Content Based Image Retrieval Using GNW Hybrid Method

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Abstract

The dramatic rise in the sizes of images databases has affected the development of effective and efficient retrieval systems and is one of the most active research areas. In this paper we proposed a new effective image retrieval method Content based image retrieval using GNW Hybrid method which usage Wavelet transform for Color feature extraction and Gabor transform for Texture feature extraction. Also in this paper we compare all three methods GNW Hybrid method, Wavelet transform and Gabor transform based on the parameter Precision, Recall and F-score for same images. The experimental results show that the proposed approach significantly improves the effectiveness of the image retrieval system.

Index terms- *Wavelet Transform, Haar, DWT, Gabor Transform and Content based Image Retrieval.*

I. INTRODUCTION

With the rapid growth of computer power, rapidly declining cost of storage and ever-increasing access to the Internet, digital acquisition of information has become increasing popular in recent years [1]. A huge amount of information is available, and daily gigabytes of new visual information is generated, stored, and transmitted. Since 1970's, image retrieval has been studied by mainly two community: Database Management and Computer Vision [2]. They adopted two different techniques:

1. Text-based
2. Visual based.

In Text-based retrieval, images are annotated using one or more keywords, subject heading, or classification codes, which in turn are used as retrieval keys during search and retrieval. Text-based retrieval is non-standardized because different users employ different keywords for annotation .Textual information about images cannot describe by text and involves a vast amount of labor and tends to be colored by personal subjective.

To overcome these difficulties, Content-based Image retrieval (CBIR) emerged as promising means for the describing and retrieving images. According to its objective, instead of being manually annotated by Text-based keywords, images are indexed by their visual content, such as color, texture, shape, and spatial layout. The Importance of Content-based retrieval for many applications, ranging from art galleries and museum archives to the picture collections, criminal investigation, medical, makes the visual information retrieval one of the fastest growing research field in information technology.

This paper proposes new improved Content-based image retrieval using GNW Hybrid method which is usage wavelet transform for extracting the color features and Gabor transform for extracting the texture features of images in horizontal, vertical and diagonal direction and normalized.

This paper is organized as follows: Section II reviews related research on image retrieval. Section III gives detail about our Proposed Method. Section IV tells about Experiments and Results. Section V presents concluding remarks.

II. Literature Survey or Related works

In paper 1 it presented the 2-D DWT operates in straight forward manner by inserting array transposition between the two 1-D DWT. The rows of the array are processed first with only one level of decomposition. This essentially divides the array into two vertical halves, with the first half storing the average coefficient, while the second vertical half stores the details coefficient. This process is repeated again with the columns, resulting in four sub-bands within the array defined by filter output [8].

Paper 2 tells that Texture is an important feature of natural images. A variety of techniques have been developed for measuring texture similarity. Gabor wavelet is widely adopted to extract texture from the images for retrieval and has been shown to be very efficient. Basically Gabor filters are a group of the wavelets, with each wavelets capturing energy at specific frequency and specific orientation. The scale and orientation property makes it especially useful for texture analysis [9].

Paper 3 described a new and more efficient images descriptor using the weighted combination of color and texture features based on simplified wavelet spatial-color statistics and applying normalized second-order statistics texture via Gabor Wavelet transforms [10].

III. PROPOSED MODEL

Figure 1 described the block diagram of the proposed retrieval approach. A single feature may lack sufficient discriminatory information to permit the retrieval of relevant images so where multiple features utilizing a combination of color and texture features that have been extracted separately. Here we used Wavelet transform for color feature extraction and Gabor transform for the texture feature extraction. For example if I Images is entered the first image is preprocessed so it is converted in to I(X, Y) which is gives separately to the wavelet transform and Gabor transform for extracting color feature *Fc* and texture feature *Ft*. Color quantization is carried out using color histogram then it is The normalized histogram is obtained by diving with the total number of pixels. After calculating the color and texture feature *Fc* and *Ft*, they are multiplied by weighting factors Wc and Wt for color and texture features respectively, and combined their results to get the features of Hybrid method *F*h, and store the value in database.

Same procedure is apply when a Query image Iq is entered it is per processed so it is converted into Iq (X, Y) Then it passes separately to the wavelet transform to get its color feature *F*qc and to Gabor transform to get its texture feature *F*qt. Color quantization is carried out using color histogram then its normalized histogram is obtained by diving with the total number of pixels. After calculating query image color feature *F*cq, texture feature *F*tq they are multiplied by weighting factor Wc and Wt respectively, and combined their result to get the Hybrid Method Query image feature *F*hq, store the value in database. To get the similarity between the query image and stored images in the database we are calculate Euclidian distance between them and that result will show the relevant images according to the Query image Iq.

3.1 Proposed Algorithm Steps

Step1: Input image I.
Step2: Extract the Red, Green, Blue Components from an Image.
Step3: Decomposed each Red, Green, Blue Component using Haar Wavelet transform to get approximate Coefficient, and vertical, horizontal, diagonal detail coefficients.
Step4: Combine approximate coefficient of Red, Green, and Blue Component.
Step5: Color quantization is carried out using color histogram.
Step6: The normalized histogram is obtained by diving with the total number of pixels.
Step7: Repeat the Step3 to Step6 for image to get the Color Features $F_{c.}$
Step8: Apply Gabor transform on Red, Green and Blue components in vertical, horizontal and diagonal direction to Get its approximate and detail coefficient.
Step9: Combined approximate coefficient of Red, Green, and Blue Components.
Step10: Calculate the Standard deviation.

Step11: Repeat the Step8 to Step10 for image to get the Texture Features F_t for Images.
Step12: Combined the Color Features (F_c) and Texture Features (F_t) to get the Hybrid Method Feature F_h.

F_h=Wt*F_t+Wc*Fc. Where Wt=0.9 and Wc=0.1.

Step13: Repeat Step1 to Step12 on all images of image database.
Step14: Apply same procedure to get Query Image Features F_{cq}, F_{tq} and F_{hq}
Step15: Calculate the Euclidean Distance between the Query Image and Images of database.
Step16: Retrieve the relevant Images

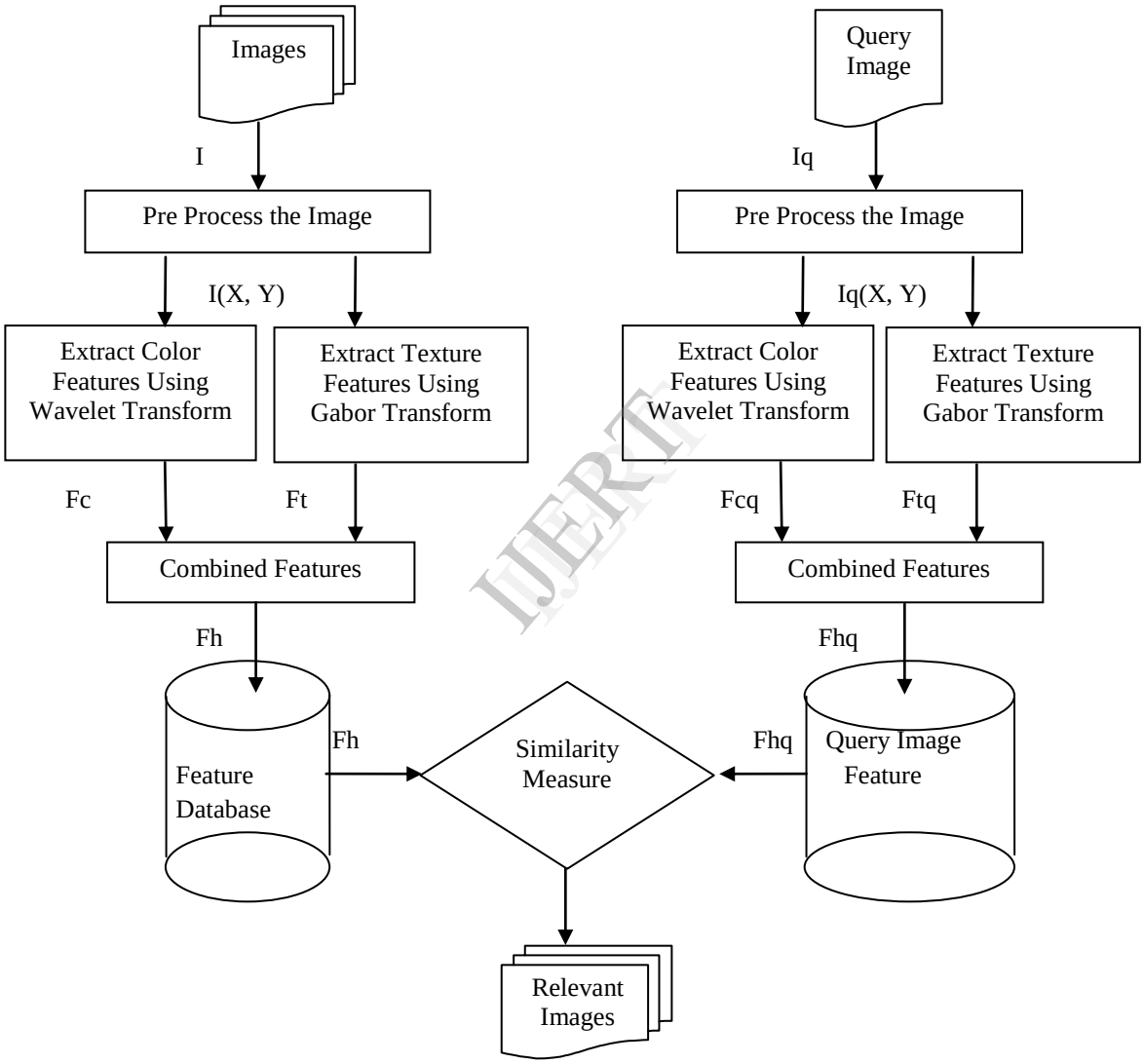

Figure 4.5 Block Diagram of the Proposed Retrieval GNW Hybrid Method

for GNW Hybrid Method used of combining wavelet and gabor method outputs

$$F_h = Wt * F_t + Wc * Fc.$$

Where Wt=0.9 and Wc=0.1.

F_h = features of GNW Hybrid method

F_t= Texture feature

Fc= Color feature

Wt= multiplying coefficient of texture features

Wc= multiplying coefficient for color features

3.2 Wavelet transform –

Wavelet transform is an automatic multilevel decomposition of a signal. It represents the input signal as a superposition of a family of the basic function called wavelets. Translating and dilating the mother wavelet corresponding to the particular basic can generate a set of basic functions. The signals are passed through a low pass (LPH) and fallowed by high pass (HPF). The outputs of the filter are down-sampled for next level decomposition, thus allowing information from signal to be represented at different scales.

Haar wavelets are widely being used since its invention after Haar. Haar wavelet is the simplest type of wavelet. In discrete form Haar wavelets are related to a mathematical operation called Haar transform. Like all wavelet transform the Haar transform decomposed a discrete signal into two sub signals of half of its length one sub signal is running average the other sub signal is a running difference or fluctuation. We have used Haar wavelets to compute color features, because they are the fastest to compute and also have been found to perform well in practices. Haar wavelet function enables us to speed up.

The Haar mother wavelet function Ψ (t) can be described as:

$$\Psi(t) = \begin{cases} 1, & 0 \le t \le 1/2 \\ -1, & 1/2 \le t \le 1 \\ 0, & \text{otherwise} \end{cases}$$

3.3 Gabor transform -

Gabor transform is a good multi resolution approach that represents the texture of an image in an effective way using multiple orientations and scales. This approach has a spatial property that is similar to mammalian perceptual vision, thereby providing researchers a good opportunity to use it in image processing. Gabor filters are found to perform better than wavelet transform and other multi resolution approaches in representing textures and retrieving images due to its multiple orientation approach

The Gabor function is a complex exponential modulated by a Gaussian function. For a given image I(X,Y) with size P X Q, its discrete Gabor wavelet transform is given by convolution:

$$G_{mn}(X, Y) = \sum_s \sum_t I(X - s, Y - t)\Psi^*_{mn}(s, t)$$

Where, s and t are the filter mask size variables, Ψ^*_{mn} and is a complex conjugate of Ψ_{mn} which is a class of self similar functions generated from dilation and rotation of the following mother wavelet:

$$\Psi_{mn}(x,y) = \frac{1}{2\pi\sigma_x \sigma_y} + \exp\left[-\frac{1}{2}\left(\frac{x^2}{\sigma_x 2} + \frac{y^2}{\sigma_y 2}\right)\right].\exp(j2\pi W x)$$

Where W is called modulation frequency. The space constants σ*x* and σ*y* define the Gaussian envelope along the *x* and *y* axes. The self-similar Gabor wavelets are obtained through the generating function:

$$\Psi_{mn}(x, y) = a^{-m}\bar{\Psi}(\bar{x}, \bar{y})$$

Where m and n specify the scale and orientation of wavelet respectively, with m=0,1,……M-1, n=0,1,……N-1.

$$\bar{X} = a^{-m}(x \cos\Theta + y \sin\Theta)$$

$$\bar{Y} = a^{-m}(-x \sin\Theta + y \cos\Theta)$$

Where a>1 and $\Theta = n\pi / N$. The scale factor a^{-m} is meant to ensure the energy is independent of m.

3.4 Similarity measure-

For calculating the similarity we calculate Euclidean Distance between the query image (Iq) and images (I) in database formula of Euclidean Distance is as fallow:

$$D_2(\bar{x}, \bar{y}) = \sqrt{\sum_{i=1}^{M} |x_i - y_i|^2}$$

Where $\bar{x}$ and $\bar{y}$, features of query image and images in database. Where x_i represents the *i*th feature of the $\bar{x}$ and y_i features of $\bar{y}$.

IV. EXPERIMENTAL RESULTS

The Proposed model is simulated on an Intel Pentium IV, 2.66GHz and 1GB RAM. The GNW Hybrid Content based technique was tested on an images database of 425 images of 17 categories each category has 25 images and 100x100 pixel resolution [3]. The system is capable of accepting images as input and finding the best match images from within the database. The performance parameters are Precision, Recall, and F-Score. Y. H. Lee et al. [10] the most common evaluation measures used in IR (Information Retrieval) are precision and recall, usually presented.

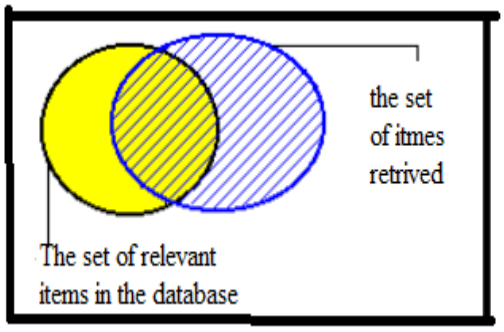

Figure 4.1 Show the relation between set of items retrieved and set of relevant images

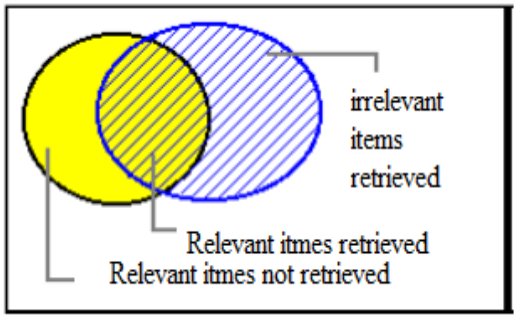

Figure 4.2 Show relations between irrelevant items retrieved, relevant items retrieved and relevant items not retrieved.

Precision

Precision is the probability of retrieving images that is relevant to query or it is of ratio of relevant records retrieved to the total number of relevant and irrelevant record retrieved it is usually express as percentage.

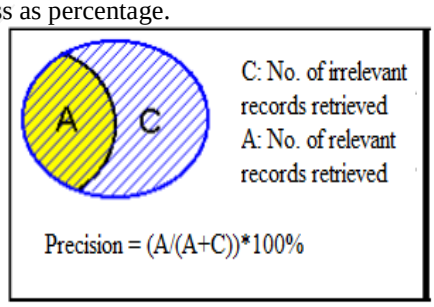

Figure 4.3 Precision

$$\textbf{Precision} = \frac{\textit{nuumber of relevant image retrieved}}{\textit{number of relevant in collection}} = \frac{A}{A+C}$$

Recall

Recall is the probability of relevant being retrieved or it is ratio of the number of relevant record retrieved to the total number of records in the database. It is usually represent as percentage.

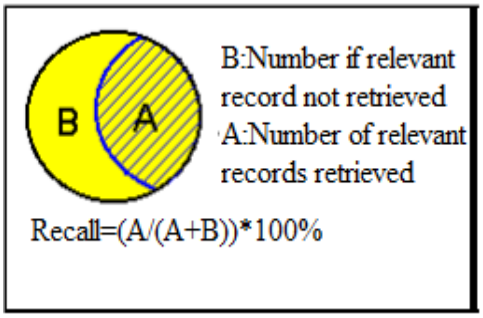

Figure 4.4 Recall

$$\textbf{Recall}= \frac{\textit{Number of relevant images retived}}{\textit{Number of relevant images in collection}}$$

$$\textbf{Recall} = \frac{A}{A+B}$$

Where A= is the number of relevant images retrieved.
B= is the number of relevant that were not retrieved.
C= is the number of irrelevant images retrieved.

F-Score

F-Score is the parameter often used to combined Precision and Recall into single performance measure, Higher the value of F-Score when value of both Precision and Recall is higher.

$$\textbf{Fscore}=\frac{\textbf{2 x precision x Recall}}{\textbf{Prescision +Recall}}$$

Table 4.1 show comparing different method (Local color histogram, Scalable Color Descriptor, Color Correlogram, Wavelet Correlogram, GLCM, Descriptor, Wavelet Method, Gabor Method, GNW Hybrid Method) based on parameter average precision.

Table 4.2 show comparing different method (Local color histogram, Scalable Color Descriptor, Color Correlogram, Wavelet Correlogram, GLCM, Descriptor, Wavelet Method, Gabor Method, GNW Hybrid Method) based on parameter average recall.

Table 4.3 show comparing different method (Local color histogram, Scalable Color Descriptor, Color Correlogram, Wavelet Correlogram, GLCM, Descriptor, Wavelet Method, Gabor Method, GNW Hybrid Method) based on parameter average Fscore.

Table (4.1) Table Comparison of Different Method Based on Average Precision

Method	Average Precision
Local color histogram[13]	0.333
Scalable Color Descriptor[7]	0.354
Color Correlogram[5]	0.324
Wavelet Correlogram[12]	0.325
GLCM[6]	0.156
Descriptor[10]	0.391
Wavelet Method	0.814
Gabor Method	0.917
GNW Hybrid Method	0.994

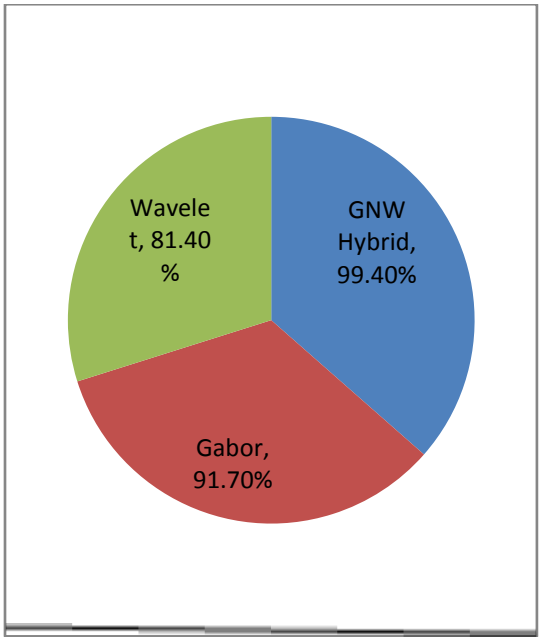

Figure 4.5 Comparison of Proposed system Wavelet method, proposed system Gabor method, proposed GNW Hybrid Method based on Average Precision

Table (4.2) Table Comparison of Different Method Based on Average Recall

Method	Average Recall
Local color histogram[13]	0.709
Scalable Color Descriptor[7]	0.716
Color Correlogram[5]	0.658
Wavelet Correlogram[12]	0.705
GLCM[6]	0.185
Descriptor[10]	0.771
Wavelet Method	0.8624
Gabor Method	0.894
GNW Hybrid Method	0.9508

Table (4.3) Table Comparison of Different Method Based on Average F-score

Method	Average F-score
Local color histogram[13]	0.453
Scalable Color Descriptor[7]	0.474
Color Correlogram[5]	0.424
Wavelet Correlogram[12]	0.445
GLCM[6]	0.169
Descriptor[10]	0.519
Wavelet Method	0.8375
Gabor Method	0.9052
GNW Hybrid Method	0.97192

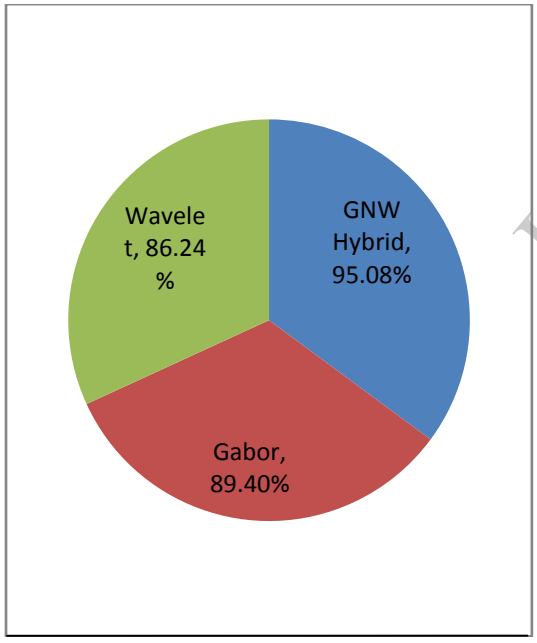

Figure 4.6 Comparison of Proposed system Wavelet method, proposed system Gabor method, proposed GNW Hybrid Method based on Average Recall

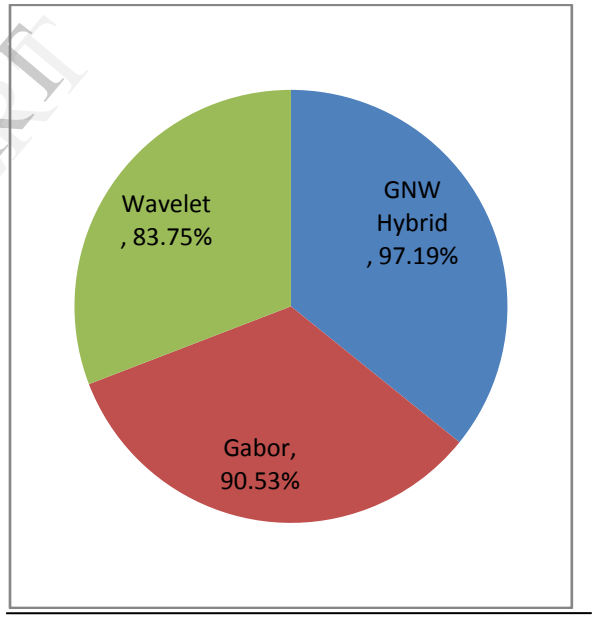

Figure 4.7 Comparison of Proposed system Wavelet method, proposed system Gabor method, proposed GNW Hybrid Method based on Average F-Score

Figure 4.8 Query Image brick2.jpg

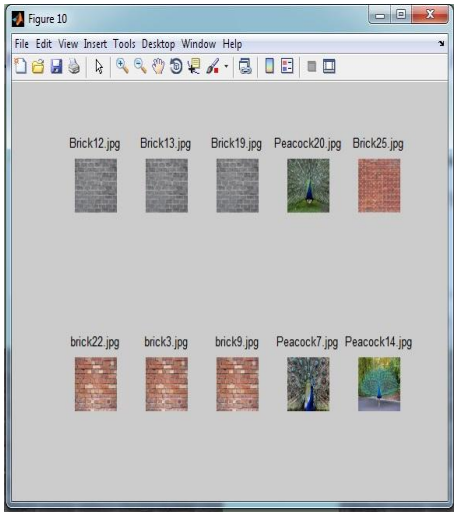

Figure 4.9 Result of Query Image (Brick2.jpg) Using Wavelet Transform

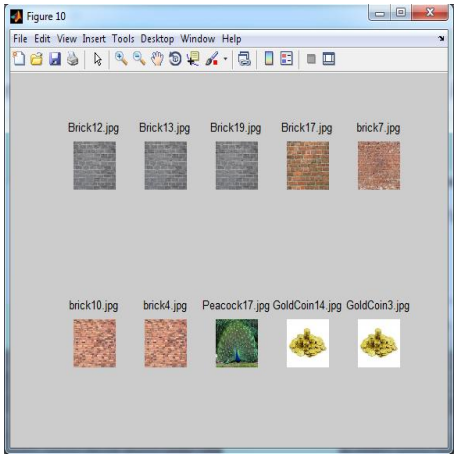

Figure 6.6 Result of Query Image (Brick2.jpg) Using Gabor Transform

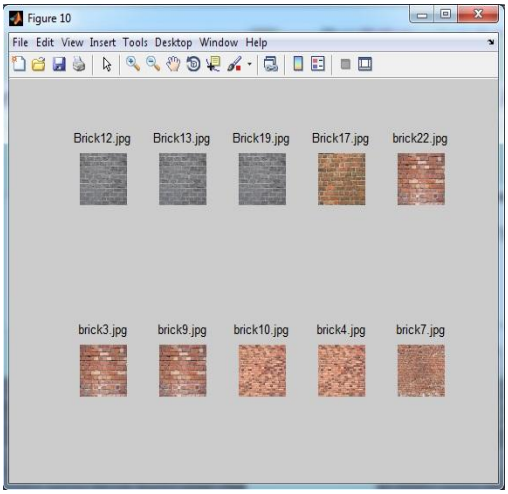

Figure 4.10 Result of Query Image (Brick2.jpg) Using GNW Hybrid Method

V.CONCLUSION

Many research have been done to develop some algorithms that solve some problems and achieve the accuracy when retrieving images and distinguishing between them. Many proposed algorithms use images to extract features and use their features for similarity matching. When only wavelet transform is applied (extract color feature) it show good result for some images and for some images we noticed it showing more irrelevant images. In the same way when Gabor transform is applied (extract texture feature) it show good result for particular type of images and for some images its result is not appropriate and show more number of irrelevant images.

Our Proposed method GNW Hybrid method that is uses wavelet transform for color features extraction and Gabor transform for texture feature extraction. And for calculate the similarity between query image and database images using Euclidian distance. Several experiments were performed to analyze of the performance of the proposed system. Our proposed GNW Hybrid method show good result in both cases where wavelet or Gabor transforms method showing more irrelevant images.

Our experiments with image also prove that only color or only texture feature is not sufficient to describe an image. The Results also reflect that GNW Hybrid method is more efficient in terms of average Precision, average Recall, and average F-score in compare to the previous methods, value of average precision 99.4%, value of average Recall 95.08%, and value of F-score 97.19%.

VI. REFERENCE

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