Gabor filters are similar to those of the human visual system, and they have been found to be particularly appropriate for texture representation and discrimination. In the spatial domain, a 2D Gabor filter is a Gaussian kernel function modulated by a sinusoidal plane wave. The Gabor filters are self-similar: all filters can be generated from one mother wavelet by dilation and rotation Its impulse response is defined by a harmonic function multiplied by a Gaussian function. Because of the multiplication-convolution property (Convolution theorem), the Fourier transform of a Gabor filter's impulse response is the convolution of the Fourier transform of the harmonic function and the Fourier transform of the Gaussian function. The filter has a real and an imaginary component representing orthogonal directions.




Quantifying texture content of an image is the most important method to image region description. No formal definition for texture, but we can say that it provides the measures of properties such as smoothness, coarseness, and regularity. Furthermore, texture can be thought as repeated patterns of pixels over a spatial domain. If the texture has exposed to some noise, the patterns and their repetition in the texture can be random and unstructured. Since there is no accepted mathematical definition for texture, many different methods are proposed for computing texture. Among these methods, no single method works best with all types of texture. Some common methods are used for texture feature extraction such as statistical, model-based, and transform-based methods.

### CBIR System Based on Single Feature

- The Content Based Image Retrieval System takes the color feature of the image
- Single image feature describes the content of an image from a specific angle.
- It may be suitable for some images, but it also may be difficult to describe other images.

### Similarity Measurement

- Energy: The energy measure tells us something about how the intensity levels are distributed
- Entropy:The entropy is a measure that tells us how many bits we need to code the image data
- Standard deviation:The standard deviation, which is also known as the square root of the variance, tells us something about the contrast
- Probability
- Skew

Moment 1: Mean

$$E_i = \frac{1}{N}\sum_{j=1}^{N} p_{ij} \quad (1)$$

Moment 2: Standard Deviation

$$\sigma_i = \sqrt{\left(\frac{1}{N}\sum_{j=1}^{N}(p_{ij} - E_i)^2\right)} \quad (2)$$

Moment 3: Skewness

$$s_i = \sqrt[3]{\left(\frac{1}{N}\sum_{j=1}^{N}(p_{ij} - E_i)^3\right)} \quad (3)$$

The color feature similarity measure is given by

$$S_{color}(Q,I) = \sum_{i=1}^{N_Q}\sum_{j=1}^{N_I} d_{i,j}S_{i,j} \quad (4)$$

Where $N_Q$ and $N_I$ denotes the number of dominant colors of the query image Q and the target image I respectively.

When retrieving the images we calculate the similarity between the query image and each target image in the image database, and then sort the retrieval results according to the similar value using Distance measurement Method :

- Euclidean Distance
  $\mathrm{Sqrt}((X_2 - X_1)^2 + (Y_2 - Y_1)^2)$
- Manhattan Distance

Take the sum of the absolute values of the differences of the coordinates. For example, if
X=(a, b) and y=(c, d), the Manhatten distance between x and y is |a - c| + |b - d|.

- Mahalanobis Metric

$$D_M(x) = \sqrt{(x-\mu)^T S^{-1} (x-\mu)}.$$

- Canberra Distance
- Bray Curtis Distance

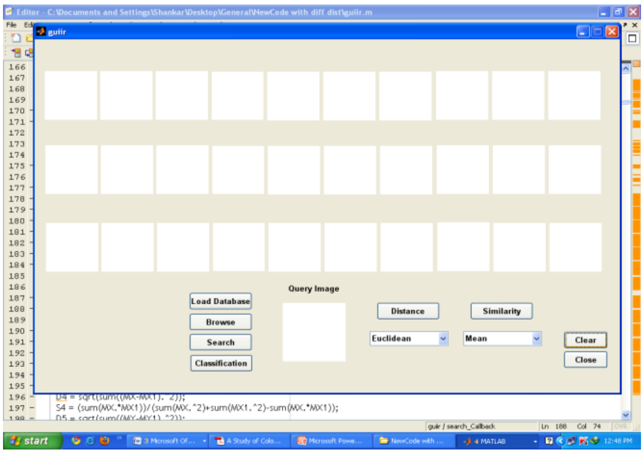
Minkowski Distance= $\left(\sum_{i=1}^{n}|x_i - y_i|^p\right)^{1/p}$

**Multi-feature Score Method:**

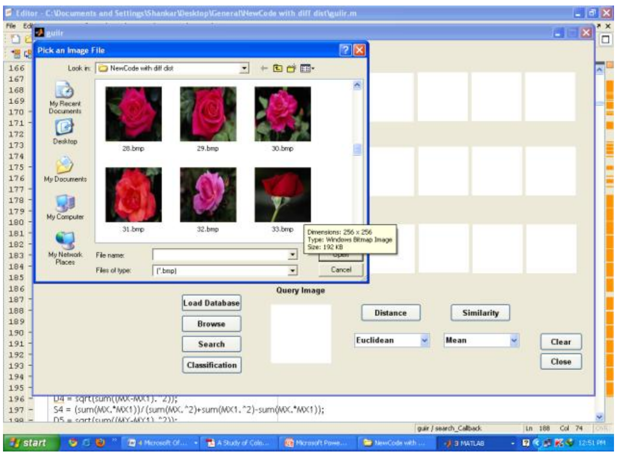
- This paper proposes an image retrieval method based on multi-feature similarity score fusion
- This paper analyzed image retrieval results based on color feature and texture feature, and proposed a strategy to fuse multi-feature similarity score.
- Further, with this algorithm, the weights of similarity score are assigned automatically, and a fine image retrieval result is gained.
- This paper only discusses the fusion method of two-feature similarity score.
- Color & Texture Features are taken for similarity score

## 5. Results

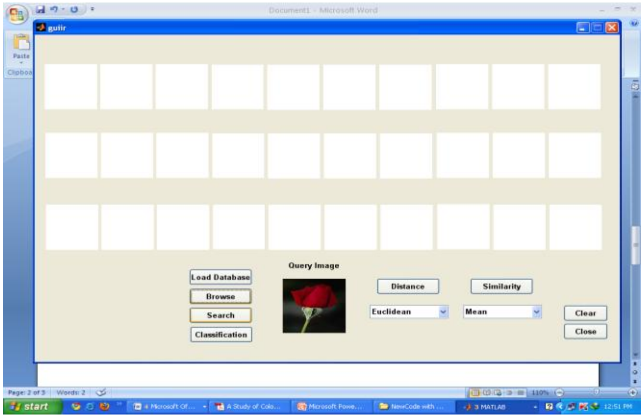
**Loading Data Base**



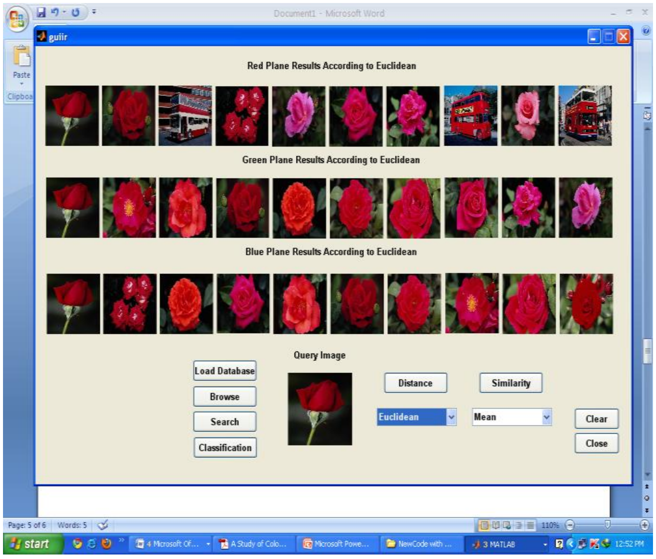

**Selecting Query Image**




**Searching**




**Classification**

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