An Introduction of Wavelet Transform and how it helps in Extracting an Image from Image Database

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Abstract— Images are widely used and measure as a prime factor of communication, commercial as well as official transactions on an effective scale. The problem involves entering an image as a query into a database that is designed to employ CBIR techniques in extracting visual properties, and matching them. Hence the need of efficient and effective tools for retrieval of query images from database is increased significantly. CBIR is a technique for retrieving images on the basis of automatically-derived features such as color, texture and shape. Feature extraction used is a technique to extract feature vectors of an image based on color, shape, texture etc. which is generally known as image data. In this paper, a highly scalable, pluggable and faster CBIR system is proposed, which is capable of operating on enormous amounts of image, which, in turn, induces the need for sufficient storage capacity and significant processing power.

Key words: CBIR, DCT, Walsh, Kekre, Haar & hybrid Wavelet

I. INTRODUCTION

Content Based Image Retrieval is an application of computer vision where digitally similar images are retrieved from the large database on the basis of their content. Content in this context refer to the Information that describes the image like color, texture, and shapes (figure 1). The detailed survey on content based image retrieval can be referred [1, 2, 3].

A. *Color Based Retrieval*

The technique which is used is based on the technique of color histogram in CBIR. Color Histogram of each image is calculated and then stored in the database which represents the proportion of pixel of each color within the image. Then matching algorithm will extract those images from the databases whose color histogram matches with the required one. There are various types of histograms: normal, weighted, dominant, and fuzzy, various color spaces: HSV, grayscale, HSL, Lab, Luv, HMMD, and YCbCr.

B. *Texture Based Retrieval*

This is a very important characteristic of an image because it is able to distinguish two images with same color and shape. Variety of techniques has been proposed for matching the texture similarity. Tamura et al. [4], proposed a texture representation on 6 statistical features, including, coarseness, contrast, directionality, line-likeness, regularity, and roughness. These features were considered to be the most visually meaningful. Various techniques designed for texture feature extractions are: statistical parameters, entropy measures, transformed spaces and Markov Hidden Fields algorithms.

C. *Shape Based Retrieval*

This is a well defined term, which refers to the shape of the image. This is feature which naturally distinguishes the images. There are two main features of the shape: Global feature (like aspect ratio) and local feature (like boundary segments). Shape of an image can be represented using area, perimeter, radiuses, skeleton, statistics moments, form signature, Fourier and Hough contour signature.

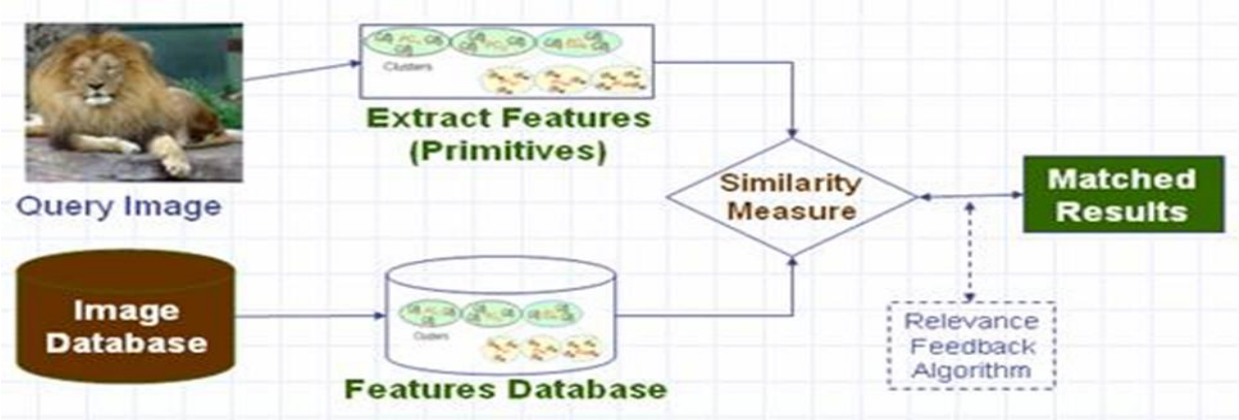

Fig. 1: Generic CBIR System

II. INTRODUCTION OF DIFFERENT WAVELET TRANSFORMS

A. *DCT*

Discrete Cosine Transform (DCT) is a technique for Image Compression which converts a signal into elementary frequency components. The Discrete Cosine Transform (DCT) attempts to de correlate the image data. After de correlation each transform coefficient can be encoded independently without losing compression efficiency.

In this transform, image is broken into 8x8 blocks of pixels. DCT is applied to each block from left to right, top to bottom. Each block is compressed through quantization. The array of compressed blocks that constitute the image is stored in a drastically reduced amount of space. When desired, the image is reconstructed through decompression, a process that uses the inverse Discrete Cosine Transform (IDCT).

B. *Walsh Transform*

Walsh transform is non-sinusoidal orthogonal transform that decomposes a signal into a set of orthogonal rectangular waveforms called Walsh functions. The transformation has no multipliers and is real because the amplitude of Walsh functions has only two values, +1 or 1.

Walsh functions are rectangular or square waveforms with values of -1 or +1. An important characteristic of Walsh functions is sequency which is determined from the number of zero-crossings per unit time interval. Every Walsh function has a unique sequency value. Walsh wavelet is generated from Walsh Transform using steps in [5].

C. *Kekre Transform*

Kekre's transform matrix [6] has the advantage that it need not be of size having integer power of 2. It can be of any size NxN. All diagonal and upper diagonal elements of Kekre transform are 1 whereas; all lower diagonal elements except the elements just below the diagonal are zero.

D. *Haar Transform*

Haar wavelet is discontinuous, and resembles a step function. Haar used these functions to give an example of an orthonormal system for the space of square-integrable function on the unit interval [0, 1]. Haar Wavelet For an input represented by a list of numbers, the Haar wavelet transform may be considered to simply pair up input values, storing the difference and passing the sum. This process is repeated recursively, pairing up the sums to provide the next scale, finally resulting in differences and one final sum. The Haar Wavelet Transformation is a simple form of compression which involves averaging and differencing terms, storing detail coefficients, eliminating data, and reconstructing the matrix such that the resulting matrix is similar to the initial matrix [7,8].

A Haar wavelet is the simplest type of wavelet. In discrete form, Haar wavelets are related to a mathematical operation called the Haar transform. The Haar transform serves as a prototype for all other wavelet transforms. Like all wavelet transforms, the Haar transform decomposes a discrete signal into two sub-signals of half its length. One sub-signal is a running average or trend; the other sub signal is a running difference or fluctuation.

E. *Hybrid Wavelet Transform*

H. B. Kekre, Tanuja Sarode and Sudeep Thepade introduced the concept of hybrid wavelet transform in [9] An idea behind use of hybrid wavelet transform is to explore the good properties of two different transforms by combining them into hybrid wavelet transform (figure 2, 3 & 4). Use of hybrid wavelet transforms generated from Kekre Walsh Transform, Kekre DCT Transform, Kekre Hartley transform and Kekre Haar transform have been explored by authors very successfully for image compression. Hybrid wavelet transform is also proved better in other image processing applications like image retrieval in [10] and biometrics applications like palm print identification in [11].

Fig. 2: Feature Extraction using Hybrid Wavelet

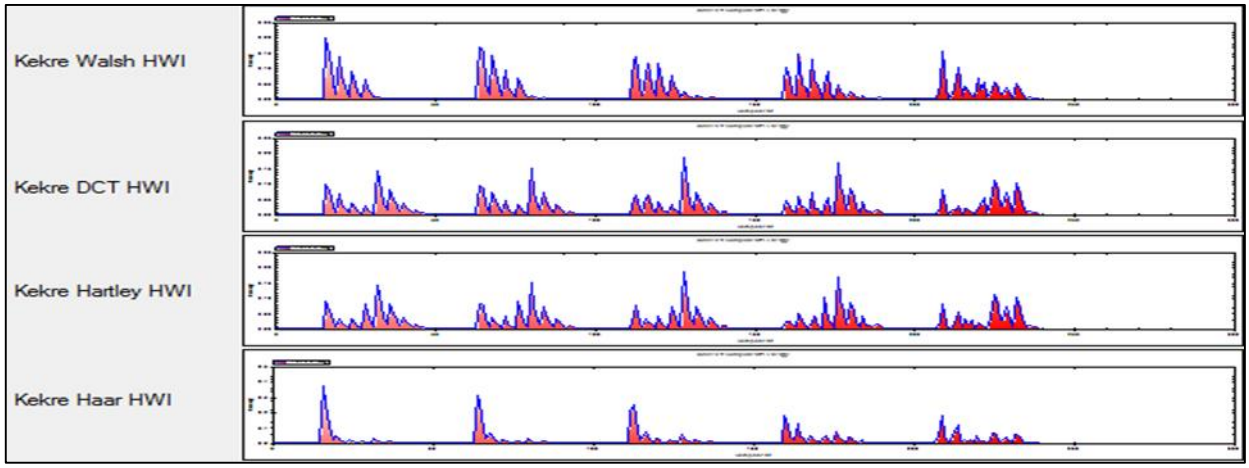

Fig. 3: Hybrid Wavelet I

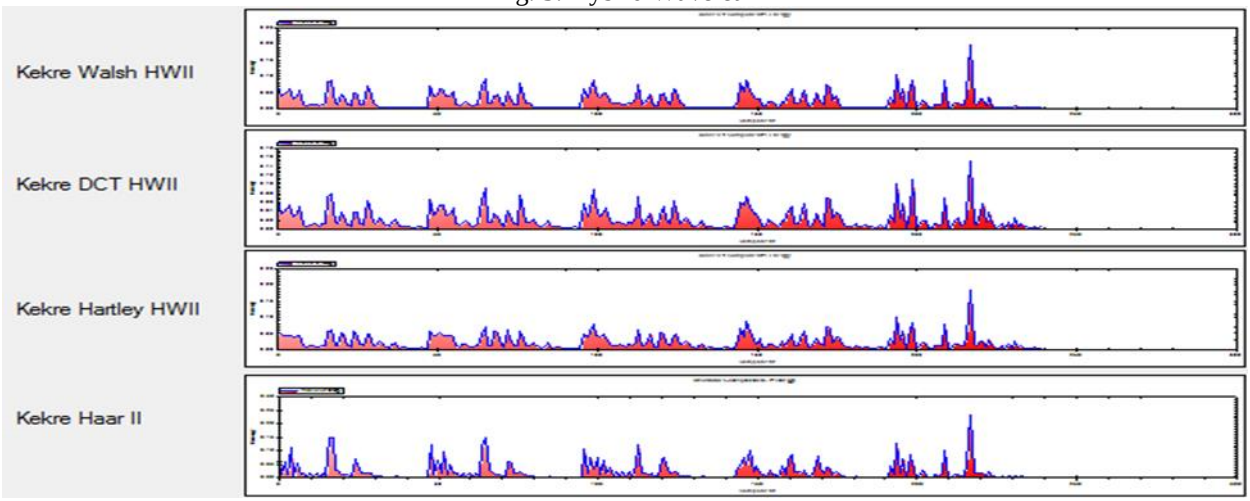

Fig. 4: Hybrid Wavelet II

III. METHODOLOGIES

The solution which we proposed is to extract the primitive features of a query image and compare them to those of database images. The image features under consideration were color, texture and shape. Thus, using matching and comparison algorithms, the color, texture and shape features of one image are compared and matched to the corresponding features of another image. This comparison is performed using color, texture and shape distance metrics.

Following methodologies will be used in the proposed work

- Collection of Image Database
- Feature Extraction
- Similarity Measures
- Comparison of results with other techniques

Algorithm

A. *Collection of Image Database*

- We consider a database containing 100 images with the formats .jpeg.
- The images will be from RGB color model.

B. *Feature Extraction*

- Feature Extraction is carried out by using colors, using textures or by using shapes. For color feature extraction, color histograms such as Local Color Histogram (LCH), Global Color Histogram (GCH) and Fuzzy Color Histogram (FCH) are used. For extracting textures Statistical, Structural, Spectral approaches are used. In addition to this, Tammura Texture and Wavelet Transform are used. Boundary-based and Region-based color representation are used with Fourier Descriptor (Fourier transformed boundary) and Moment Invariants (Region based moments).
- The images are registered with their corresponding features such as color, texture, shape.
- These extracted features will be forwarded to Feature Vector Module

C. *Similarity Measures*

The Direct Euclidian Distance between an image P and query image Q can be given as the equation below ED=∑ (Vpi -Vqi). (Vpi -Vqi).
Where, Vpi and Vqi be the feature vectors of image P and Query image Q respectively with size 'n'

D. *Comparison of results with other techniques*

– When the user passes a query image, the composite feature vector of both query image and the image which is stored in database will go through Similarity Comparison

E. *Finally the image will be retrieved.*

IV. CONCLUSION

In this paper we Design and Develop a system for Features Extraction of images for Content Based Image Retrieval (CBIR) And propose a novel method with highly accurate and retrieval efficient approach which will work on large scale of image database with varied contents and background. It Optimize the effectiveness and accuracy of the CBIR system.

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