Face Features Comparison For Real and Pencil Portrait Using Moments Invariants

Ph.D.(Prof.) Abdul Monem S. Rahma*, (Lecturer)Dunia F. Saffo** ,
(Assist.Lecturer) Tarik Zaid**

Abstract

In this paper, comparisons for the detected features of human face real photo and the human face pencil portrait is done to evaluate the features properties. Moments based features are used in the comparisons so as to produce the seven invariant values for the features of the faces. These moments are invariant to translation, scale, contrast and rotation in the faces presented as a real photo and a pencil portrait and both of these photos are represented as digital gray scale images. Face's features in both images are detected by the user, cropped and sent to the implemented method so as to compute the seven moments for these parts of the faces' images, and then determining the range of differences between the moments resulted of the two face images features so as to determine that the two images are for the same person. The results showed that the differences in moments values computed for the symmetrical features in the two photos (the real photo and the pencil portrait) lie in a limited range, and the moments values are invariant according to view, scale and contrast variations of the two photos.

Keywords : Pencil portrait ,moments, Face features, real photo

* Computer Science Department, University of Technology,
** Computer Science Department, University of Baghdad,

1.Introduction

Faces are complex objects with features that can vary overtime. However, humans have a natural ability to recognize faces and identify persons in a glance of course. Natural recognition ability extends beyond face recognition, where patterns, sounds, or smells may be recognized. Unfortunately, this natural ability does not exist in machines, thus the need to simulate recognition artificially in our attempts to create intelligent autonomous machines [1].

Face recognition is a task that humans perform routinely and effortlessly in their daily lives. Wide availability of powerful and low cost desktop and embedded computing system has created an enormous interest in automatic processing of digital images and videos in a number of applications including biometric authentication, surveillance, human-computer interaction, research and development in automatic face recognition follows naturally. Face recognition became more and more important owing to rapid advances in technologies, such as digital cameras, the internet and mobile devices, and increased demands on security [2].

Face detection segments the face areas from the background. Facial components, such as eyes, nose, mouth and facial outlines are located. Feature extraction is performed to provide effective information that is useful for distinguishing between faces of different persons. For face matching, the extracted feature vector of the input face is matched against those of enrolled faces. Face recognition depend highly on feature extracted to represent the face pattern and classification methods used to distinguish between faces [3].

Moments and functions of moments have been extensively employed as invariant global features of images in pattern recognition [4]. In this study, a flexible recognition system that can compute the good features for high classification of real faces and pencil portrait photos is investigated. For object recognition, regardless of orientation, size and position, feature vectors are computed with the help of nonlinear moment invariant functions. Representations of objects using two-dimensional images that are taken from different angles of view are the main features leading us to our objective. After efficient feature extraction, the recognition performance of classifiers in conjunction with moment–based feature sets is introduced.

2.The Process of Face Recognition

Automated face recognition is a relatively new concept developed in the 1960s, the first semi-automated system for face recognition required the administrator to locate features (such as eyes, ears, nose and mouth) on the photographs before its calculated distances and ratios to a common reference point, which were then compared to reference data. In the 1970s, Goldstein, Harmon, and Lesk used 21 specific subjective markers such as hair color and lip thickness to automate the recognition. In 1988 a principle component analysis which a standard linear algebra technique was applied [5].

There are several reasons for recent increased interest in face recognition, including rising public concern for security, the need for identity verification in the digital world, and the need for face analysis and modeling techniques in multimedia data management and computer entertainment. Face recognition mainly involves the following three tasks:[6]

- Verification: the recognition system determines if the query face image and the claimed identity match.
- Identification: the recognition system determines if the identity of the query face image by matching it with a database images with known identities, assuming that the identity of the face image is inside the database.
- Watch list: the recognition system first determines if the identity of the query face image is in the stored watch list, and, if yes, then identify the individuals.

Over the last quarter of a century, scientists and engineers have endeavored to build machines capable of automatic face perception. This effort has been multidisciplinary and has benefited from areas [7].
Face recognition is a visual pattern recognition problem. There, a face is to be identified based on its two-dimensional image (three-dimensional images e.g., obtained from laser may also be used).A face recognition system generally consists of four modules as depicted in Figure 1: detection, alignment, feature extraction, and matching, where localization and normalization (face detection and alignment) are processing steps

before face recognition (facial feature extraction and matching) is performed. Face detection segments the face areas from the background. Face alignment is aimed at achieving more accurate localization and at normalizing faces thereby whereas face detection provides coarse estimates of the location and scale of each detected face. Facial components, such as eyes, nose, and mouth and facial outline, are located; based on the location points, the input face image is normalized with respect to geometrical properties, such as size and pose, using geometrical transforms or morphing. The face is usually further normalized with respect to photometrical properties such illumination and gray scale. After a face is normalized geometrically and photo metrically, feature extraction is performed to provide effective information that is useful for distinguishing between faces of different persons and stable with respect to the geometrical and photometrical variations. For face matching, the extracted feature vector of the input face is matched against those of enrolled faces in the database; it outputs the identity of the face when a match is found with sufficient confidence or indicates an unknown face otherwise [8].

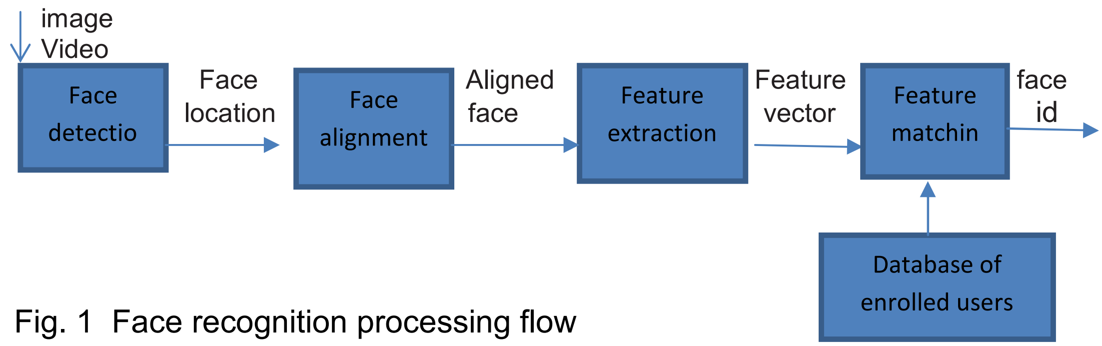


Fig. 1 Face recognition processing flow

Face recognition results depend highly on features that are extracted to represent the face pattern and classification methods used to distinguish between faces whereas face localization and normalization are the basis for extracting effective features. The machines capable of automatic face perception. This effort has been multi-disciplinary and has benefited from areas as varied as computer science, cognitive science, mathematics, physics, psychology and neurobiology. Computer-based face perception is becoming increasingly desirable for many applications including human machine interfaces, multimedia, security, teleconferencing, communication, animation, visually medicated and anthropomorphic environments[7].

3.Concepts of Moments Invariants

An essential issue in the field of pattern analysis is the recognition of objects regardless of their position, size and orientation [9]. Moments are very useful because their computation is algorithmically simple and uniquely defined for any image function. Besides that, moment-based methods often yield features from an image that are invariant to translation, scaling, and rotation [10]. The idea of using moments in shape recognition gained prominence when Hu (1962), derived a set of invariants using algebraic invariants [11]. Since that time, numerous works have been devoted to various improvements and generalizations of Hu's invariants and also to its use in many application areas [12].
Recognition of visual patterns and characters independent of position, size, and orientation in the visual field has been a goal of much recent research. To achieve maximum utility and flexibility, the methods used should be insensitive to variations in shape and should provide for improved performance with repeated trials [13].
Recognition of objects and patterns that are deformed in various way has been a goal of much recent research. There are basically three major approaches to this problem – brute force, image normalization, and invariant features. The approach using invariant features appears to be the most promising and has been used extensively. Its basic idea is to describe the objects by a set of measurable quantities called invariants that are insensitive to particular deformations and that provide enough discrimination power to view, invariant I is a functional defined on the space of all admissible image functions which does not change its value under degradation operator. This property is called invariance [14].
Moments based invariants have been widely used over the years as features for recognition in many areas of image analysis. Typical examples include the use of moments for optical character recognition and shape identification [4]. Image moments have been shown to be useful in image analysis [11].

Moments invariants who employed the results of the theory of algebraic invariants [10,11] and derived his seven famous invariants to the rotation of 2-D objects:

Two-dimensional moments of a digitally sampled M × M image f(x , y), (x , y = 0, . . . M − 1) is given as

$$m_{pq} = \sum_{x=0}^{M-1} \sum_{y=0}^{M-1} x^p y^q \; f(x,y) \quad \ldots\ldots(1)$$

p , q = 0,1,2,3,….

The moments translated by an amount (a , b) are defined as

$$\mu_{pq} = \sum_x \sum_y (x+a)^p (y+b)^q \; f(x,y) \quad \ldots\ldots (2)$$

substituting $a = -\bar{x}$ and $b = -\bar{y}$ as

$$\bar{x} = \frac{m10}{m00} \quad \text{and} \quad \bar{y} = \frac{m01}{m00}$$

$$\mu_{pq} = \sum \sum (x - \bar{x})^p \cdot (y - \bar{y})^q f(x,y) \quad \ldots\ldots(3)$$

when scaling normalization is applied the central moments change as

$$\eta_{pq} = \mu_{pq} / \mu_{00}^{y} \quad \ldots\ldots (4)$$

$y = [\,(p+q)/2\,] + 1$

in particular , Hu (1962), defines seven values, computed by normalizing central moments through order three, that an invariant to object scale, position, and orientation.

In terms of central moments, the seven moments are given as:

$M1 = (\eta_{20} + \eta_{02})$

$M2 = (\eta_{20} + \eta_{02})^2 + 4\eta_{11}^{\;2}$

$M3 = (\eta_{30} - \eta_{12})^2 + (3\eta_{21} - \eta_{03})^2$

$M4 = (\eta_{30} + \eta_{12})^2 + (\eta_{21} + \eta_{03})^2$

$M5 = (\eta_{30} - 3\eta_{12})(\eta_{30} + \eta_{12})\,[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} - \eta_{03})^2] +$
$(3\eta_{21} - \eta_{03})(\eta_{21} + \eta_{03})\,[3(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2]$

$$M6=(\eta_{20}-\eta_{02})[(\eta_{30}+\eta_{12})^2-(\eta_{30}-\eta_{12})^2-(\eta_{21}+\eta_{03})^2]+4\eta_{11}(\eta_{30}-\eta_{12})(\eta_{21}-\eta_{03})(\eta_{30}-\eta_{12})^2$$

$$M7=(3\eta_{21}-\eta_{03})(\eta_{30}+\eta_{12})[(\eta_{30}+\eta_{12})^2-3(\eta_{21}+\eta_{03})^2]-(\eta_{30}+3\eta_{12})(\eta_{21}+\eta_{03})[3(\eta_{30}+\eta_{12})^2-(\eta_{21}+\eta_{03})^2]$$

4.The Implementation of the Comparison Method Using Moments Invariants:

This paper aims to examine and find similarities of face features located in a real photo and a pencil portrait of specified persons in order to be used in many applications as determining the drawing accuracy, identify people through their descriptions, etc. This implemented method depends on computing the seven moments for extracted face features in the real face photo and pencil portrait which is to be performed in the presence of large pose changes.

Two images are provided, one is the real face photo in gray scale, and the other is a pencil portrait. The preprocessing of the algorithm includes the accessing of these two images, which are the real face photo, and the pencil face portrait. The user partitions each image into a number of blocks, detects blocks boundaries, crops the blocks, and saves them as distinct image files since the detection, extraction, and cropping of face's features are not to be considered as one of the automated system tasks, it should be done by the user and it does not belong to the technique responsibilities. Each image file will represent one of the face's features (eye, nose, mouth, …) and will act as an input to the implemented algorithm illustrated in figure (2).

These input images are to be represented as a seven invariant moments each, and the resulted seven moments values of the input image files that relate to the same feature of the original and face portrait are to be compared.

This work is useful for many applications like

- Checking the accuracy of drawing: when a human face is drawn, the comparison may be used to check the accuracy of the resulted pencil face portrait.
- Criminal investigations: when it is required to draw a pencil portrait according to the descriptions provided by the witness, the resulted

portrait may be compared to original face photos using the method of this paper.

- Cosmetology surgery: usually before applying this type of surgery operations, a portrait is drawn. To check the results accuracy, a comparison may be done between the drawn portrait and the resulted real face photo.

Input consists of
Image F1 (width1 x height1) is a Digital image of a cropped feature of a real face Photo.
Image F2 (width2 x height2)is a Digital image of related cropped feature of a pencil face portrait.
Output:
Difference in moments calculated for the two images F1 and F2.
==
Step 1: convert F1 to a two dimensional array A1 (width1 x height1)
Step 2: convert F2 to a two dimensional array A2 (width2 x hieght2)
Step 3: i ⟵ 1
Step 4: repeat through step 8 until i>7
Step 5: compute moment $_i$ _A1for array A1
Step 6: compute moment $_i$ _A2 for array A2
Step 7: compute the difference between moment$_i$_A1 and moment $_i$_A2.The difference in moment value is calculated as follows absolute value of (moment$_i$_A1– moment $_i$_A2)/ moment $_i$_A1
Step 8: i ⟵ i+1

Fig. (2) : Algorithm for comparing real and portrait face photos using moments invariants.

5. Experimental Results of The Face Features Comparison

Many examples were implemented for the proposed comparison. Here are three of these examples showing the results of the implemented comparison of the seven moments measured for the face features in original face photo and the pencil portrait face photo.

Example 1.

Figure 3 and Figure 4 represent the two real and pencil portrait face photos input to the algorithm. The features of the two faces are to be detected, extracted and saved by the user, as shown in figures 5,and 6. The seven moments values are computed for the images of figures 5, and 6 as displayed in table 1 and the differences in computed moments values of the related features in real photo and pencil portrait are shown in table 2.

Figure 3. The real photo of a face in gray scale.

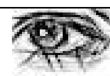
Figure 4. The pencil portrait of the face in figure 3.

a.Digital image represents the eye feature block of the face in Figure 3

b.Digital image represents the nose feature block of the face in Figure 3

c.Digital image represents the mouth feature block of the face in Figure 3

Figure 5 : the clipped features of real photo image in figure 3



a. Digital image represents the eye feature block of the face in Figure 4

b. Digital image represents the nose feature block of the face in Figure 4

c. Digital image represents the mouth feature block of the face in Figure 4

Figure 6 : the clipped features of pencil portrait image in figure 4

Table 1 : the seven moments computed for Figure 5(a,b,c) and Figure 6 (a,b,c).

input	Moment 1	Moment 2	Moment 3	Moment 4	Moment 5	Moment 6	Moment 7
Figure 5-a	-1.4E-3	4.1E-6	7.4E-8	1.1E-9	-1.4E-18	2.2E-12	3.2E-18
Figure 6-a	-3.3E-4	7.1E-7	2.1E-8	1.6E-12	9.6E-21	2.2E-14	6.9E-21
Figure 5-b	-8E-4	2.1E-6	4.6E-8	4.6E-10	-3.7E-19	6.8E-13	-5.3E-20
Figure 6-b	-5.1E-4	8.7E-7	2.2E-8	2.5E-13	-7.9E-20	6.2E-14	-1.1E-20
Figure 5-c	-1.2E-3	2.9E-6	5.3E-8	7.8E-10	-7.3E-19	1.2E-12	2.1E-18
Figure 6-c	-5.9E-4	9.8E-7	2.1E-8	6.6E-13	-2.1E-19	9.8E-14	-6.9E-22

Table 2 : the difference in moments for clipped features of real face photo (Figure 5) and the portrait clipped features(Figure 6).

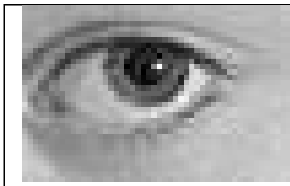
	Figure 5-a and Figure6-a	Figure 5-b and Figure 6-b	Figure 5-c and Figure 6-c
Difference in moment 1	0.76	0.41	0.51
Difference in moment 2	0.82	0.59	0.66
Difference in moment 3	0.71	0.52	0.62
Difference in moment 4	0.99	0.90	0.89
Difference in moment 5	0.99	0.78	0.70
Difference in moment 6	0.89	0.90	0.91
Difference in moment 7	0.89	0.70	0.90

Example 2

Figure 7 and Figure 8 represent the real and pencil portrait face photos respectively that are the input to the algorithm. The features of the two faces are to be detected, extracted and saved by the user, as shown in figure 9(a,b,c) and figure 10 (a,b,c). The seven moments values are computed for the images of figures 9, and 10 as displayed in table 3 and the differences in computed moments values of the related features in real photo and pencil portrait are shown in table 4.

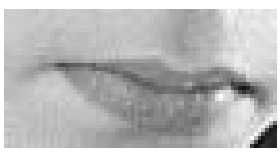
Figure 7 :The real photo of a face in gray scale.

Figure 8 :The pencil portrait of the face in figure 7.



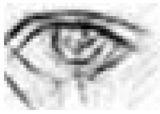
a. Digital image represents the eye feature block of the face in Figure 7

b. Digital image represents the nose feature block of the face in Figure 7



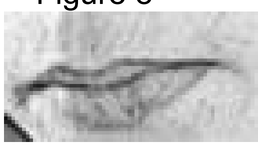
c. Digital image represents the mouth feature block of the face in Figure 7

Figure 9 : the clipped features of real photo image in figure 7



a. Digital image represents the eye feature block of the face in Figure 8

b. Digital image represents the nose feature block of the face in Figure 8



c. Digital image represents the mouth feature block of the face in Figure 8

Figure 10 : the clipped features of pencil portrait image in figure 8

Table 3 : the seven moments computed for Figure 9(a,b,c) and figure 10(a,b,c)

input	Moment 1	Moment 2	Moment 3	Moment 4	Moment 5	Moment 6	Moment 7
Figure 9-a	-1.2E-3	3.1E-6	5.7E-11	7.7E-10	-7.5E-19	1.2E-12	1.9E-18
Figure 10-a	6.2E-4	1.0E-6	2.1E-8	5.3E-12	2.3E-19	1.2E-13	1.8E-21
Figure 9-b	-9.0E-4	2.2E-6	5.2E-8	4.0E-10	-3.5E-19	6.0E-13	1.5E-19
Figure 10-b	-4.2E-4	7.8E-7	2.4E-8	1.2E-11	-2.6E-20	2.9E-14	-1.6E-20
Figure 9-c	-1.0E-3	2.4E-6	4.2E-8	5.7E-10	-4.2E-19	8.2E-13	1.0E-18
Figure 10-c	-6.5E-4	1.1E-6	2.4E-8	3.6E-12	-2.5E-19	1.3E-13	6.4E-21

Table 4 : the differences in moments values for related features of real face photo (Figure 9) and the pencil portrait (Figure 10).

	Figure 9-a and Figure 10-a	Figure 9-b and Figure 10-b	Figure 9-c and Figure 10-c
Difference in moment 1	0.50	0.56	0.39
Difference in moment 2	0.65	0.65	0.51
Difference in moment 3	0.99	0.53	0.43
Difference in moment 4	0.68	0.99	0.99
Difference in moment 5	0.90	0.92	0.40
Difference in moment 6	0.90	0.95	0.83
Difference in moment 7	0.99	1.0	0.99

Example 3

Figure 11 represent a real photo it is the same face image of figure 3. Figure 12 represents a pencil portrait for image in figure 11, differs than portrait of figure 4 in size and contrast.The features of the two faces are to be detected, extracted and saved by the user, as shown in figures 13(a,b,c) and 14(a,b,c). The seven moments values are computed for the images offigure 13 and figure 14 as depicted in table 5 and the differences in computed moments values of the related features in the real photo and the pencil portrait are shown in table 6.

Figure 11.The real photo of a face in gray scale.

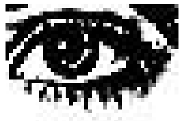
Figure 12 :The pencil portrait of the face in figure 11.

a.Digital image represents the eye feature block of the face in Figure 11

b.Digital image represents the nose feature block of the face in Figure 11

c.Digital image represents the mouth feature block of the face in Figure 11

Figure 13 : the clipped features of real photo image in figure 11



a. Digital image represents the eye feature block of the face in Figure 12

b. Digital image represents the nose feature block of the face in Figure 12

c.Digital image represents the mouth feature block of the face in Figure 12

Figure 14 : the clipped features of pencil portrait image in figure 12

Table 5 : the seven moments computed for Figure 13(a,b,c) and figure 14(a,b,c)

	Moment 1	Moment 2	Moment 3	Moment 4	Moment 5	Moment 6	Moment 7
Figure 13-a	-1.4E-3	4.1E-6	7.4E-8	1.1E-9	-1.4E-18	2.2E-12	3.2E-18
Figure 14-a	-3.3E-4	7.1E-7	2.1E-8	1.6E-12	9.6E-21	2.2E-14	6.9E-21
Figure 13-b	-8E-4	2.1E-6	4.6E-8	4.6E-10	-3.7E-19	6.8E-13	-5.3E-20
Figure 14-b	-5.1E-4	8.7E-7	2.2E-8	2.5E-13	-7.9E-20	6.2E-14	-1.1E-20
Figure 13-c	-1.2E-3	2.9E-6	5.3E-8	7.8E-10	-7.3E-19	1.2E-12	2.1E-18
Figure 14-c	-5.9E-4	9.8E-7	2.1E-8	6.6E-13	-2.1E-19	9.8E-14	-6.9E-22

Table 6: the differences in moments values for related features of real face photo (Figure 13) and the pencil portrait(Figure 14).

	Figure 13-a and Figure 14-a	Figure13-b and Figure14-b	Figure13-c and Figure 14-c
Difference in moment 1	0.50	0.56	**0.3**9
Difference in moment 2	0.65	0.65	0.51
Difference in moment 3	0.99	0.53	0.43
Difference in moment 4	0.68	0.99	0.99
Difference in moment 5	0.90	0.92	0.40
Difference in moment 6	0.90	0.95	0.83
Difference in moment 7	0.99	1.0	0.99

The results of differences in moments for the related features extracted from real and pencil portrait of the same person's face, showed that these differences lie in the range 0 to 1 as depicted in tables 2 and 4 of example 1 and example 2 respectively.

Main advantage of our approach is that the faces features are invariants under scale, view, and contrast, that agreed with the definition of moments that are invariant, as shown in:

- Example 2, where the view of figure 9-c(mouth feature of real face) is the opposite view side of figure 10-c (mouth feature of pencil portrait), but that did not affect the resultant moments differences values.
- Example 3, where the pencil portrait depicted in figure 12 differs than pencil portrait depicted in figure 4 in size and thickness of pencil lines. However, table 6 values are equivalent to table 2 values.

6. Conclusions and suggested work

The moment invariant approach used in this paper provides an easy way to describe and compare faces images in two dimensions through the use of moments functions upon extracted faces' features .Invariants seven moments that are calculated for the faces' features are compared to determine the similarity of faces' images regardless of rotation, scale and contrast.

For future work it is suggested to

- Apply the comparison method upon colored images as input instead of gray scale photo and pencil portrait .
- In the proposed technique the detection and extraction of the face features is done by the user, instead this operation may be implemented as a part of the future improvements for the implemented method.

References

1. Shaohua Kevin Zhou, Rama Chellappa, Wenyi Zhao **"Unconstrained Face Recognition ",** SpringerScience+Business Media, Inc, 2006.
2. Stan Z. Li Anil K. Jain "**Handbook of Face Recognition "** Springer ScienceBusiness Media, Inc., 2008
3. Shaogang Gong, Stephen J McKenna, Alexandra Psarrou " **Dynamic vision From Images to Face Recognition**", Imperial College Press, 2008.
4. Mantas J., "**An Overview of character recognition methodologies**", Pattern recognition, Vol. 19, No .6, pp. 425-430, 1986 .
5. HengFuiLiau, KahPhooiSeng, Li-MinnAng and Siew Wen Chin,"**New Parallel Models for Face Recognition**", In-Teh, 2008.
6. KresimirDelac, MislavGrgic and Marian Stewart Bartlett "**Recent Advancesin Face Recognition**", In-Teh,2008.
7. DengpanMou **"Machine-based Intelligent Face Recognition**", Higher Education Press, Beijing and Springer-Verlag Berlin Heidelberg, 2010.
8. Bartlett M.; Movella J., Sejnowski T, " **Face Recognition by Independent Component Analysis**", IEEE Transactions on neural networks, Vol. 13, No. 6, pp. 1450-1464, 2002.

9. CheowwayNeoh, " **Computing Moments Of a Binary Horizontally/ Vertically Convex Image Using Run-Time Recognition",**B.S., Louisiana State University, A ThesisSubmitted to the Graduate Faculty of the Louisiana State University andAgricultural and Mechanical College, 2002.

10. Jan Flusser, JaroslavKautsky · FilipŠroubek, "**Implicit Moment Invariants"**, Springer Science Business Media, LLC 2009.
11. MuharremMercimek, KayhanGulez andTarik,"**Real object recognition using moment invariants"** ,Sadhan ¯ a¯ ,Vol. 30, Part 6,pp.765–775,2005.

12. M.K. Hu, "**Visual pattern recognition by moment invariants**" ,IRE Trans. Inform. Theory 8 (1962).
13. M - K . H u , " **Pattern recognition by moment invariants** ", PROC . IRE (Correspondence) , vol. 49, p .1428; September ,1961.
14. JanFlusser, BarbaraZitov,"**Moments and Moment Invariants in Pattern Recognition**", John Wiley and Sons, Ltd, Publications, 2009.

مقارنة الصفات العامة لوجه الأنسان في الصورة الحقيقية والصورة المرسومة بقلم الرصاص باستخدام العزوم الثابتة

أ.د.عبدالمنعم صالح ابو طبيخ* ، م.دنيا فضيل صفو** م.م.طارق زيد

المستخلص

في هذا البحث تم اجراء المقارنات للخصائص العامة في الصورة الحقيقية لوجه الانسان والصورة المرسومة بقلم الرصاص باستخدام العزوم الثابتة والتي تمتاز بمقاومتها العالية للتزحيف ,التقييس , التباين والتدوير لغرض استخلاص خواص الصفات المحددة في نوعي الصور المذكورة ومن ثم اعداد المقارنة بين قيم العزوم الناتجة حيث تم استخدام الصور الرمادية المقياس. الصفات العامة في كلا النوعين من الصور من قبل المستفيد واقتطاعها ومن ثم ارسالها الى الطريقة المستخدمة لاجل احتساب العزوم السبعة لذلك الجزء المقتطع من الصورة حيث تم تحديد مدى الفرق بين نتائج العزوم المحتسبة للجزء المقتطع من الصورة الحقيقية والجزء المناظر المقتطع من الصورة المرسومة وذلك للتحقق من التطابق في الصفات العامة للصورة الحقيقية للوجه والصورة المرسومة ومن ثم التطابق بين الصورتين.وقداظهرتالنتائج أن الفروقات في قيم العزوم المحتسبة للصفات المتناظرة في الصورتين الحقيقية والمرسومة تقع في نطاق محدود و قيم العزوم هذه تكون ثابتة مع اختلاف الاتجاه والحجم وكثافة الخطوط في صور الوجوه.

*قسم علوم الحاسوب /الجامعة التكنولوجية
**قسم علوم الحاسوب/جامعة بغداد