Human Face Recognition is Dependent on Computing the Similarity and Difference of the Seven Moments Values as a Face Features

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ABSTRACT

Recognition of personal identification needs numerous techniques. Solution of this problem needs the development of technique for arriving to the highest accuracy for recognition. Some of techniques depend on human personal image. This research presents new technique for human face recognition. Two tests are executed for the image. The first test depends on splitting the image vertically into two parts (left part and right part) for evaluating the seven moments for each part to find similarity and difference between these parts. The second test depend on taking the image in different cases such as (image rotation and turn the angle of photo with different values) , extract the characteristics(such as eyes, nose, and mouth) of these images in these cases ,then compute the seven moments for these characteristics and then finding the similarity and difference between these characteristics .

Keywords: Rules of Moments, and Digital image of Human Face

تمييز وجه الأنسان بالاعتماد على حساب ألتشابهه و الاختلاف لقيم العزوم السبعة كصفات للوجه

الخلاصه

تمييز الهويه الشخصية يحتاج الى تقنيات متعدده.وحل المشكله يحتاج لتطوير تقنية الوصول الى دقة عالية للتمييز وان بعض التقنيات تعتمد على صورة الأنسان الشخصية. يُقدّمُ هذا البحثِ تقنية جديدةَ لتمييز صورة الأنسان وهنالك إختباران مُنَفّذان للصورةِ. يَعتمدُ الإختبارُ الأولُ على تقسّيمَ الصورة وبشكل عمودي إلى جزءين(جزء ايسر وجزء ايمن) ثم تحسب العزوم السبع لكّلّ جزء لإيجاد التشابه والأختلاف بين هذه الأجزاء.يعتمد الإختبارُ الثانيُ على أَخْذ الصورةِ في الحالاتِ المختلفةِ مثل (دوران صورةِ وتَدُويرُ زاوية التصوير بقِيَم مختلفةِ)،ثم تنتزعُ خصائصَ هذه الصور (مثل العين والأنف والفم) في هذه الحالاتِ، ثمّ تحْسبُ العزوم السبع لهذه الخصائص وبعد ذلك تَجِدُ التشابهَ والإختلافَ بين هذه الخصائص.

الكلمات المرشدة: قوانين العزوم السبعه ، وصورة رقميه لوجه الأنسان

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INTRODUCTION

Some of the major applications of image processing that we have witnessed in the last two decades are in the areas of biometric and biomedical image processing. The human vision system comes across a large set of biometric features and biomedical images and recognizes them without any conscious effort. To impart this capability to a machine is, however, difficult. The biometric identification systems are useful in several applications such as commercial and law enforcement applications, especially in criminal identification, security system, videophone, credit card verification, and photGIDs for personal identification, etc. Recognition of human faces, fingerprints, signatures, and many other such biometric images constitute an important area of research in the field of computer vision [1].

In general Face recognition and the recognition of moving people in natural scenes, require a set of visual tasks to be performed robustly. These include

1) Acquisition the detection and tracking of face like image patches in a dynamic scene.

2)Normalization the Segmentation, alignment and normalization of the face images.

3) Recognition the representation and modeling of face images as identifies, and the association of face images with known models [2]. These tasks seem to be sequential and have traditionally often been treated as such.

However, it is both computationally and psychophysically more appropriate to consider them as a set of cooperative visual modules with closed loop [3].

The face recognition tasks considered in this paper depend on applying the seven moments to sub image after splitting the human face image vertically intro two pats.Many images of person can be acquired in a few seconds. Given sufficient data, it becomes possible to model class conditional structure, i.e to estimate probability densities for each person [4].

BIOMETRIC PATTERN RECOGNITION

Human face and human signature represent some of the most common bio-metric patterns that our visual system encounters daily. The major strategies used in face identification are either based on features or they are based on face space, Most of the feature based methods extract features from front view of the face and sometimes also from side face profiles. An automatic face recognition system employing both front and side views of the face is more accurate, since it takes advantage of the explicit information inherently available in both the views of the human face [4].

FEATURE SELECTION

A set of landmark points are first identified from the front and side views of the human face, which are then used for feature measurement based on area, angle and distances between them. The combined set of features extracted from both the views is usually very effective to distinguish faces and provides more reliability over systems

Using features only from a single view because the side profile features provide Additional structural profile information of the face, not visible from the frontal images [5]. Extraction of features from the front view may be performed from the edge images**.** The template matching may be used for extraction of the eyes from the face image, while features such as nose, lips, chin, etc., may be extracted from the horizontal and vertical edge maps of a human face [6].

EXTRACTION OF FRONT FACIAL FEATURES

Correlation-based technique extracts several front facial components such as eyes, eyebrows, eye points, etc. A set of eye templates are initially chosen. The facial image f (i , j) is convolved with a set of appropriately chosen templates *T(m, n),* represented by the following filter operation:

$$F(i,j)=\sum\sum T(m,n)*f(i+m,j+n) \quad \ldots (1)$$

This convolution process generates a set of energy measures at the output of the filter. The position of the eye is determined from the output of the convolution filter. Using translation, scale, and rotation invariant affine transform, we can detect the eyes from the convolution filter [7].

Once the two eyes have been detected, the eyebrow positions can be located within a small search region above the eye-center. Subsequently, a set of eyebrow templates can be matched along the column of the iris in each half of the eyebrow template window to detect the eyebrows above the left and right eyes [7]. Some of the front facial features are invariant features, which do not change with facial expression, whereas others are variant features. Some of the front facial points are shown in Figure1. Among the front facial features, eyes have a significant role in the recognition process [8].

a b c d

Figure (1a) some of the fiducially feature points of front face, b) Side view, c) binarized side view (d) contour of the side profile marked on it.

Some of the invariant and variant features from the front face view are illustrated as follows:

1. Invariant Features

a) Distance between left and right iris centers

b) Distance between two inner eye points, and

c) Distance between two outer eye points

d) Distance form eye-center (mid point of distance between two iris centers) to nose tip.

2. Variant Features:

a) Distance between left iris center and left eyebrow (same column)

b) Distance between right iris center and right eyebrow (same column), and

c) Face width at the nose tip

FACE RECOGNITION TASKS

Given a database consisting of a set, £ of N known people, different face recognition tasks can be envisaged. Four tasks are defined here as follows [9]:

1) Face classification: the task is to identify the subject under the assumption that the subject is a member of set £ [10].

2) Known/unknown: the task is to decide if the subject is a member of set £ [10].

3) Identity verification: the subject's identity is supplied by some other means and must be confirmed [10].

4) Full recognition: This task is used to determine whether or not the subject is a member of £, and if so, then to determine the subject's identity [10].

Moment Invariants

Let *F (x,* y) denote an image in the two-dimensional spatial domain [11]. *Geometric moment* of order *p* + *q* is denoted as

$$m_{p,q} = \sum_{x}\sum_{y} x^p y^q F(x,y) \qquad \ldots (2)$$

for *p* , *q* = 0 , 1 , 2 , ... The central moments are expressed as

$x_c = m_{1,0} / m_{0,0}$

$y_c = m_{0,1} / m_{0,0}$

Where $m_{1,0}$ mentioned in Eq. 2 and ***(xc,*** yc) is called the center of the region of object. Hence the *Central moments,* of order up to 3, can be computed as mentioned in [11].The *normalized central moments,* denoted by $h_{p,q}$, are defined as

$$h_{p,q} = m_{p,q} / m^{g}{}_{0,0} \qquad \ldots (3)$$

Where:

$$g = p + q / 2 \quad \ldots (4)$$

for p + q = 2 , 3 ,…, P*q. A set of seven *transformations invariant moments* can be derived from the second- and third-order moments as follows [11]

$$\begin{aligned}
f1 &= h_{2,0} + h_{0,2} \\
f2 &= (h_{2,0} + h_{0,2})^2 + 4h_{1,1} \\
f3 &= (h_{3,0} - 3h_{1,2})^2 + (3h_{2,1} - h_{0,3})^2 \\
f4 &= (h_{3,0} + 3h_{1,2})^2 + (3h_{2,1} + h_{0,3})^2 \\
f5 &= (h_{3,0} - 3h_{1,2})(h_{3,0} + 3h_{1,2})[(h_{3,0} + 3h_{1,2})^2 \\
&\quad - 3(h_{2,1} + h_{0,3})^2] + (3h_{2,1} - h_{0,3})(h_{2,1} + h_{0,3}) \\
&\quad [3(h_{3,0} + h_{1,2})^2 - (h_{2,1} + h_{0,3})^2] \\
f6 &= (h_{2,0} + h_{0,2})[(h_{3,0} + h_{1,2})^2 - (h_{2,1} - h_{0,3})^2] \\
&\quad + 4h_{1,1}(h_{3,0} + h_{1,2})(h_{2,1} - h_{0,3}) \\
f7 &= (3h_{2,1} - h_{0,3})(h_{3,0} + h_{1,2})[(h_{3,0} + h_{1,2})^2 \\
&\quad - 3(h_{2,1} + h_{0,3})^2] + (3h_{1,2} - h_{3,0})(h_{2,1} + h_{0,3}) \\
&\quad [3(h_{3,0} + h_{1,2})^2 - (h_{2,1} - h_{0,3})^2]
\end{aligned} \quad \ldots (5)$$

This set of normalized central moments is invariant to translation, rotation, and scale changes in an image [11].

THE PROPOSED TECHNIQUE FOR HUMAN FACE RECOGNITION

The proposed technique used to recognize the human face depends on split the original image into two sub images (or sides) left side and right side after splitting it can compute the seven moments for each side individually, the test can apply to image with different sizes such as 120×144 and 90×108 and it can be seen that any of these human images has approximately the same values of the seven moments for left side and right side. Also the proposed technique used to recognize the features of the original image original image human face (such as eyes, nose, and mouth) before and

after turning the angle of the photo by the degrees (15,30,25,60,75, and 90) and computing the seven moments for each feature individually.

The algorithm of the proposed technique is illustrated as:

Input : original image contains human face
Output : seven moments for each side of human face

Step1:
1) Enter original image ***(O)*** contain human face image
2) Compute the width ***w*** and height ***h*** for original image ***(O)***.

Step 2: Rotate original image ***(O)*** by angles ***(5, 10, 15, 20)*** to obtain the image ***(OR).***

Step 3: Turn the angle of photo of the original image ***(O)*** by the angles ***(15, 30, 45, 60, and 75, 90 degree)*** to obtain the image ***(OPR).***

Step 3:
1) For i= 1 to ***w***.
2) For j 1 to ***h***
3) Split the images (***O, OR, and OPR***) vertically into two sub images ***A1*** for left side and ***A2*** for the right side.
4) Compute the seven moments for A1.
5) Compute the seven moments for A2.
6) Compare between moments results for each sub image in sides A1 and A2.
7) next
8)next

Step 4:
1)Extract the features(such as eyes, noise, and mouth), (***E1*** for right eye,***E2*** for left eye, ***N*** for nose ,and ***M*** for mouth) from the image (***O, OR , and OPR***)
2) Compute the seven moments for each feature individually.
3) Compare between moments results for each feature.

Step 5: End

EXPERIMENTAL RESULTS

In this section it done different examples to show the result of our algorithm and the experiment can be divided into two tests such as **Test 1:** suppose it has original images with different sizes such as 120×144, 90x108, and 64x64.The original image can berotated, and the furn of aphoto can be changed with any angle as illustrated in the figures below:-

Example (1)

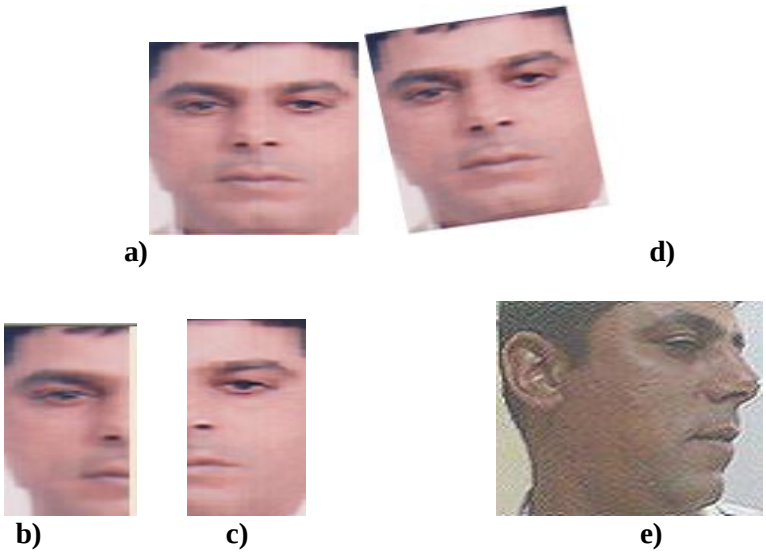


Figure (2 a) Original image with size, b) The left part of image, c) The right part of image, d) Original image after rotation, e) Original Image after turning the angle of photo.

Table (1) shows the seven moment's values can be computed from Fig.2 with different images sizes in the cases (b-left side, c -right side and e-side after turning the angle of photo)

	Image with size 120×144			**Image with size 90x108**			**Image with size 64×64**		
	Left side	Right side	One side	Left side	Right side	One side	Left side	Right side	One side
Moment 1	0	0	0	0	0	0	0	0	0
Moment 2	0	0	0	0	0	0	0	0	0
Moment 3	1.30	7.83	2.12	4.05	8.93	4.73	1.38	1.10	1.05
Moment 4	1.30	7.83	2.12	4.04	8.93	4.73	1.38	1.10	1.05
Moment 5	-1.49	-6.93	-3.08	-2.57	-2.67	-3.25	-1.63	-1.16	-3.41
Moment 6	0	0	0	0	0	0	0	0	0
Moment 7	0	0	0	0	0	0	0	0	0

Example (2)

a)

d)

b)

c)

e)

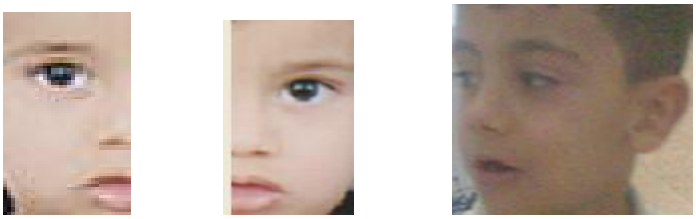
Figure (3 a) Original image with size, b) The left part of image, c) The right part of image, d) Original image after rotation, e) Original image after turning the angle of photo.

Table (2) shows the seven moment's values can be computed from Figure (3) with different images sizes in the cases (b-left side, c -right side and e-side after turning the angle of photo)

	Image with size 120×14			Image with size 90x108			Image with size 64×64		
	Left side	Right side	One side	Left side	Right side	One side	Left side	Right side	One side
Moment 1	0	0	0	0	0	0	0	0	0
Moment 2	0	0	0	0	0	0	0	0	0
Moment 3	9.95	7.35	3.71	2.25	1.86	1.69	2.09	1.04	2.10
Moment 4	9.95	7.35	3.71	2.25	1.86	1.69	2.09	1.04	2.10
Moment 5	-9.92	-6.31	-9.66	-3.03	-1.07	-3.98	-3.38	-2.55	-2.26
Moment 6	0	0	0	0	0	0	0	0	0
Moment 7	0	0	0	0	0	0	0	0	0

Example (3)

a) d)



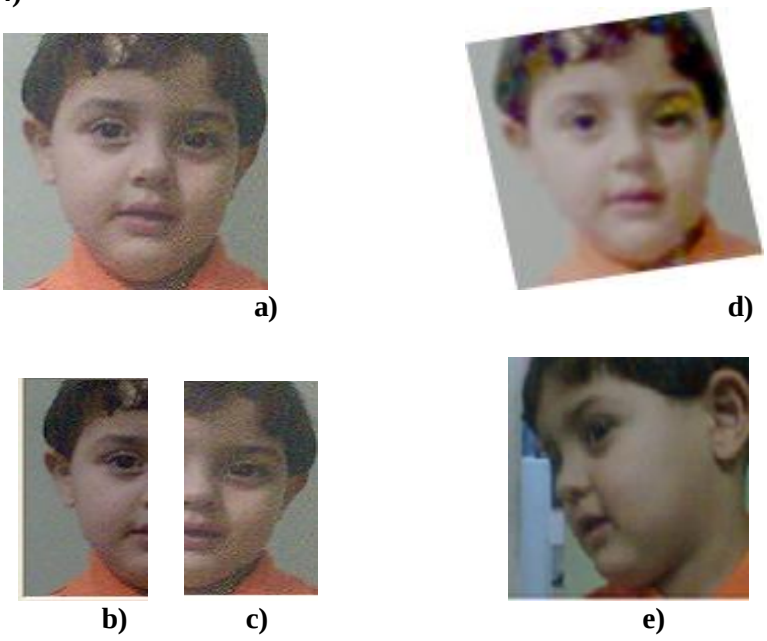
b) c) e)

Figure (4 a) Original image with size , b) The left part of image , c) The right part of image, d) Original image after rotation, e) Original image after turning the angle of photo.

Table (3) shows the seven moment's values can be computed from Fig.4 with different images sizes in the cases (b-left side, c -right side and e-side after turning the angle of photo)

	Image with size 120×144			**Image with size 90x108**			**Image with size 64×64**		
	Left side	Right side	One side	Left side	Right side	One side	Left side	Right side	One side
Moment 1	0	0	0	0	0	0	0	0	0
Moment 2	0	0	0	0	0	0	0	0	0
Moment 3	1.31	9.71	6.47	7.62	1.35	3.61	5.39	2.93	6.05
Moment 4	1.31	9.71	6.47	7.62	1.35	3.61	5.39	2.93	6.05
Moment 5	-1.51	-9.58	-9.16	-3.95	-1.59	-2.22	-2.10	-4.96	-4.71
Moment 6	0	0	0	0	0	0	0	0	0
Moment 7	0	0	0	0	0	0	0	0	0

Example (4)



a) d) b) c) e)

Figure (5 a) Original image with size , b) The left part of image , c) The right part of image, d) Original image after rotation, e) Original image after turning the angle of photo.

Table (4) shows the seven moment's values can be computed from Fig.5 with different images sizes in the cases (b-left side, c -right side and e-side after turning the angle of photo)

	Image with size 120×144			**Image with size 90x108**			**Image with size 64×64**		
	Left side	Right side	One side	Left side	Right side	One side	Left side	Right side	One side
Moment 1	0	0	0	0	0	0	0	0	0
Moment 2	0	0	0	0	0	0	0	0	0
Moment 3	1.52	4.40	1.85	2.73	1.74	1.34	1.45	3.83	3.56
Moment 4	1.52	4.40	1.85	2.73	1.74	1.34	1.45	3.83	3.56
Moment 5	-1.88	-2.91	-2.52	-4.52	-7.26	-4.92	-5.55	-2.37	-2.13
Moment 6	0	0	0	0	0	0	0	0	0
Moment 7	0	0	0	0	0	0	0	0	0

Example (5)

a)

d)

b)

c)

e)

Figure (6 a) Original image with size , b) The left part of image , c) The right part of image, d) Original image after rotation, e) Original image after turning the angle of photo.

Table (5) shows the seven moment's values can be computed from Fig.6 with different images sizes in the cases (b-left side, c -right side and e-side after turning the angle of photo)

	Image with size 120×144			**Image with size 90x108**			**Image with size 64×64**		
	Left side	Right side	One side	Left side	Right side	One side	Left side	Right side	One side
Moment 1	0	0	0	0	0	0	0	0	0
Moment 2	0	0	0	0	0	0	0	0	0
Moment 3	3.77	2.31	1.40	4.74	3.09	2.09	4.32	3.28	4.86
Moment 4	3.77	2.31	1.40	4.74	3.09	2.09	4.32	3.28	4.86
Moment 5	-2.32	-1.11	-3.02	-1.03	-5.45	-4.28	-2.84	-1.88	-2.38
Moment 6	0	0	0	0	0	0	0	0	0
Moment 7	0	0	0	0	0	0	0	0	0

Example (6)

a)

d)

b)

c)

e)

Figure (7 a) Original image with size , b) The left part of image , c) The right part of image, d) Original image after rotation, e) Original image after turning the angle of photo.

Table (6) shows the seven moment's values can be computed from Fig.7 with different images sizes in the cases (b-left side, c -right side and e-side after turning the angle of photo)

	Image with size 120×144			**Image with size 90x108**			**Image with size 64×64**		
	Left side	Right side	One side	Left side	Right side	One side	Left side	Right side	One side
Moment 1	0	0	0	0	0	0	0	0	0
Moment 2	0	0	0	0	0	0	0	0	0
Moment 3	1.02	3.44	1.92	3.44	1.64	1.10	9.05	1.29	1.53
Moment 4	1.02	3.44	1.92	3.44	1.64	1.10	9.05	1.29	1.53
Moment 5	-1.02	-2.02	-8.46	-6.39	-2.12	-3.65	-2.72	-4.66	-3.82
Moment 6	0	0	0	0	0	0	0	0	0
Moment 7	0	0	0	0	0	0	0	0	0

Example (7)

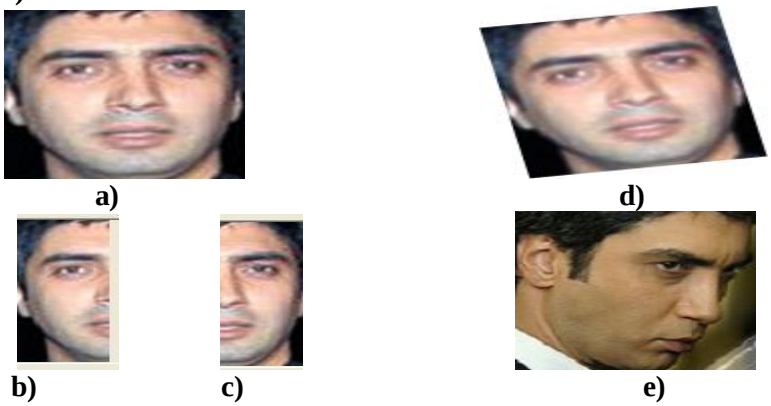
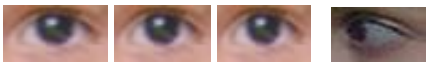


Figure (8 a) Original image with size , b) The left part of image , c) The right part of image, d) Original image after rotation, e) Original image after turning the angle of photo.

Table (7) shows the seven moment's values can be computed from Fig.2 with different images sizes in the cases (b-left side, c -right side and e-side after turning the angle of photo)

	Image with size 120×144			**Image with size 90x108**			**Image with size 64×64**		
	Left side	Right side	One side	Left side	Right side	One side	Left side	Right side	One side
Moment 1	0	0	0	0	0	0	0	0	0
Moment 2	0	0	0	0	0	0	0	0	0
Moment 3	2.37	2.69	4.71	3.23	3.13	2.26	1.66	1.62	1.63
Moment 4	2.37	2.69	4.71	3.23	3.13	2.26	1.66	1.62	1.63
Moment 5	-2.15	-4.43	-3.41	-5.80	-5.53	-3.28	-3.66	-2.06	-1.35
Moment 6	0	0	0	0	0	0	0	0	0
Moment 7	0	0	0	0	0	0	0	0	0

Test 2: suppose it has the features of the original images ,rotate the original images with the 10 degree , and the image after turning the angle of photo with N degrees (such as N=45 degree).The pictures of these features can be shown in figures.9,10,11,12,13, and 14. It can extract the features of the figure 3 and figure 7 to trace the seven moments for these features.

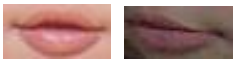


a) b) c) d)

Figure (9 a) Left eye of original image ,b) Right eye of original image , b) Right eye after image rotation, d) Eye after turning c) the angle of photo.

a) b) c)

Figure (10 a) Nose of original image, b) Nose after image rotation, d) Nose after turning the angle of photo.



a) b)

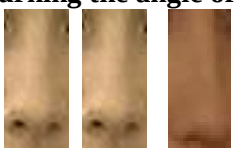
Figure (11 a) Mouth of original image, b) Mouth after turning the angle of photo.

Table (8) shows the values of the seven moments that can be computed from the features in figures (9, 10 .and 11)

	Features of original image				*Features of original image after rotation*				*Features of original image after turning the angle of photo*			
	left eye	right eye	nose	mouth	left eye	right eye	nose	mouth	left eye	right eye	nose	mouth
Moment 1	0	0	0	0	0	0	0	0	0	0	0	0
Moment 2	0	0	0	0	0	0	0	0	0	0	0	0
Moment 3	1.07	1.02	1.61	1.29	1.11	1.06	1.76	1.75	6.22	6.14	7.76	9.6
Moment 4	1.07	1.02	1.61	1.29	1.11	1.06	1.76	1.75	6.22	6.14	7.76	9.63
Moment 5	-3.70	-3.24	-6.50	-1.46	-3.30	-3.12	-2.50	-7.34	-1.55	-1.30	-5.34	-2.99
Moment 6	0	0	0	0	0	0	0	0	0	0	0	0
Moment 7	0	0	0	0	0	0	0	0	0	0	0	0

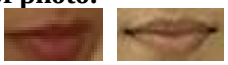
a) b) c) d)

Figure (12) a) Left eye of original image ,b)Right eye of Original image, c) Right eye after image rotation, d) Eye After turning the angle of photo.



a) b) c)

Figure (13) a) Nose of original image, b) Nose after image rotation, c) Nose after turning the angle of photo.



a) b)

Figure (14) a) Mouth of original image, b) Mouth after image.

Table (9) shows the values of the seven moments that can be computed the features in figures (12,13,and 14)

	Features of original image				*Features of original image after rotation*				*Features of original image after turning the angle of photo*			
	left eye	right eye	nose	mouth	left eye	right eye	nose	mouth	left eye	right eye	nose	mouth
Moment 1	0	0	0	0	0	0	0	0	0	0	0	0
Moment 2	0	0	0	0	0	0	0	0	0	0	0	0
Moment 3	2.11	2.89	4.28	3.51	2.16	2.33	4.35	3.99	5.75	5.84	7.32	6.72

Moment 4	2.11	2.89	4.28	3.51	2.16	2.33	4.35	3.99	5.75	5.84	7.32	6.72
Moment 5	-3.06	-3.92	-2.79	-2.08	-3.21	-3.97	-3.06	-2.38	-7.28	-7.33	-9.06	-5.74
Moment 6	0	0	0	0	0	0	0	0	0	0	0	0
Moment 7	0	0	0	0	0	0	0	0	0	0	0	0

Figure (15) illustrates the relationship between the values that can be used for turning the angle of photo and the difference of the seven moments of the face characteristics such as (eyes, noses and mouths). The degrees that used for turning are 0, 15, 30, 45, 60, 75, and 90.From the testing results that applied to all images in the figures (9, 10,11,12,13, and 14) it can see that the difference between original image characteristics and characteristics after turning is increases if the angle of turning is increased and decrease if the angle of turning is decrease and the relation between the angle and differences is extrusive.

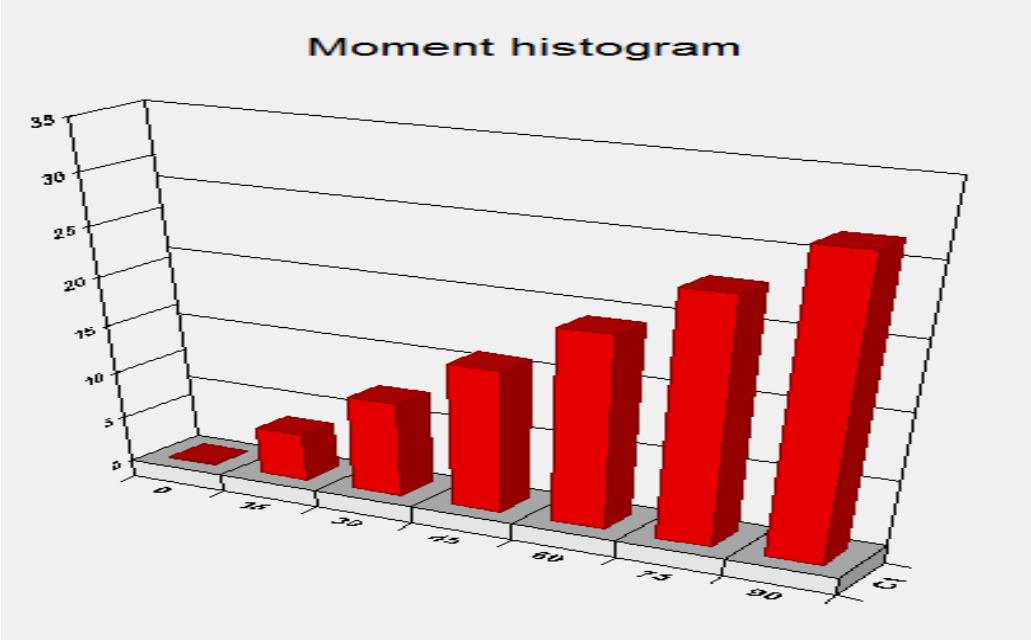


Figure (15) the relationship between differences in the seven moments and the angles of photo.

CONCLUDING REMARK

The proposed technique for face recognition passes into two tests.

The first test depend on splitting the face image into two parts (left part and right part) then extract the feature for each part independently by applying the seven moments to each part.

The second test depend on computing the seven moments of face characteristics such as (left eye, right eye, nose, and mouth) for numerous mages in different cases such as image rotation and turn the angle of photo with the values (0,15,30,45,60,75, and 90).

From the first test, it can see that he seven moments values of the left part is approximately similar to the seven moments values of the right part if the dimensions of an image is small and decrease if the dimensions of an image is big and these values are different if the angle of photos is turned.

This means that the similarities between these parts are increases if the dimensions of an image are small and decrease if the dimensions of an image are big.

From the second test, it can see that the seven moment's values of each characteristic are relatively similar if the image is rotated with any angle's value and different when turn the angle of photo and this difference is great if the angle's value is increase.

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