

Image Classification Based on Hybrid Compression System

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ABSTRACT

Due to fast development of internet technologies and multimedia archives are growing rapidly, especially digital image libraries which represent increasingly an important volume of information, so, it is judicious to develop powerful browsing computer systems to handle, index, classify and recognize images in database. In this paper a new algorithm image classification is proposed. This paper presents an efficient content-based image indexing technique for searching similar images using daubechies wavelet with discrete cosine transform. The aim of this work was to realize the image classification using hybrid compression system. The image was classified using 10 classes.

اقترح خوارزمية لتصنيف الصور بناء على نظام الدمج لضغط الصورة

الخلاصة

بسبب التطور السريع لتكنولوجيا الانترنت وارشيف الوسائط المتعددة التي تنمو بسرعة، خاصة مكتبات الصور الرقمية التي تمثل خزين هام للمعلومات، لذلك من الحكمة تطوير أنظمة قوية للتصفح تقوم بمعالجة، فهرسة، تصنيف وتمييز الصور في قاعدة البيانات. في هذا البحث تم اقتراح خوارزمية جديدة لتصنيف الصور. في هذه الورقة تقنية جديدة للفهرسة قدمت للبحث عن الصور المتشابهة معتمدة على موجات دوباجيز وتحويل المتقطع للجيب تمام. الهدف من العمل هو ادراك تصنيف الصور باستخدام نظام الضغط. الصورة تم تصنيفها باستخدام 10 اصناف.

Keywords: Image Classification, Compression, Image Features.

INTRODUCTION

The current improvement in the digital storage media, image capturing devices like scanners, web cameras, digital cameras and rapid development in internet provide a huge collection of images. This leads to the retrieval of these images for visual information efficiently and effectively in different fields of life like medical, medicine, art, architecture, education, crime preventions. To achieve this purpose many image retrieval systems have been developed [2]. A successful image classification will

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significantly enhance the performance of the content-based image retrieval system by filtering out images from irrelevant classes during matching. The proposed algorithm improve classical technique by using hybrid compression (daubechies wavelet and discrete cosine), the result of hybrid compression show a good deal of promise.

Image Classification

Image Classification refers to grouping of a digital image into different classes within a particular dataset, based on attribute values. It is done to replace visual analysis of the image data with quantitative techniques. The most important step in an image classification system is the image description. Indeed, features extraction gives a feature vector per image which is a reduced representation of the image visual content, because images are too big to be used directly for Indexing and retrieval [8].Intelligently classifying image by content is an important way to mine valuable information from large image collection. The classification procedures can be "supervised" or "unsupervised".

Supervised Classification

Supervised Classification can identify examples of the information classes of interest in the image. These are called "training sites". Supervised classification categories the unknown pixels into different themes, based on the spectral (or statistical) characteristics of manual defined sampled pixels. After the classification process, all the unknown pixels with similar spectral characteristics of the defined categories is assigned and pixels which have their characteristics difference from the categories is categorized as unknown [5].

Unsupervised Classification

Unsupervised classification is a method which examines a large number of unknown pixels and divides into a number of classed based on natural groupings present in the image values [5].

Image Compression System

Image compression system is used to reduce the amount of data required to represent a given quantity of information, The size of image data files are reduced, while retaining necessary image information[2].In the image compression significance coding, unknown pixels is classified and coded based on the information provided by the known pixels [10].

Transform Coding Techniques

Transform coding relies on the premise that pixels in an image exhibit a certain level of correlation with their neighboring pixels consequently; these correlations can be exploited to predict the value of a pixel from its respective neighbors [2]. Compression schemes that operate in the transform domain, first transform the image using daubechies wavelet transform (DAWT), and then apply the discrete cosine transform (DCT) on low-low(LL) subband to obtain the optimal compressed image. For our work compression system in the two most used transforms (the DCT and DAWT) is explained below.

Daubechies Wavelets Transform (DAWT)

Ingrid Daubechies, one of the brightest stars in the world of wavelet research, invented what are called compactly supported orthonormal wavelets — thus making discrete wavelet analysis practicable. The names of the Daubechies family wavelets are written dbN, where N is the order, and db the “surname” of the wavelet [11].

Image Decomposition

The wavelet filters for sub-band decomposition derived from Daubechies wavelets are of non-linear phase, for this reason they are rarely used in image processing applications, such as denoising and compression. However, Daubechies wavelets can be derived from the mother wavelet high pass and low-pass filters in the dyadic sub-band image decomposition. The coefficients of the lowest frequency band are grouped in the upper left corner, mean while the coefficients of the higher frequency bands are in the other three image corners, in order to obtain the information contained in the images, sub-level signal decompositions is performed to separate the signal characteristics and to analyze them independently [13].Figure (1) shows the transformation of the image into the sub-images. Approximation image is the sub-image compose of the low frequency parts in both row and column directions (LL), and details images are the remaining three images, containing high frequency components (LH, HL, and HH).

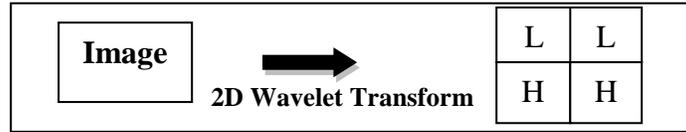


Figure (1): Transformation of The Image into Sub-Images [14].

- The scaling function coefficients are:

$$h0 = 1 + \frac{\sqrt{3}}{4\sqrt{2}} \dots (1)$$

$$h1 = 3 + \frac{\sqrt{3}}{4\sqrt{2}} \dots (2)$$

$$h2 = 3 - \frac{\sqrt{3}}{4\sqrt{2}} \dots (3)$$

$$h3 = 1 - \frac{\sqrt{3}}{4\sqrt{2}} \dots (4)$$

- The wavelet function coefficient values are [49]:

$$g0 = h3 \dots (5)$$

$$g1 = -h2 \dots (6)$$

$$g2 = h1 \dots (7)$$

$$g3 = -h0 \dots (8)$$

The sub band LL represents the approximation of the original signal, while the sub bands LH, HL, and HH represent the details [14].

Discrete Cosine Transform

Discrete cosine transform is a lossy compression algorithm that discards those frequencies which do not affect the image as the human eye perceives it [8]. Minimizes the amount of visible blocking artifacts compared to other transforms provides a good compromise or balance between information packing ability and computational complexity [1]. The two dimensional DCT can be written in terms of pixel values $f(i, j)$ for $i, j = 0, 1, \dots, N-1$ and the frequency-domain transform coefficients $F(u, v)$ [3]:

$$F(u, v) = \frac{1}{\sqrt{2N}} C(u) C(v) \sum_x \sum_y \overline{\cos \left[\frac{\pi(2x+1)u}{2N} \right]} \cos \left[\frac{\pi(2y+1)v}{2N} \right] \quad \dots (9)$$

For $u = 0, 1, 2, \dots, N-1$. Similarly, the inverse transformation is defined as

$$F(i, j) = \sum_x \sum_y C(u) C(v) F(u, v) = \cos \left[\frac{\pi(2x+1)u}{2N} \right] \cos \left[\frac{\pi(2y+1)v}{2N} \right] \quad \dots (10)$$

For $x = 0, 1, 2, \dots, N-1$. In both equations (1) and (2) $C(x)$ is defined as $c(x)$

$$= \begin{cases} \frac{1}{\sqrt{N}} & \text{for } x = 0 \\ 1 & \text{for } x \neq 0 \end{cases} \quad \dots (11)$$

Image Feature Extraction

Feature extraction involves simplifying the amount of resources required to describe a large set of data accurately [23]. Every image is characterized by a set of features such as Texture, color, shape and others, extract these features at the time of injecting new image in image database. Then summarize these features in a reduced set of k indexes and store it in image feature database. The query image is processed in the same way as images in the database. Matching is carried out on the feature database [17]. Nine features are exploited for our proposed algorithm.

Color Feature

Color Feature is the most significant one in searching collections of color images of arbitrary subject matter. Color plays very important role in the human visual perception mechanism, besides that image color is easy-to analyze, and it is invariant with respect to the size of the image and orientation of objects on it. The simplest and most frequently used way to represent color is color histograms [17].

Mean

It tells something about the general brightness of the image, where a bright image has a high mean while a dark image has a low mean. It provides average color value in the image [19]. It is calculated using following statics:

$$\bar{g} = \sum_{g=0}^{L-1} g P(g) = \sum_r \sum_c \frac{I(r, c)}{M} \quad \dots (12)$$

Where L is the gray level range such as [0, 1], [0 to 7] or [0 to 255], r is image row, c is image column and I(r, c) is the pixel at row r and column c.

Standard Deviation

Standard deviation is the square root of the variance of the distribution [19]. It is calculated using following statics:

$$\sigma = \sqrt{\sum_{g=0}^{L-1} (g - \bar{g})^2 P(g)} \quad \dots (13)$$

Skewness

It gives measure of the degree of asymmetry in the distribution [19]. It is calculated using following statics:

$$Skew = \frac{1}{\sigma^3} \sum_{g=0}^{L-1} (g - \bar{g})^3 P(g) \quad \dots (14)$$

Texture Feature

Textures are homogeneous patterns or spatial arrangements of pixels that cannot be sufficiently described by regional intensity or color features [18]. They are six texture

Entropy

The entropy is a measure that tells how many bits are needed to code image data. Entropy is a measure of information content. It measures the randomness of intensity distribution [16]. It can be calculated using the following equation:

$$Entropy = - \sum_{g=0}^{L-1} P(g) \log_2 [P(g)] \quad \dots (15)$$

Energy

The Energy measure tells something about how gray levels are distributed. Energy measures the uniformity of intensity in the histogram [32]. It is defined as follows:

$$Energy = \sum_{g=0}^{L-1} [P(g)]^2 \quad \dots (16)$$

Homogeneity

Homogeneity returns a value that measures the closeness of the distribution of elements in image [20]. Homogeneity takes high values for low-contrast images [24].

$$Homogeneity = \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} \frac{p(i,j)}{|1+i-j|} \quad \dots (17)$$

Variance

Variance in the gray level in a region in the neighborhood of a pixel is a measure of the texture [25].

$$Var = \frac{1}{w^2 \sum_{i=0} \sum_{j=0} img(i,j) - mean(k)^2} \dots (18)$$

3rd Moment

3rd moment measures the skewness of a histogram [33]. 3rd Moment measures distortion of gray level.

$$3^{rd} \text{ Moment} = \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} ((i - j))^3 p(i, j) \dots (19)$$

Step

Step measures distribution of gray level [33].

$$Step = \sum_{i=0}^{m-1} \sum_{n=0}^{n-1} p(i, j) \dots (20)$$

Proposed Hybrid DAWT-DCT Based Algorithm

In this algorithm, hybrid compression is performed on query image and database images. First compression method is 2D DAWT followed by DCT. In DCT image data are divided up into 8*8 number of block.

DCT converts the spatial image representation into a frequency map: the average value in the block is represented by the low-order term, strength and more rapid changes across the width or height of the block represented by high order terms. The DCT is applied to the DAWT low-frequency components that generally have zero mean and small variance, and accordingly results in much higher compression ratio (CR) with important diagnostic information. Figure (2) shows the flowchart of Hybrid DAWT-DCT algorithm. Which are also illustrating in algorithms (1), (2) and (3).

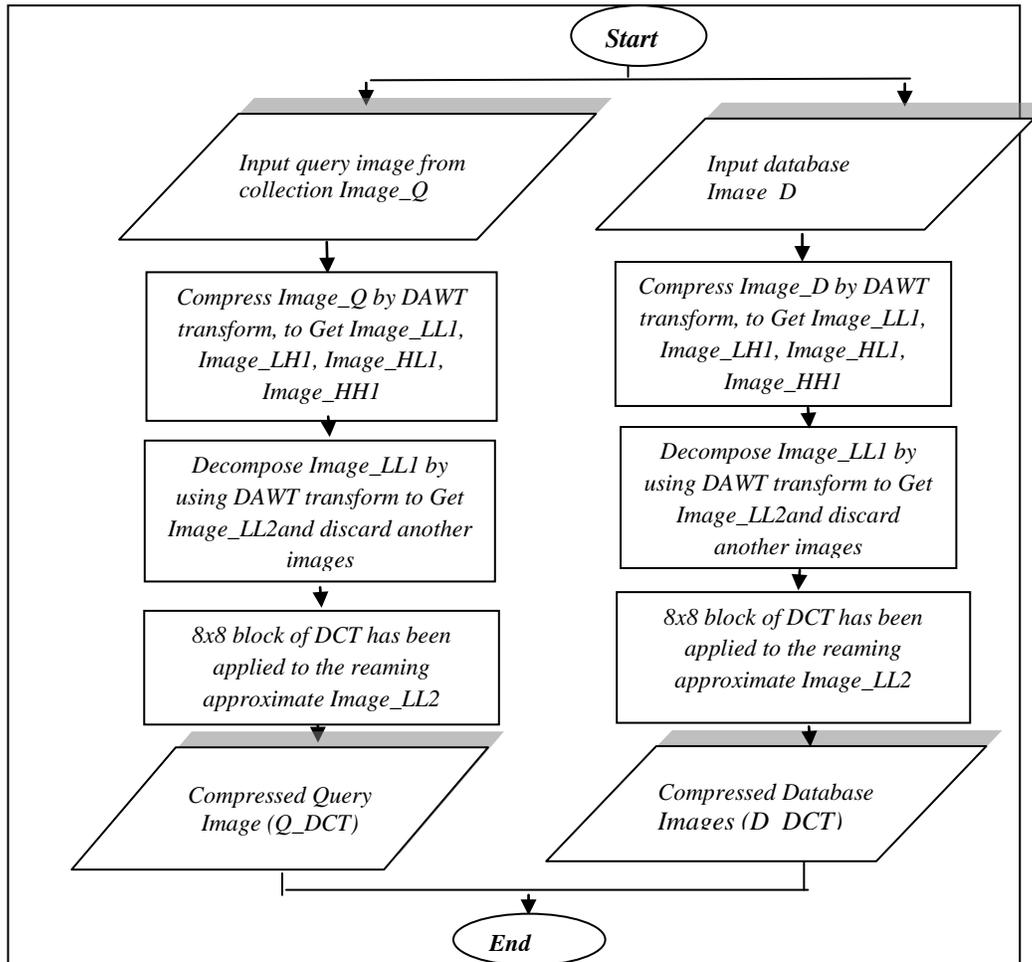


Figure (2): The Flowchart of Hybrid DAWT-DCT Compression Algorithm.

First Level of DAWT Decomposing

2-D DWT decomposed the each 2x2 blocks of the Image_q and Image_d to be classified, the low-frequency coefficients are LL and high-frequency coefficients are HL, LH and HH. Approximation image is the sub-image composes of the low frequency parts in both row and column directions (LL). By convolution of the Image_q and Image_d with a filter bank(-0.48296,-0.8365,-0.2241,0.1294). Perform the average of four pixels then divide the result on 4.

new value is saved in an array called LL_array (), to be used in the next step. Like LL Decomposes, high-frequency coefficients HL is obtained by convolution of the Image_q, Image_d with same filter bank (-0.48296, -0.8365, -0.2241, 0.1294). applying the average of four pixels then divide result on 4. a new value is saved in an array called HL_array (), to be discarded. High-frequency coefficients HL is obtained by convolution of the Image_q, Image_d with same filter bank (0.1294, -0.2241, -0.8365, 0.48296). performing the average of four pixels then divide result on 4. a new value is saved in an

array called LH_array (), to be discarded. High-frequency coefficients HH is obtained by convolution of the Image_q, Image_d with same filter bank (0.1294, -0.2241, -0.8365, 0.48296). performing the average of four pixels then divide result on 4 .a new value is saved in an array called HH_array (), to be discarded. The following algorithm (1) illustrates these steps.

Algorithm (1): First Level of DAWT Decomposing.

Input: The query image (Image_Q)

Output: The first decomposed images (Image_LL1), (Image_LH1), (Image_HL1) and (Image_HH1) level.

Step 1: Initialize j=0,i=0

Step 2: For x = 0 To Image_Q.Width Step 2 do
 For y = 0 To Image_Q.Height Step 2 do
 Get X1 'get pixel (x,y) from Image_Q and multiply X1 by Lowpass coefficient filter X5 = (-0.48296 * X1)
 Get X2 'get pixel (x,y) from Image_Q and multiply X2 by Lowpass coefficient filter X6 = (-0.8365 * X2)
 Get X3 ' get pixel (x,y) from Image_Q and multiply X3 by Lowpass coefficient filter X7 = (-0.2241 * X3)
 Get X4 ' get pixel (x,y) from Image_Q and multiply X4 by Lowpass coefficient filter X8 = (0.1294 * X4)
 Find the average of four pixels
 LL1(i, j) = ((X5 + X6 + X7 + X8) / 4) ' LL1-array () represents lowlow frequency image to use it in second level decomposition then display LL1_array () in Image_LL1.
 End For
 End For

Step 3: For x = 0 To Image_Q.Width Step 2 do
 For y = 0 To Image_Q.Height Step 2 do
 Get X2 ' get pixel (x,y) from Image_Q and multiply X2 by Lowpass coefficient filter X10 = (-0.8365 * X2)
 Get X3 ' get pixel (x,y) from Image_Q and multiply X3 by Lowpass coefficient filter X11 = (-0.2241 * X3)
 Get X4 ' get pixel (x,y) from Image_Q and multiply X4 by Lowpass coefficient filter X8 = (0.1294 * X4)
 Get X1 'get pixel (x,y) from Image_Q and multiply X1 by Lowpass coefficient filter X9 = (-0.48296 * X1)
 Find the average of four pixels
 HL1(i, j) = ((X9 + X10) - (X11 + X12)) / 4
 ' HL1_array () represents highlow subband which discard in second level of decomposing then display HL1_array () in Image_HL1

Second Level of DAWT Decomposing

The passed LL components are further decomposed using another 2-D DAWT with same filter bank and the detail coefficients (HL, LH and HH) are discarded. The following algorithm (2) illustrates these steps.

Algorithm (2): Second Level Decomposing of DAWT .

Input: The low frequency subband image (Image_LL1) .

Output: The lowlow frequency image (Image_LL2).

Step 1: Initialize j=0,i=0.

Step 2: For x = 0 To Image_LL1.Width Step 2 do

For y = 0 To Image_LL1.Height Step 2 do

' Convolution window of 2*2 from Image_LL1.

X5 = (-0.48296 * X1)

Get X2 ' get pixel (x,y) from Image_LL1 and multiply X2 by Lowpass coefficient filter

X6 = (-0.8365 * X2)

Get X3 ' get pixel (x,y) from Image_LL1 and multiply X3 by Lowpass coefficient filter

X7 = (-0.2241 * X3)

Get X4 ' get pixel (x,y) from Image_LL1 and multiply X4 by Lowpass coefficient filter

X8 = (0.1294 * X4)

Find the average of four pixels

LL2(i, j) = ((x5 + x6 + x7 + x8) / 4

' LL2_array () represent lowlow frequency image then display LL2_array () in Image_LL2.

End For

End For

Hybrid DAWT-DCT Compression

The presented hybrid **DWT-DCT** algorithm for image compression is to exploit the properties of both the **DAWT** and the **DCT**. After **LL** decomposing, 8x8 block of **DCT** has been applied to the reaming approximate **DAWT** coefficients (**LL**) and can be achieved high CR. **DCT** converts the spatial image representation into a frequency map. the average value in the block is represented by the low-order term, strength and more rapid changes across the width or height of the block represented by high order terms. The Discrete Cosine Transform (DCT) has been shown to be near optimal for a large class of images in energy concentration and decorrelating. The following algorithm (3) illustrates these steps.

Algorithm (3): Hybrid DAWT_DCT Compression.

Input: lowlow frequency subband image (Image_LL2).

Output: The compressed image (CM_ Image).

Step 1: Initialize f=1,d=0, pi = 3.14159265358932.

Step 2: For X = 1 To Image_LL2.Width - 8 Step 8 do
 For Y = 1 To Image_LL2.Height - 8 Step 8 do
 Get 8*8 block of pixels from Image_LL2
 P_array(f) = Image_LL2(x,y)
 F = F+1 'Increment f value to get another pixels from Image_LL2.

Step 3: For r = 0 To f do

Step 4: Perform discrete cosine equations:
 $transf(0) = 1 / \sqrt{f} * transf(0)$

Step 5: For u = 1 To f do
 For k = 0 To f do
 $transf(u) = transf(u) + p(k) * \cos(2 * k + 1) * (u * \pi) / (2 * f))$
 End For
 $transf(u) = transf(u) * \sqrt{2} / \sqrt{f})$
 End For

Step 6: For l = 0 To f do
 ' Transfer values of discrete cosine for one block to bigcolor_array() and use transf_array() for another block of original image.
 bigcolor(d) = transf(l): D = D + 1
 transf(l) = 0: P(l) = 0
 End For
 F=0
 End For

Step 7: Display bigcolor_array() values in CM_ Image .

Features Based Algorithm

Feature Extraction is a process that begins with feature selection. In this Algorithm, the image classification process deals with the compressed image from previous section to generate feature vectors .Training the classification systems with these features incorporated could increase accuracy rate. The extracted features include: mean,standarddeviation,entropy,energy,homogeneity,step,3rdMoment,skewness,variance .After trying a number of features for query and database images , these nine features are chosen, feature extraction is divided into following steps:

- 1.Compute probability of each pixel in image and save it in prob_array .after that we are calculating **mean** feature. each element of prob _array is saved in variable called pro then make prob_array =0 to be used for another iteration. pro is divided on size of image (width and height) are called **s** and **q**.
2. Extract standard deviation feature.
3. Extract the entropy feature.
4. Extract the Energy feature
5. Extract the homogeneity feature.
6. Extract the step feature.

7. Extract the variance feature.
8. Extract the 3rd moment feature.
9. Extract the skewness feature .The following algorithm (4) illustrates these steps.

Algorithm (4): Image Feature Extraction.

Input: The compressed image (CM_Image).

Output: feature vector (FV_query).

Step 1: Initialize i=0.

Step 2: Compute probability of each pixel in image using the following equations:

```

For f = 1 To CM_Image.Width - 1 do
    For g = 1 To CM_Image.Height - 1 do
        pro = prob(i)
        pro = pro / (s * q)
    End For
End For

```

Step 3: Extract mean feature

```

V = pro * i
Mean = Mean + V
Textbox1 = (10000 * Mean) / 10000

```

Step 4: Manipulating of standard deviation feature is accomplished by using

The following equations:

```

StdDev = StdDev + ((i - Mean) ^ 2 * pro)
Std = Sqrt(StdDev)
TxtStdDev = (10000 * Std) / 10000

```

Step 5: The entropy feature can be extracted by performing following equations:

Step 7: The homogeneity feature can be extracted by applying the following equations:

```

V = pro / (1 + Abs(i))
Homo = Homo + V
Textbox3 = (10000 * Homo) / 10000
Textbox4 = (10000 * Distr) / 10000

```

Step 8: The step feature can be extracted by performing the following equations:

```

V = pro
Distr = Distr + D

```

Step 9: The variance feature can be extracted by performing the following equations:

```

V = pro * (i * i)
Var = Var + V
Textbox5 = (10000 * Var) / 10000

```

Step 10: The 3rd moment feature can be extracted by applying following equations:

```

V = pro * (i * i * i)
Disto = Disto + V
TextBox6 = (10000 * Disto) / 10000

```

Step 11: The skewness feature is extracted by performing the following equations:

```

Skew = Skew + ((i - mean) ^ 3 * pro)
Skew1 = (1 / std) * Skew
TextBox7 = (10000 * Skew1) / 10000

```

Algorithm (4): Image Feature Extraction.

Input: The compressed image (CM_Image).

Output: feature vector (FV_query).

Step 1: Initialize i=0.

Step 2: Compute probability of each pixel in image using the following equations:
 For f = 1 To CM_Image.Width – 1 do
 For g = 1 To CM_Image.Height – 1 do
 pro = prob(i)
 pro = pro / (s * q)
 End For
 End For

Step 3: Extract mean feature
 $V = pro * i$
 Mean = Mean + V
 Textbox1 = (10000 * Mean) / 10000

Step 4: Manipulating of standard deviation feature is accomplished by using
 The following equations:
 $StdDev = StdDev + ((i - Mean) ^ 2 * pro$
 $Std = Sqrt(StdDev)$
 TxtStdDev = (10000 * Std) / 10000

Step 5: The entropy feature can be extracted by performing following equations:
 $V = pro * Log(pro) * Log(2)$
 Entropy = Entropy + V
 Textbox3 = (10000 * Entropy) / 10000

Step 6: The energy feature is extracted by using the following equations:
 $V = pro * pro$
 Energy = Energy + V
 Textbox2 = (10000 * Energy) / 10000

Step 7: The homogeneity feature can be extracted by applying the following equations:
 $V = pro / (1 + Abs(i))$
 Homo = Homo + V
 Textbox3 = (10000 * Homo) / 10000
 Textbox4 = (10000 * Distr) / 10000

Step 8: The step feature can be extracted by performing the following equations:
 $V = pro$
 Distr = Distr + D

Step 9: The variance feature can be extracted by performing the following equations:
 $V = pro * (i * i)$
 Var = Var + V
 Textbox5 = (10000 * Var) / 10000

Step 10: The 3rd moment feature can be extracted by applying following equations:
 $V = pro * (i * i * i)$
 Disto = Disto + V
 TextBox6 = (10000 * Disto) / 10000

Step 11: The skewness feature is extracted by performing the following equations:

$$\begin{aligned} \text{Skew} &= \text{Skew} + ((i - \text{mean})^3 * \text{pro}) \\ \text{Skew1} &= (1 / \text{std}) * \text{Skew} \\ \text{TextBox7} &= (10000 * \text{Skew1}) / 10000 \end{aligned}$$

Sum-of-Absolute Differences (SAD)

The similarity measurement is done using Sum-of-Absolute Differences distance. Then the top closest images are retrieved. Where ΔD is the distance between the feature vector Q_f and D_f and N represent the number of color and texture feature.

ΔD is calculated using the following equation [21]:

$$\Delta D (Q_f, D_f) = \sum_{i=0}^{n-1} |Q_f(i) - D_f(i)| \quad .. (21)$$

Subsequently, the ΔD is stored in the ascending order then the selected images are retrieved. Both query and database images are similar for $\Delta D = 0$ and the small value of ΔD shows the relevant image to the query image [21].

Results and Discussion

DCT and Daubechies Transform algorithms are implemented on 100 color images. Size of the images is 256*256pixels. These images are arranged in 10 semantic groups: People, Beaches, Building, Buses, Dinosaurs, Elephants, Roses, Horses, Mountains and Food. It includes 100 images from each semantic group. The images are in jpeg format. The algorithm is executed with 10 query images selected for each category in the image database. The results obtained are shown in the following tables. Table (1) shows precision and recall for performing daubechies wavelet transform. Table (2) shows precision and recall for performing Discrete Cosine Transform. Table (3) shows precision and recall for hybrid system of Daubechies Wavelet Transform and Discrete Cosine Transform.

Table (1):

Class number	Categories	precision	recall
1	People	0.20	0.02
2	Beaches	0.20	0.02
3	Buildings	0.40	0.04
4	Buses	0.30	0.03
5	Dinosaurs	0.90	0.09
6	Elephants	0.30	0.03
7	Roses	0.60	0.06
8	Horses	0.40	0.04
9	Mountains	0.20	0.02
10	Foods	0.10	0.01

Table(2):

Class number	Categories	precision	recall
1	People	0.40	0.04
2	Beaches	0.20	0.02
3	Buildings	0.40	0.04
4	Buses	0.40	0.04
5	Dinosaurs	0.90	0.09
6	Elephants	0.20	0.02
7	Roses	0.30	0.03
8	Horses	0.50	0.05
9	Mountains	0.20	0.02
10	Foods	0.10	0.01

Table(3):

Class number	Categories	precision	recall
1	People	0.70	0.07
2	Beaches	1	0.10
3	Buildings	0.10	0.01
4	Buses	0.70	0.07
5	Dinosaurs	0.80	0.08
6	Elephants	0.80	0.08
7	Roses	0.90	0.09
8	Horses	0.70	0.07
9	Mountains	0.90	0.09
10	Foods	0.80	0.08

Conclusions

Classification is the process of finding a model or a function that describes and distinguishes data classes. In this paper, a new algorithm is proposed to classify images, the basic idea is depend on using hybrid compression method (DAWT and DCT). To evaluate this algorithm, a heterogeneous image database is used which is downloaded from the website <http://wang.ist.psu.edu/iwang/test1.tar>. Hybrid compression produced better result (precision and recall values are improved 80%) in compare with using DAWT or DCT alone and are improved 90% in compared with proposed method which is presented in[22].the proposed compression produced better result(since precision and recall values are improved 80%)in compared with proposed method which is also presented in [23]. Figure (3) shows the classification of images using proposed compression algorithm. Table (4) shows the values of images features that are saved in database.

Query image	Classified images
	
	
	
	
	
	
	



Figure(3) : The classification of images using proposed compression algorithm.

Image number	Mean	Standard Deviation	Entropy	Energy
Image_1	44.48	94.08	0.56	0.5965
Image_2	42.54	92.80	0.56	0.6065
Image_3	43.38	93.37	0.57	0.602
Image_4	43.35	93.24	0.56	0.6027
Image_5	43.3	93.39	0.57	0.602
Image_6	43.38	93.39	0.56	0.6019
Image_7	43.33	93.34	0.57	0.6024
Image_8	43.30	93.35	0.56	0.6028
Image_9	43.29	93.25	0.56	0.6028
Image_10	43.14	93.02	0.56	0.6043

Homogeneity	Step	Variance	3rd Moment	Skewness
0.7685	0.9439	11241	2840596	21494
0.7759	0.9439	10737	2709732	21310
0.7727	0.9439	10955	2766436	21407
0.7729	0.9439	10951	2766418	21362
0.7727	0.9439	10952	2765166	21399
0.7727	0.9439	10955	2766554	21414
0.7729	0.9439	10940	2762217	21385
0.7731	0.9439	10938	2763357	21384
0.7731	0.9439	10932	2761024	21377
0.7737	0.9439	10895	2751924	21269

Image number	Mean	Standard Deviation	Entropy
Image_1	46.07	95.73	0.5636
Image_2	44.428	94.72	0.5617
Image_3	44.7588	94.8742	0.5542
Image_4	44.7858	94.9751	0.5652
Image_5	44.7804	94.9698	0.5629
Image_6	44.81	94.94	0.56
Image_7	44.8134	94.8542	0.5518
Image_8	44.8891	95.0928	0.5662
Image_9	44.9312	95.1089	0.5666
Image_10	44.6819	94.882	0.5622

Variance	Step	Homogeneity
11645	0.9439	0.7623
11223	0.9439	0.7687
11313	0.9439	0.7675
11314	0.9439	0.7673
11311	0.9439	0.7673
11324	0.9439	0.7673
11327	0.9439	0.7673
11340	0.9439	0.7669
11348	0.9439	0.7667
11287	0.9439	0.7677

Image number	mean	Standard Deviation	entropy	variance	3rd moment
Image_1	43.1996	93.1829	0.5627	10911	2756267
Image_2	40.3539	90.8815	0.5527	10181	2569194
Image_3	43.4536	93.456	0.5696	10975	2772379
Image_4	42.6145	92.6438	0.5625	10757	2715831
Image_5	42.6288	92.8084	0.5691	10764	2718604
Image_6	42.6724	92.7629	0.5698	10774	2720511
Image_7	42.7244	92.7146	0.5626	10787	2723858
Image_8	42.8336	92.7799	0.5532	10829	2738152
Image_9	42.6738	92.7334	0.5676	10774	27206987
Image_10	42.6928	92.6916	0.5593	10784	2724260

<i>step</i>	<i>variance</i>	<i>3rd moment</i>	<i>skew value</i>
0.9439	10911	2756267	21332
0.9439	10181	2569194	20994
0.9439	10975	2772379	21414
0.9439	10757	2715831	21268
0.9439	10764	2718604	21319
0.9439	10774	2720511	21329
0.9439	10787	2723858	21278
0.9439	10829	2738152	21294
0.9439	10784	2724260	21274
0.9439	10784	2724260	21274

Image number	mean	standard deviation	entropy	energy
Image_1	41.3967	91.7218	0.5706	0.6128
Image_2	41.1353	91.4941	0.5665	0.6144
Image_3	40.6066	91.1871	0.5707	0.6171
Image_4	40.6258	91.043	0.5668	0.6173
Image_5	40.6694	91.096	0.5674	0.6169
Image_6	40.674	91.201	0.5694	0.6167
Image_7	40.6159	91.0585	0.5649	0.6173
Image_8	40.6702	91.1047	0.5636	0.617
Image_9	40.6686	91.0572	0.5658	0.6169
Image_10	40.6774	91.1151	0.5657	0.6169

homogeneity	step	variance	3 rd moment	skew value
0.7803	0.9439	10438	2632582	21141
0.7814	0.9439	10371	2615096	21086
0.7834	0.9439	10232	2578910	21033
0.7834	0.9439	10242	2582601	21028
0.7832	0.9439	10251	2584431	21041
0.7832	0.9439	10254	2585311	21067
0.7834	0.9439	10237	2580676	21014
0.7832	0.9439	10252	2584525	21025
0.7832	0.9439	10251	2584230	21043
0.7832	0.9439	10255	2585922	21048

Image name	mean	standard	entropy	energy	homogeneity
<i>e1.jpg</i>	43.4035	93.3789	0.566	0.6024	0.7727
<i>e2.jpg</i>	42.8221	92.867	0.5657	0.6055	0.7749
<i>e3.jpg</i>	45.3545	94.6669	0.5697	0.592	0.7651
<i>e4.jpg</i>	45.3037	94.7517	0.5745	0.592	0.7653
<i>e5.jpg</i>	45.3567	94.5969	0.567	0.5922	0.7651
<i>e6.jpg</i>	45.5556	94.8877	0.5719	0.5907	0.7643
<i>e7.jpg</i>	45.4715	94.7912	0.5686	0.5915	0.7647
<i>e8.jpg</i>	45.6181	95.0514	0.5755	0.5901	0.7641
<i>e9.jpg</i>	45.4181	94.7058	0.5687	0.5918	0.7649
<i>e10.jpg</i>	45.2131	94.6221	0.5672	0.593	0.7657
<i>f11.jpg</i>	47.439	96.052	0.5739	0.5817	0.757
<i>f12.jpg</i>	47.9479	96.4617	0.5732	0.5787	0.755
<i>f13.jpg</i>	48.2037	96.2517	0.5656	0.5788	0.754
<i>f14.jpg</i>	48.3713	96.5506	0.5635	0.5774	0.7534
<i>f15.jpg</i>	48.5183	96.5111	0.5634	0.5768	0.7528
<i>f16.jpg</i>	48.6835	96.6032	0.5696	0.5764	0.7522
<i>f17.jpg</i>	48.4786	96.7154	0.569	0.5765	0.753
<i>f18.jpg</i>	48.3221	96.5584	0.5668	0.5774	0.7536
<i>f19.jpg</i>	48.5177	96.8713	0.5736	0.5756	0.7528
<i>f110.jpg</i>	48.4667	96.191	0.5561	0.579	0.7532
<i>h1.jpg</i>	47.5627	96.3046	0.5844	0.58	0.7564
<i>h2.jpg</i>	47.5835	95.5368	0.5538	0.5828	0.7564
<i>h3.jpg</i>	47.3237	95.9934	0.5706	0.5822	0.7574
<i>h4.jpg</i>	47.3289	96.0089	0.5701	0.5819	0.7574
<i>h5.jpg</i>	47.3261	96.0264	0.5724	0.5819	0.7574
<i>h6.jpg</i>	47.6375	96.084	0.5665	0.5808	0.7562
<i>h7.jpg</i>	47.3801	95.8081	0.5641	0.5825	0.7572
<i>h8.jpg</i>	47.5328	96.2051	0.5731	0.5809	0.7566
<i>h9.jpg</i>	47.3795	96.0024	0.5695	0.5819	0.7572
<i>h10.jpg</i>	47.4048	95.9576	0.5656	0.5825	0.7572
<i>m1.jpg</i>	46.6563	95.615	0.5723	0.5852	0.7601

<i>m2.jpg</i>	46.5542	95.5911	0.5697	0.5859	0.7605
<i>m3.jpg</i>	46.4558	95.2079	0.5581	0.5872	0.7609
<i>m4.jpg</i>	46.2837	95.3915	0.5753	0.5869	0.7615
<i>m5.jpg</i>	46.5534	95.5127	0.5688	0.586	0.7605
<i>m6.jpg</i>	46.3874	95.4782	0.5762	0.5862	0.7611
<i>m7.jpg</i>	46.8007	95.3393	0.5597	0.5856	0.7595
<i>m8.jpg</i>	46.3943	95.4835	0.5755	0.5863	0.7611
<i>m9.jpg</i>	46.6571	95.7205	0.5737	0.5851	0.7601
<i>m10.jpg</i>	46.4158	95.4765	0.5681	0.5866	0.7611
<i>fo1.jpg</i>	43.3053	93.2759	0.5635	0.6029	0.7731
<i>fo2.jpg</i>	41.2208	91.6048	0.5614	0.6142	0.7812
<i>fo3.jpg</i>	41.5647	91.9569	0.5688	0.6118	0.7797
<i>fo4.jpg</i>	41.2896	91.795	0.5562	0.614	0.781
<i>fo5.jpg</i>	41.5584	91.932	0.5724	0.6118	0.7797
<i>fo6.jpg</i>	41.4296	91.7403	0.5617	0.613	0.7803
<i>fo7.jpg</i>	41.2152	91.6817	0.5628	0.6142	0.7812
<i>fo8.jpg</i>	41.8168	92.1205	0.5569	0.6112	0.7789
<i>fo9.jpg</i>	41.5947	91.8403	0.5606	0.6122	0.7797
<i>fo10.jpg</i>	41.0956	91.4835	0.5649	0.6147	0.7816
step	variance	moment	skew value		
0.9439	10963	2769318	21372		
0.9439	10811	2729580	21298		
0.9439	11459	2895645	21538		
0.9439	11446	2892440	21573		
0.9439	11460	2896114	21510		
0.9439	11509	2908172	21579		
0.9439	11493	2905060	21556		
0.9439	11528	2913589	21643		
0.9439	11478	2901288	21540		
0.9439	11426	2888056	21519		
0.9439	12126	3066921	2176		
0.9439	12191	3083340	21582		
0.9439	12237	3095884	21683		
0.9439	12272	3104576	21657		
0.9439	12317	3116790	21632		
0.9439	12265	3103463	21759		

0.9439	12225	3092977	21715
0.9439	12272	3104447	21813
0.9439	12272	3107831	21538
0.9439	12022	3038824	21771
0.9439	12032	3042611	21421
0.9439	11965	3025446	21669
0.9439	11968	3026437	21698
0.9439	11966	3025903	21703
0.9439	12046	3046492	21661
0.9439	11981	3029738	21595
0.9439	12019.628	3039485	21700
0.9439	11980	3029614	21673
0.9439	11993	3034477	21628
0.9439	11795	2982237	21670
0.9439	11769	2975696	21646
0.9439	11745	2969810	21523
0.9439	11697	2956476	21654
0.9439	11769	2975572	21635
0.9439	11724	2963318	21674
0.9439	11829	2990327	21511
0.9439	11727	2964615	21675
0.9439	11796	2982398	21678
0.9439	11738	2968713	21671
0.9439	10939	2763465	21373
0.9439	10401	2624641	21118
0.9439	10484	2644971	21192
0.9439	10422	2631188	21134
0.9439	10481	2643891	21198
0.9439	10455	2638621	21148
0.9439	10398	2623600	21113
0.9439	10560	2667091	21195
0.9439	10499	2650668	21177
0.9439	10363	26138268	21093

Table (4): The values of Images Database Features for People, beaches, buildings, buses, dinosaurs, elephant, roses ,horses, mountains, foods Category.

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