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RESEARCH ARTICLE

FUSION APPROACH TO CONTENT BASED IMAGE RETRIEVAL USING COLOR AND PHASE CONGRUENCY

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ABSTRACT

Based on a user's query, Content Based Image Retrieval (CBIR) returns photos of similar types from an image repository. It is necessary to extract colour, texture, or shape attributes from the photographs and store them in the feature database in order to find comparable images. The properties of the query image such as its colour, texture, or shape are compared to those of the photos stored in the database. CBIR is a image retrieval system that retrieves similar type of images from database of images. Generating a novel set of descriptors for feature matching is challenging task in IR Systems. Colour, texture, or shape distance measurements are used in this comparison. In order to increase the CBIR System's accuracy, we present a novel system that integrates colour and log Gabor wavelet-based feature detectors.

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INTRODUCTION

Content-Based Image Retrieval, or CBIR, is the process of extracting comparable pictures from an image repository by using attributes like colour, texture, or form. The conventional techniques for indexing images, which involve allocating a number or keyword to a picture together with a classified description, have shown to be inadequate and laborious. It is not a CBIR system. Colour, texture, and form properties are taken from each picture in the dataset and matched to the features of the input image in CBIR (6). The feature database in conventional CBIR systems (Fig. 1) stores the characteristics derived from the pictures (2-7). A query image is entered by the user into the retrieval system to obtain a comparable group of photos. Next, the query image's feature vector is extracted by the system. The user is then shown the results of the retrieval through the use of an indexing strategy. Distance metrics are used to determine the likeness between the feature vectors of the query picture and those of the database images.CBIR involves two steps. The first stage determinescolor, texture or shape properties. The second stagecalculateslikeness between the feature vectors of the input image and those of the images in the database. CBIR requires two actions (2-7). Features with colour, texture, or form are extracted in the first stage. The subsequent phase involves identifying commonalities amongthe feature vectors of the input picture and those of the dataset images. CBIR applications (2-7) are utilized for access rights and crime prevention. They include automatic facial recognition systems and iris recognition systems. It is also utilized in a medical picture database to discover comparable instances from the past, which aids in diagnosis.

Extraction of Features: Feature extraction primarily makes use of the colour, texture, and form feature descriptors.

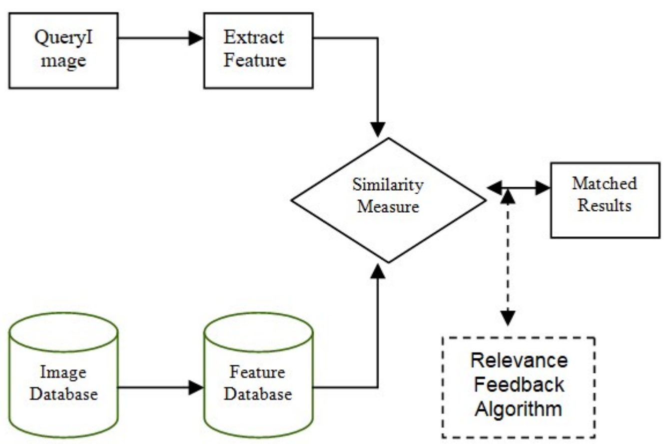

Figure 1. CBIR System

a) **Color Schemes:** A key component of humanoid visual insight (HVS) that is utilized to separate and identify visual information is colour. Colour histograms are the primary means by which colour information about pictures is represented in CBIR systems.
b) **Features of Textures:** All surfaces, including bricks, leaves, textiles, flowers, and other objects with homogeneous qualities, have a texture that specifies visual patterns. It gives details on the

surface's structural configuration. It is, in essence, a characteristic that characterizes a surface's physical makeup.

c) Shape Features: An object's contours or outline can be defined as its shape. It allows the outline of an item to stand out from its backdrop. Boundary-based or region-based shape feature representations are possible.

The outside edge of the object is used by the boundary-based shape feature. The pixels that border the item are taken into account. Using the internal features of the considered region—that is, the pixels inside it—the region-based shape feature makes use of the whole form region.

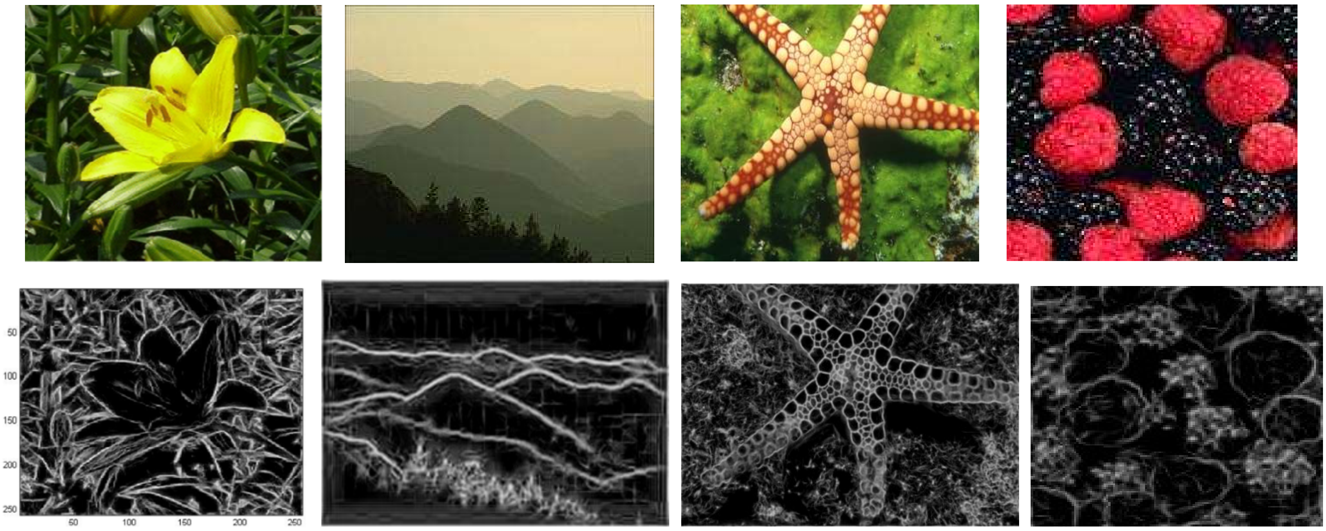

Figure 2. Original Image and Corresponding Phase Congruency Feature Map

Phase BAsed Feature detector: The phase-based feature detector, also known as phase congruency, is a unique feature detector (2, 8, 9, 10, 11, 15, 16)). Boundary and step responses are detected. Its features include consistency to magnification and variations in illumination within photos. The local energy model suggests that a place in an image where the Fourier elements are in phase is where features are seen. Owens and Morrone created this model (3). Phase congruency values are highest around the object's border and edge points. Thus, phase congruency may be employed in CBIR systems as a detection method for features for obtaining shape information from images.

Logarithmic-Wavelet Filters for Shape Information: A logarithmic Gabor wavelet approach for calculating phase congruency was suggested by Peter Kovesi (2. 10, 11, 15, 16). The logarithmic wavelets are utilized is because they can large frequency assortment. It maintains zero direct current components. Directional coordinate systems are used to build filters in the frequency domain. The radial and rotational components of the filter are its two constituent parts. The overall filter is built by multiplying two components. A collection of log Gabor wavelets at various orientations and sizes are used to compute phase congruency in picture convolution. The transfer function of 1-D log Gaussians has the following shape when viewed radially:

$$g(w) = e^{\frac{-(\log(w/w_0))^2}{2(\log(k/w_0))^2}} \quad (1)$$

Where w_0 = filter's center frequency. It is moreover required to have the value k/w0 persistent for variable center frequency in direction to generate persistent-size proportion filters.

The definition of the GCS (Gaussian) in the rotationalway is

$$G(\theta) = \frac{(\theta-\theta_0)^2}{2\sigma_\theta^{\,2}} \quad (2)$$

Where the regular deviance of the GCS (Gaussain) in the rotational path is signified by σ_o and the location position of the filter is signified by θ_o. The estimated noise impact is then subtracted from the energy E(x) at each position in the picture for each orientation. Apply the frequency spread Wo(x) weighting to remove false responses to noise, then calculate the total across all orientations. After that, the total energy is standardized by distributing it by the totality of the amplitudes of each discrete wavelet reply at that specific place in the picture across all locations and measures. As a result, the 2-D phase congruency equation is as follows:

$$E_{no} = A_{no}(x)\Delta\phi_{no}(x) \quad (3)$$

$$PC(x) = \frac{\sum_o\sum_n W_o(x)\lfloor E_{no}(x)-T\rfloor}{\sum_o\sum_n A_{no}(x)+\varepsilon} \quad (4)$$

Where, $A_{no}(x)$ is the amplitude of the filter pair, where o and n stand for the index over rotational position and scale, correspondingly. What is defined as the phase deviation function is

$$\Delta\phi_{no}(x) = \cos(\phi_n(x)-\overline{\phi(x)}) - \left|\sin(\phi_n(x)-\overline{\phi(x)}\right| \quad (5)$$

The noise T is defined as –

$$T = \mu_R + k\sigma_R \quad (6)$$

Where μ_R and S_R are the mean and variance of Rayleigh distribution. The Weighting function is defined as

$$W(x) = \frac{1}{1+e^{g(c-s(x))}} \quad (7)$$

N is the number of scales, and the amplitude is represented by Amax(x)., e is a small non-zero value to evade divide by zero, c, the threshold if the value of Phase congruency is below, value is omitted.

Extracting Color Informaation: Colour is one of the most significant characteristics that enable human identification of pictures. The properties of colour rely on how light is reflected into the eye and how the brain interprets that information. Colour histograms are the primary means by which colour information about pictures is represented in CBIR systems. A colour histogram can be classified as either a local or global colour histogram. A single colour histogram for a whole image is represented by a GCH. An LCH extracts the colour histogram from each of the fixed blocks that make up the picture.

When comparing photos, LCHs are computationally costly yet hold more information about the image. In order to extract the colour characteristics of photos, we employed global colour histograms. (7)

FEAture Integration and Similarity Distance Measure: First Phase congruency is utilized for feature extraction in order to obtain a comparable group of pictures. Between each picture in the database and the phase congruency map of the query image, the Euclidean distance is computed. After the Euclidean distance method is finished, an array of Euclidean distances is produced, and this array is sorted. The outcomes of phase congruency comparison are then used to the sorting of photos according to colour similarity. Colour characteristics are represented by colour histograms. In order to solve the issue of disparate colour mappings, we employ the quadratic distance metric to detect similarities.

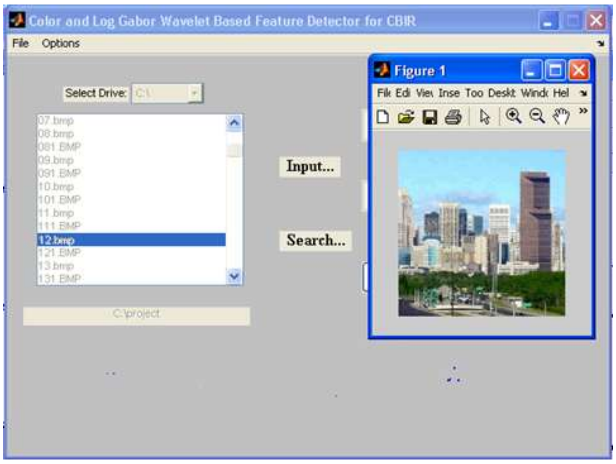

Figure 3. CBIR System

Figure 4. Phase Congruency Based CBIR Systems

Figure 5. Phase Congruency + Color feature Based CBIR Systems

Figure 6. Phase Congruency Based CBIR System : Query Image

EXPERIMENTAL RESULTS

We keep a thousand photos on a computer in order to build our system. The system is implemented using MATLAB image processing tools. We applied an integrated strategy to CBIR. For feature extraction, First Phase congruency is employed. Phase characteristics of the query image and photos in the database are compared using the Euclidean distance metric. Next, in order to increase the system's accuracy, we employ colour characteristics. The outcomes of the experiment are promising.

CONCLUSION

Low-level features include phase congruency, or phase-based feature detectors. It demonstrates excellent capacity to extract shape information from images. When paired with colour characteristics, it can increase the CBIR System's accuracy.

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