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Content Based Image Retrieval by Using Daubechies Wavelet Transform

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ABSTRACT— In this paper, a new algorithm for image indexing and retrieval using Daubechies Wavelet Transform (DWT) is presented. In this DWT has been implemented by using wavelet sub-bands of R, G and B components of images from Coral-1000 database. The database images are decomposed up to third level decomposition. The features of database images are stored in matrix. The query image is decomposed up to third level decomposition by same method and its features are compared with saved database features by using City-block and Euclidean distances and top-20 similar images are retrieved. The extracted wavelet features and the retrieval results demonstrate significant improvement in precision and average retrieval rate. From experimental results it is revealed that Dinosaur class gives excellent results.

KEYWORDS—CBIR, Image database, Wavelet Transform, Daubechies Wavelet Transform, Similarity measure.

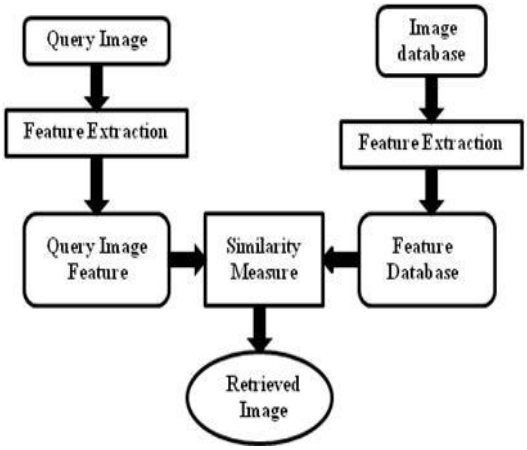
I. INTRODUCTION

Now days digital images are used for storing the information contained in a variety of domains. It makes difficult for a user to find out an image within an entire database. Therefore, an efficient, reliable and automatic procedure is needed for indexing and retrieving images from databases. A CBIR method which shown in fig.1 is produced more accurate retrieval results. Thus, the concept of recognizing images with respect to their content came into existence. Content includes color, shape, texture or any piece of the accuracy of the image and thus content based image retrieval techniques are now in favor. The concept of retrieving images based on their content is called as CBIR [1, 3].The CBIR system based on color, texture and shape are low level image features. From database images low level features are extracted and stored in a feature database. Similarly, the low level features of query image are extracted compared with the database image features using the distance measure. The images having the least distance with query image generates the result [6].

The Daubechies wavelet transform is used for retrieval of images. The section II discusses image database, section III gives details of wavelet transform, section IV describes feature extraction, section V gives similarity measure, section VI deals with performance

measure parameters & section VII gives the results of Daubechies family.

Fig.1 CBIR Syste



II. IMAGE DATABASE

The dataset used by research groups are the Corel photo 100 pictures roughly similar in theme. Predefined groups of the same subject such as the Corel Photo CDs are interesting because they are easy to use without any effort. Whereas the fact that groups contain very dissimilar images which gives reasons for manipulations [7].

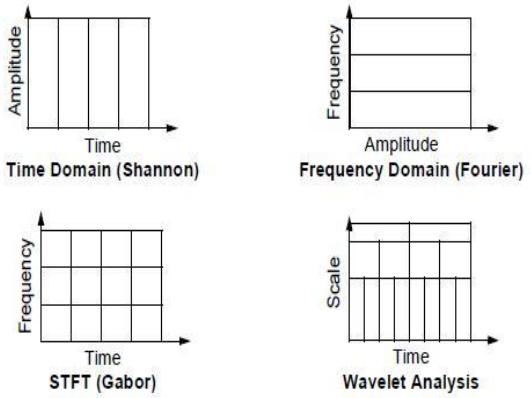
Fig.4 Image Decomposition
Fig.2 COREL Image Database

Corel image database of 1000 images have been used. Each image is of size 256x384. There are 10 classes in this database like Africans, Beaches, Buildings, Buses, Dinosaurs, Elephants, Flowers, Horses, Mountains and Food Dishes in database as shown in fig. 2. Each class contains 100 images. This image database has been used to demonstrate the performance of content-based image retrieval systems.

III. WAVELET TRANSFORM

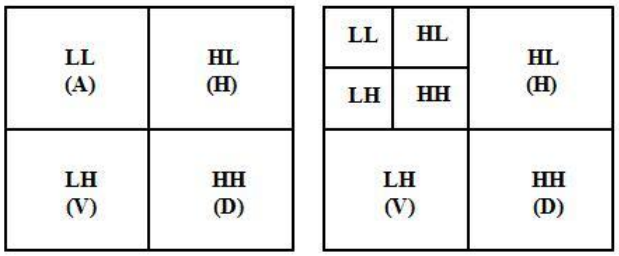
The transforms are mainly based on small waves, called *wavelets*. It shows that both the frequency and temporal information uses wavelets. Human vision is much more sensitive to small variations in brightness or color that is more sensitive to low frequency signals. To determine the low frequency area and high frequency area wavelet transform has been used.

Wavelet analysis shown in fig.3 represents a windowing technique with variable-sized regions. Wavelet analysis allows uses of long time intervals where we want more precise low frequency information, and shorter regions where we want high frequency information. [2]



This analysis is capable of revealing aspects of data that other signal analysis techniques like breakdown points, discontinuities in higher derivatives, trends, and self-similarity also compress as well as de-noise a signal without appreciable degradation were miss.

A. Image Decomposition



Where,

LL - Approximation details of the original image.
HL - Horizontal details of the original image.
LH -Vertical details of the original image.
HH- Diagonal details of the original image. (L=Low, H=High).

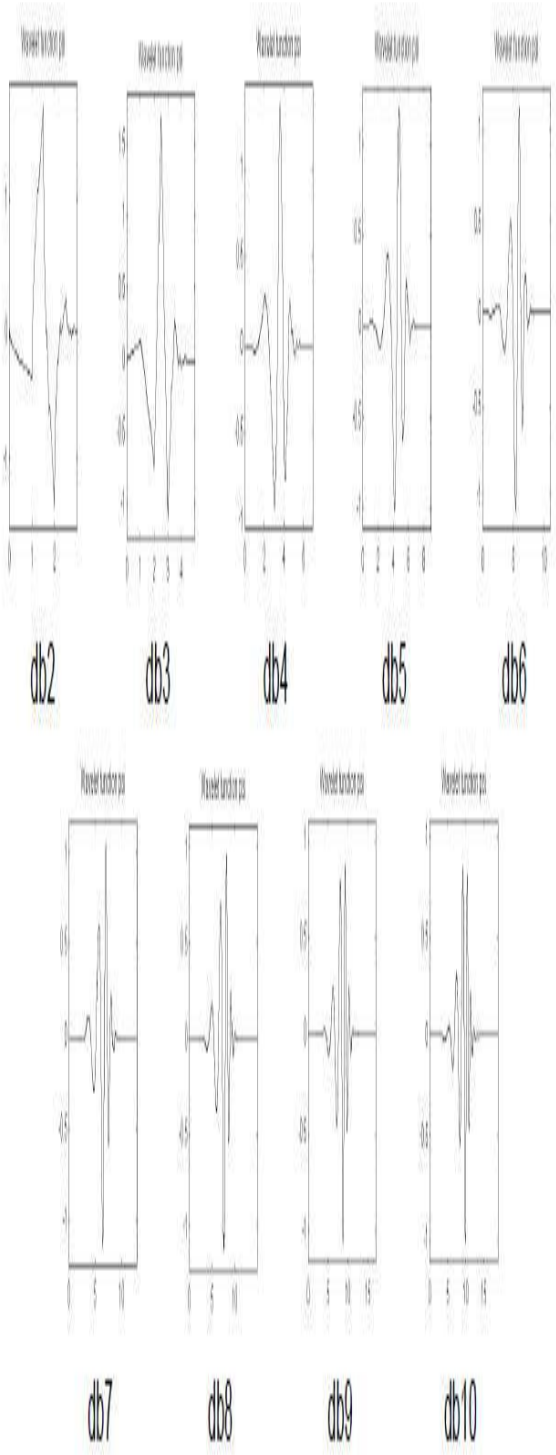
In decomposition, firstly image is decomposed into four sub bands i.e. LL, HL, LH and HH called One Level Decomposition. The LL- sub band further decomposed then called Two Level Decomposition shown in fig.4 [4, 8].

B. Daubechies Wavelet Transform

Daubechies family wavelets are written as dbN, where N is the order, and db the "surname" of the wavelet.

There are total 10 Daubechies families. The db1 wavelet is the same as Haar. Families of the Daubechies are as shown in fig.5

Fig5 Daubachues Families



Gabor functions provide the optimal resolution in both the time and frequency domains, but Gabor wavelet suffered through few disadvantages and these are as follows –

1. There is no efficient algorithm exists for computing the forward & inverse transformation.
2. For storage it requires large space because Gabor function do not form orthogonal basis set. Hence representation will not be compact.**Fig.3 WaveleAnalysis**

3.For feature extraction quite high computational time is required, which limit retrieval speed.

To overcome from these disadvantages we use the Daubechies wavelet transform. Some properties of Daubechies wavelet transforms are –

1. High compressibility.
2. Finite number of filter parameters implementations.
3. Fine scale amplitudes are very small in regions where the function is smooth.

IV. FEATURE EXTRACTION

Feature Extraction is done 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 also used [5].

In this paper wavelet feature extraction has been used. Firstly we extract the Red colors of the each image & decompose red color up to third level decomposition. Find the image decomposition factor like mean, standard deviation & entropy. Same procedure is followed for the Green & Blue color. The feature matrix of 1000X9 (1000 images & 9 columns) has been used. Feature vector of query image is compared with this feature matrix & retrieve the images.

V.SIMILARITY MEASURES

Once we extract a good set of features, we compare the extracted feature for similarity; if good sets of features are extracted of query image and compared with features of database images then similarity between two images is given by how close these two images are. There are different kind of similarity measure like Euclidean Distance, Manhattan Distance and Canberra Distance as given by equation 1, 2 and 3 respectively [4].

VI.ALGORITHM

1. *Collection of image database*

Take COREL image database of 1000 color image. In this database there are 10 classes & each class containing 100 images.

2. *Read & Write image*

Read the image by giving the correct path to the system & write the given image in dialog box.

3. *Feature Extraction*

For feature extraction many feature extraction techniques are available. We used Wavelet feature extraction technique. In this firstly extract the RGB colors of the images. For decomposition each image decomposes up to third level decomposition & finds the decomposition factors like mean, standard deviation & entropy.

4. *Similarity Measure*

For finding the similarities in the images we use some distances. These are Euclidean distance, Manhattan distance, Canberra distance. By using these distances we find the similarity between images & retrieve most similar images with query image.

5. *Comparing the result*

While using the Daubechies wavelet transform we find the retrieval result for each family & by comparing the result find the family which give excellent results.

- Euclidean Distance

$$d_E(x, y) = \sqrt{\sum_{i=1}^{d}(x_i - y_i)^2} \quad \ldots (1)$$

- Manhattan Distance

$$d = \sum_{i=1}^{n} | Xi - Yi | \quad \ldots (2)$$

- Canberra Distance

$$Canb(x, y) = \sum_{i=1}^{d} \frac{| x_i - y_i |}{| x_i | + | y_i |} \quad \ldots (3)$$

VII.PERFORMANCE MEASURE PARAMETERS

A. Precision

Precision is defined as the ratio of the number of retrieved relevant images to the total number of retrieved images. We denote the precision by P [3].

$$P = \frac{\text{Number of relevant images are retrived}}{\text{Total number of images retrived}}$$

B. Recall

Recall is defined as the ratio of the number of retrieved relevant images to the total number of relevant images in the database. We denote to the recall by R [3].

$$R = \frac{\text{Number of relevant images are retrived}}{\text{Total number of relevant images in database}}$$

VIII.RESULTS FROM DAUBECHIES WAVELET TRANSFORM (db6 & db4)

Table 1 and 2 show the results of Daubechies Wavelet Family db4 & db6 which uses mean, standard deviation and entropy for Euclidean distance & Manhattan distance respectively.

TABLE I
RESULTS OF AVERAGE PRECISION & AVERAGE RECALL BY EUCLIDEAN DISTANCE BY USING MEAN, STANDARD DEVIATION & ENTROPY

Sr. No.	Image Class	P (%)	R (%)
1.	Africans	65	13
2.	Beaches	75	15
3.	Buildings	60	12
4.	Buses	65	13
5.	Dinosaurs	100	20
6.	Elephants	75	15
7.	Flowers	100	20
8.	Horses	95	19
9.	Mountains	60	12
10.	Food Dishes	70	14
Average		76.5%	15.3%

TABLE II
RESULTS OF AVERAGE PRECISION & AVERAGE RECALL BY MANHATTAN DISTANCE BY USING MEAN, STANDARD DEVIATION & ENTROPY

Sr. No.	Image Class	P (%)	R (%)
1.	Africans	65	13
2.	Beaches	75	15
3.	Buildings	60	12
4.	Buses	65	13
5.	Dinosaurs	100	20
6.	Elephants	75	15
7.	Flowers	100	20
8.	Horses	95	19
9.	Mountains	60	12
10.	Food Dishes	70	14
Average		76.5%	15.3%

Table 3 shows the results of Daubechies Wavelet Family db4 & db6 which uses mean and standard deviation for Canberra distance.

TABLE 3
RESULTS OF AVERAGE PRECISION & AVERAGE RECALL BY CANBERRA DISTANCE BY USING MEAN & STANDARD DEVIATION

Sr. No.	Image Class	P (%)	R (%)
1.	Africans	60	12
2.	Beaches	95	19
3.	Buildings	60	12
4.	Buses	65	13
5.	Dinosaurs	100	20
6.	Elephants	80	16
7.	Flowers	90	18
8.	Horses	100	20
9.	Mountains	65	13
10.	Food Dishes	65	13
Average		78.0%	15.6%

In fig. 6 & 7 took query image of class Horse and find retrive images for that class uses Euclidean distance to measure the precision and recall parameter.

Fig.6 Query Image (761.jpg)

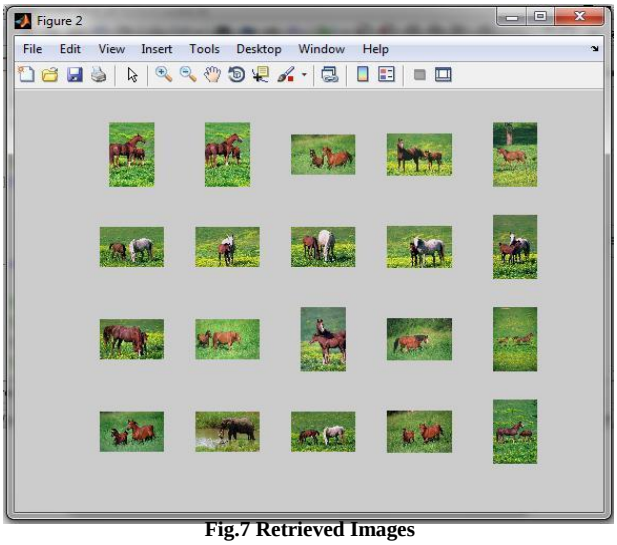


Fig.7 Retrieved Images

IX. CONCLUSION

The db1 family i.e. Haar wavelet, db4 family, db6 family & db10 family gives the better result by Euclidean distance and Manhattan distance than Canberra distance.

TABLE IV
DWT FAMILIES WITH AVERAGE PRECISION &AVERAGE RECALL

DWT Families	Average Precision	Average Recall
db1	73.5	14.7
db4	76.5	15.3
db6	76.5	15.3
db10	72.0	14.4

From Daubechies wavelet families db4 family & db6 family gives the better result i.e. precision gives 76.5% and recall gives 15.3%. These results are better than the other Daubechies Wavelet Families.

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