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The Invariant Moments Based With Wavelet Used To Decide the Authintication and Originality of Images

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Abstract

The digital image with the wavelet tools is increasing nowadays with MATLAB library, by using this method based on invariant moments which are a set of seven moments can be derived from the second and third moments , which can be calculated after converting the image from colored map to gray scale , rescale the image to (512 * 512) pixel , dividing the image in to four equal pieces (256 * 256) for each piece , then for gray scale image (512 * 512) and the four pieces (256 * 256) calculate wavelet with moment and invariant moment, then store the result with the author ,owner for this image to build data base for the original image to decide the authority of these images by using comparison using Mean Square Error (MSE) as shown below :-

$$MSE = \frac{1}{N*M} \sum_{x=0}^{N-1} \sum_{y=0}^{M-1} [\ (x, y) - f(x, y)]^2$$

The moments value of any image will be compared with the original data base images moment. The experiments were performed on a Pentium IV, 1.6 GHz processor, running Microsoft Windows XP and the programs were implemented by MATLAB .

Index Terms— wavelet, digital image, moment

Introduction

Searching a digital library having large numbers of digital images or video sequences has become important in this visual age. Every day, large numbers of people are using the Internet for searching and browsing through different multimedia databases.

Image feature vector indexing has been developed and implemented in several multimedia database systems such as the IBM QBIC System developed at the IBM Almaden Research Center, the Virage System developed by Virage, Inc., and the Photo book System developed by the MIT Media Lab[1].

For each image inserted into the database, a feature vector on the order of 500 elements is generated to represent accurately the content of the image.

This vector is much smaller in size than the original image. The difficult part of the problem is to construct a vector that both preserves the image content and yet is efficient for searching. Once the feature vectors are generated, they are then stored in permanent storage. To answer a query, the image search engine scans through the previously computed vector indexes to select those with shortest distances to the image query vector.

In this project, the research develops a new algorithm to make semantically-meaningful comparisons of images efficient and accurate. Figure 1 shows the basic structure of the system. To accurately encode semantic features of images we employ wavelets based. Using these wavelets and statistical moments' analysis, the algorithm produces feature vectors that provide much better frequency localization than other traditional color layout coding algorithms.

The libraries can use the digital image processing to decide the authority of each picture in them by using simple algorithm by extracting the moment of each picture and store that values in term of data base to compare these values with any unknown picture. As a result, millions of pictures flow on the Internet everyday. Nowadays, the interchange of images becomes more and more frequent.

Many techniques operating on images formats have been published and become publicly available. To answer a query, the image search engine scans through the previously computed vector indexes to select those with shortest moment terms to the image query vector.

Many color image formats are currently in use, e.g., GIF, JPEG, PPM and TIFF are the most widely used formats. Because images in the image database can have different formats and different sizes.

For the test database of relatively small images, a rescaled thumbnail consisting of 512 x 512 pixels in Red-Green-Blue (RGB) color space is adequate for the purpose of computing the feature vectors, and then convert the input image from colored image to the gray-scale image. The original gray scale image (512 * 512) will be divided into four equal divisions ,each part is (256 * 256) pixel as shown in fig. 2 .

Wavelet

Wavelets are mathematical functions that cut up data into different frequency components, and then study each component with a resolution matched to its scale. Wavelets were developed independently in the fields of mathematics, quantum physics, electrical engineering, and seismic geology.

Interchanges between these fields during the last ten years have led to many new wavelet applications such as image compression, turbulence, human vision, radar, and earthquake prediction [2]. So that , this project use the Haar as a type of wavelet with MATLAB Language as a function of image compression.

The Haar wavelet is the oldest and simplest transform and based on the Haar scaling and wavelet functions. The decomposition and reconstruction filter for a Haar based transform are of length 2 and obtained as followes :

```
>> [ Lo_D, Hi_D, Lo_R, Hi_D] = wfilters('Haar')

   Lo_D = 0.7071     0.7071

   Hi_D = -0.7071    0.7071

   Lo_R = 0.7071     0.7071

   Hi_D = 0.7071     -0.7071
```

Invariant Moments

Invariant moments which are a set of seven moments can be derived from the second and third moments.

Moment features used in this paper can provide the properties of invariance to scale, position, and rotation. We used moment analysis to extract invariant features from tessellated cells in an ROI. This section gives a brief description of the moment analysis. For a 2-D continuous function f(x, y), the moment of order (p+q) is defined as [3,4]:

$$\mu pq = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} x^p y^q f(x,y)\, dxdy \quad \text{for } p,q = 0,1,2,\ldots\ldots\ldots \quad (1)$$

A uniqueness theorem states that if f(x, y) is piecewise continuous and has nonzero values only in a finite part of the xy-plane, moment of all orders exist, and the moment sequence (μpq) is uniquely determined by f(x, y). Conversely, (μpq) is uniquely determined by f(x, y). The central moments are defined as:

$$\mu pq = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty}(x - xbar)^p(y - ybar)^q f(x, y)\, dx\, dy \ldots\ldots\ldots\ldots\ldots\ldots(2)$$

Where xbar =(μ10/ μ00) and ybar = (μ01/ μ00).
i.e. moments where the centre of gravity has been moved to the origin
(i.e. μ10 = μ01 = 0).

If f(x, y) is a digital image, then Eq. (2) becomes

$$\mu pq = \sum_x \sum_y (x - xbar)^p (y - ybar)^q f(x, y) \ldots\ldots\ldots\ldots(3)$$

and the normalized central moments, denoted ŋpq ,are defined as:

$$ŋpq = \mu pq / \mu 00 \quad ; \text{where } ybar = (p + q) / 2 + 1 \quad \text{for } p + q = 2, 3, \ldots\ldots(4)$$

A set of seven invariant moments can be derived from the second and third moments (4), It shows the derivation of expressions from algebraic invariants applied to the moment generating function under a rotation transformation.

The moments consist of groups of nonlinear centralized moment expressions. The result is a set of absolute orthogonal moment invariants that can be used for scale, position, and rotation invariant pattern identification, by using the invariant moments which are a set of seven moments can be derived from the second and third moments as below[5].

$$Ø1 = ŋ20 + ŋ02$$
$$Ø2 = (ŋ20 - ŋ02)^2 + 4ŋ^2 11$$
$$Ø3 = (ŋ30 - 3ŋ12)^2 + 3(ŋ21 + ŋ03)^2$$
$$Ø4 = (ŋ30 + ŋ12)^2 + (ŋ21 + ŋ03)^2$$
$$Ø5 = (ŋ30-3ŋ12)(ŋ30+ŋ12)[(ŋ30+ŋ12)^2-3(ŋ21+ŋ03)^2] + (3ŋ21- ŋ03)(ŋ21+ŋ03)[3(ŋ30+ ŋ12)^2 - (ŋ21+ ŋ03)^2]$$
$$Ø6 = (ŋ20-ŋ02)[(ŋ30+ŋ12)^2 - (ŋ21+ŋ03)^2] +4ŋ11(ŋ30+ŋ12)(ŋ21+ŋ03)$$
$$Ø7 = (3ŋ21-ŋ03)(ŋ30+ŋ12)[(ŋ30+ŋ12)^2-3(ŋ21+ŋ03)^2] +(ŋ30-3ŋ12)(ŋ21+ŋ03)[3(ŋ30 + ŋ12)^2 - (ŋ21+ŋ03)^2]$$

Central moments have the advantage of being invariant to translation. It is well known that a small number of moments can characterize an image fairly well; it is equally known that moments can be used to reconstruct the original image (1).

In order to achieve invariance to common factors and operations such as scale, rotation and contrast, rather than using the moments themselves algebraic combinations there of known as moment invariants are used that are independent of these transformations.

Experimental Results and Discussion

The moment invariant descriptors described above were used to index an image database of many images (10 images as a sample). An example of an image of a flower was used to perform image retrieval on the whole dataset. The result of this query is given which shows the descending similarity from other stored images data.

Unfortunately, due to the lack of enough samples of images, we are in the processes of collecting a large number of images, This documented dataset will then provide a test for the evaluation of our method proposed in this paper as well as future approaches.

As public databases, were established with the aim of providing acquired system by using scanners.

Here the proposed algorithm was evaluated on image taken from the database which contains five distinctive databases: DB1, DB2, DB3, DB4 and DB5. Each database consists of many images data in gray scale levels.

A series of experiments was conducted to evaluate the performance of the proposed method.

Conclusions

We have investigated the application of content-based image retrieval to the domain images. Each image is characterized by a set of moment invariants which are independent to translation, scale, rotation and contrast as shown in table (1,2).

Retrieval is performed by returning those images whose moments are most similar to the ones of a given query image. A moment based object recognition system is proposed.

In a given scene, an object may be occluded due to various reasons and hence recognition of original object becomes necessary for machine vision systems. The invariant moments as well as some of the lower order moments are used to authorize of unknown images owner. In this paper the search for known image is more accurate than the comparison of two colored images as pixel to pixel, because the use of moment and invariant moment is done by comparing little values of moments.

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Table(1): Example of calculating the moment of the image

Moments	Origin	first quarter	second quarter	third quarter	fourth quarter
μ00	0	0	0	0	0
μ10	3.783863e+007	4.938875e+006	5.871984e+006	3.908114e+006	4.200341e+006
μ01	8.913924e+009	2.514108e+008	2.944227e+008	3.014090e+008	3.480867e+008
μ20	9.738164e+009	2.690497e+008	3.935360e+008	2.041220e+008	2.833067e+008
μ02	2.277567e+012	1.214415e+010	2.021076e+010	1.672020e+010	2.333748e+010
μ11	3.204147e+012	1.214415e+010	2.062193e+010	2.905460e+010	3.337624e+010
μ30	3.475306e+012	2.176426e+010	3.441361e+010	1.629083e+010	2.486389e+010
μ12	1.379838e+015	2.060579e+012	3.370046e+012	1.534540e+012	2.446069e+012
μ21	8.146100e+014	9.409422e+011	1.800647e+012	1.354361e+012	2.033085e+012
μ03	8.214088e+014	8.776290e+011	1.437899e+012	1.662394e+012	2.235337e+012

Table(2):Example of retrieving the set of seven invariant moments of the image

PHI	Origin	first quarter	second quarter	third quarter	fourth quarter
Ø1	1.448088e-003	5.644571e-004	4.030901e-004	7.489013e-004	5.829668e-004
Ø2	9.441665e-009	1.652168e-008	4.767174e-009	1.652238e-008	5.077208e-009
Ø3	2.284418e-011	1.643365e-011	4.770410e-013	2.653920e-011	6.309182e-012
Ø4	3.304694e-011	8.909984e-012	1.111096e-012	2.546404e-011	1.096206e-011
Ø5	3.087560e-022	-7.821719e-23	4.962452e-025	-5.997825e-22	8.625016e-023
Ø6	3.191786e-015	-1.032175e-15	-7.380705e-17	-3.010348e-15	-7.610436e-016
Ø7	8.538908e-022	-7.420455e-23	6.388198e-025	2.801038e-022	-2.952706e-023

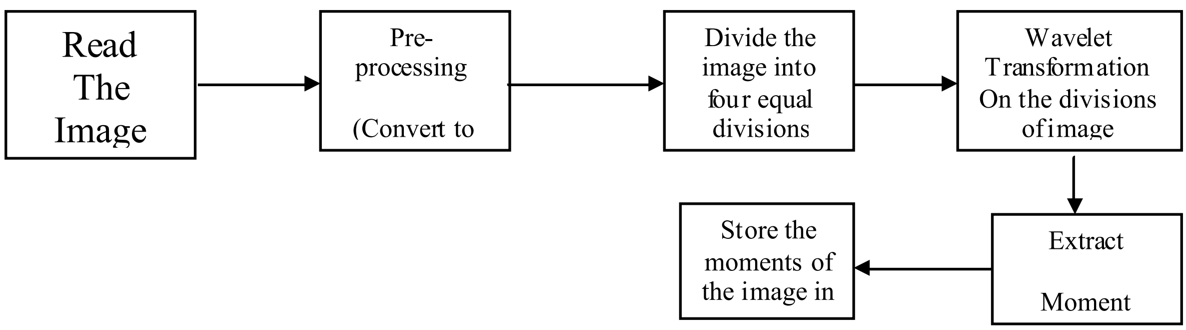

Fig. (1a) illustrates the overview of the system to build the database.

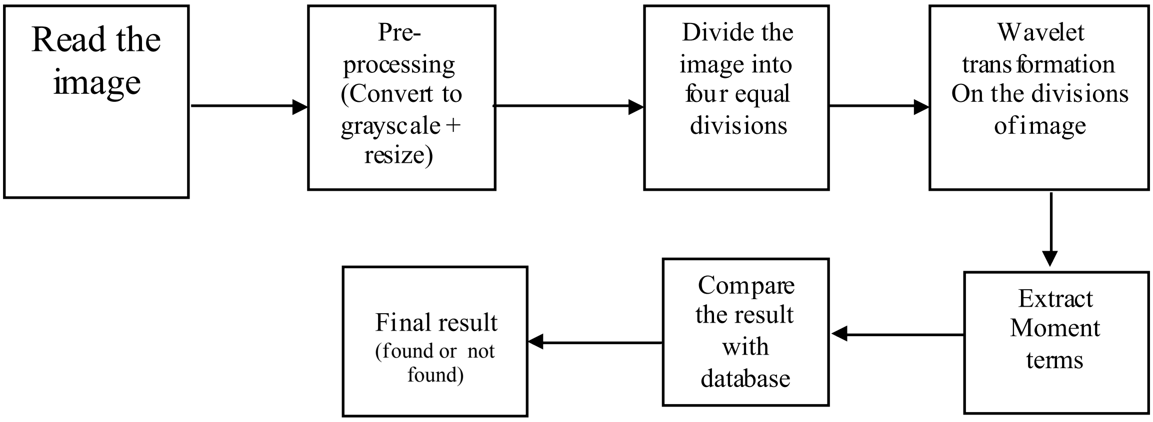

Fig. (1b) illustrates the overview of the comparison system of image information with the database .

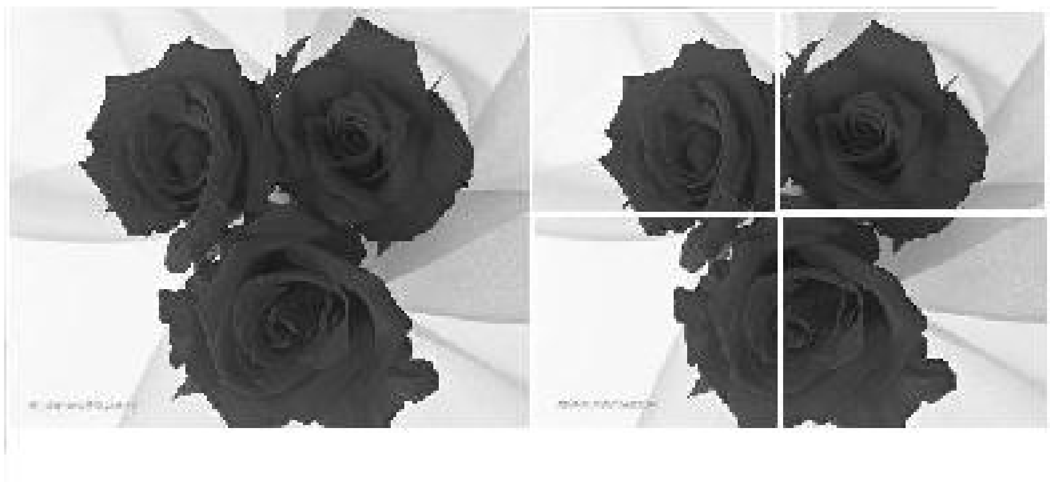

Fig.(2.a) the gray scale of the original image **Fig.(2.b) the four equal divisions**

مجلة ابن الهيثم للعلوم الصرفة والتطبيقية المجلد23 (2) 2010

اللحظات الثابتة
إستندتْ مَع التحويل الموجي
يُستَعملُ لتَقْرير عائدية واصالة الصورِ الرقمية

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الخلاصة

إستعمال الصورِ الرقميةِ وبأدواتِ التحويل الموجي مع لغة ماتلاب تزايد في الوقت الحاضر وباستخدام هذه التقنية مستندة على اللحظاتِ الثابتةِ وهي مجموعة مِنْ سبع لحظاتِ يُمْكِنُ أَنْ تُشتَقَّ مِنْ اللحظاتِ الثانيةِ والثالثةِ ، التي يمكن حسابها بعد قراءة الصورة الرقمية وتحويلها من الصور الملونة الى الصور ذي التدرج الرمادي ، ثم تحجيم الصورة وجعلها ثابتة بقياس (512 * 512) ، وتقسيم هذه الصورة على اربعة اجزاء متساوية بقياس (256 * 256) لكل جزء منها ، ثم عملِ التحويل الموجي للصورة (512 *512) ذي التدرج الرمادي و الاجزاء الاربعة الاخرى (256 * 256) ، لغرض ضغط الصورة مع ازالة الضوضاء منها ، مع احتساب اللحظات الاولى ومشتقتها (Ø) الثالثة وخزن النتيجةِ لبِناء قاعدةِ البيانات للصورِ الأصليةِ لتَقْرير اصالة هذه الصور عند مقارنتها مع صور اخرى .

حيث تبين ان عملية المقارنة بين الصور الرقمية تكون صعبة وتاخذ وقتا كبيرا نتيجة لكمية البيانات التي تعمل عليها عملية المقارنة ولكن باستخدام هذه الخوارزمية اصبحت العملية اسرع وادق لان المقارنة تعتمد على قيم اللحظات بعد ضغط الصورة باستخدام مربع معدل الخطأ لتحديد اقل نسبة الاخطاء المقبولة وكما مبين في الجدولين (1 و 2) .