Performance Evaluation of Face Image Recognition Based Voila-Joins with SVM

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Abstract

Nowadays face image recognition became an effective research area. It covers a wide range of activities from many aspects of life such as authentication and identification, airport security, inmate tracking, e-commerce and face book's automatic tag. The aim of face image recognition is to recognize the face of a person's depend on the features extracted from their faces. In this paper, two proposed systems were developed, the conventional proposed system of image recognize include many steps to recognize faces. The first step is the preprocessing of images for all training and testing images. The second step is detecting accurate the accuracy of the face by using Viola and Jones algorithm. The third step is features extraction. The proposed system has been implemented by using the (MUCT) datasets. This dataset is considered taking the processing of faces for frontal position. The results show that the proposed system with SVM classifier recognition provides an accuracy total rate of 96.77% for the same test images.

Keywords—Face Detection, Face Recognition, Feature Extraction, Viola-Jones, Support Vector Machine (SVM), MUCT.

المستخلص

اصبح التعرف على صور الوجه في الوقت الحاضر مجال بحث فعال. ويغطي مجموعة واسعة من الأنشطة في العديد من جوانب الحياة مثل إثبات الأصالة وتحديد الهوية ،أمن المطارات، تتبع السجناء، والتجارة الإلكترونية وعلامة الفيسبوك التلقائية. الهدف من تمييز و التعرف على صور الوجه هو للتعرف على وجوه الاشخاص المعنيين بالاعتماد على الميزات المستخرجة من وجوههم. في هذه البحث تم تطوير نظامين مقترحين، النظام المقترح التقليدي للتعرف على الصورة و الذي يتضمن العديد من الخطوات للتعرف على الوجوه. الخطوة الأولى هي المعالجة المسبقة للصور لجميع صور التدريب والاختبار. الخطوة الثانية هي الكشف عن دقة الوجه باستخدام خوارزمية فيولا –جونز. الخطوة الثالثة هي استخراج الميزات. وقد تم تنفيذ النظام المقترح باستخدام مجموعة قواعد البيانات (موكت). واعتمدت هذه المجموعة بأخذ معالجة الوجوه من الاتجاه الأمامي. وأظهرت النتائج أن النظام المقترح اعطى دقة معدل إجمالي 96.77٪ لنفس صور الاختبار.

الكلمات المفتاحية: كشف الوجه، تمييز الوجه،استخراج الميزات،فيولا–جوز،متجهات الدعم الآلي،موكيت

1. Introduction

Recently, face image recognition is a rapidly increasing field for its several uses in the several applications such as security, biometric authentication and neuromas other area. There are numerous problems that appear because to the exactness of several factors that affects the feature of image. When processing images one must take into account the variations in light, image quality, the persons pose and facial expressions along with others. The face image recognition is an essential ability of human, but it is hard for face image recognition systems to perform as well as human under different conditions, including illumination, variation of poses, expressions, occlusion..etc. [1].

The face image recognition manly consists of four steps. The first step is the face detection which finds the interest area in the image that contains the face. The second step is the face extraction features which positions the face detected into an estimate pose, usually represented by a target face or model. The third step is face representation describes the face with certain aspects of interest, the final step is face classification which decides whether the representation belongs to a model or target face or not [2].

The detection phase is the first phase; it consist of identifying and locating a face in an image. The recognition phase is the second phase; it consist of feature extraction, where significant data for recognition is stored, and the matching, where the recognition result has been given with the help of a face database. Face classification has been an in process research area, and it must be used in vast range of applications. It is about identifying a person from one or every images of his/her face [3]. Feature extraction are to extract feature reduction method will be applied after face detection. Finally used the support vector machine (SVM) method is widely used to classification in pattern recognition.

2. Methodology of Face Recognition System

2.1. Voila-Joins detection

Viola Jones image detection suggested by Paul Viola and Michael Jones in 2001 was one of the first methods to supply object with detection at very fast rates [4]. Viola and Jones method was adopted because it characterized by fast processing and high accuracy by applying robust algorithm and used accurate

cropping of a face, eye, mouth, and nose regions from a detected image. It is the method for fast and to make a correction for object detection through AdaBoost machine learning [5].

2.1.1 Adaboost machine discovering based method

This method attempts to discover a particular Haar features in terms of the face of the human. This method has three meanings which are explained in the following [6].

- Integral Image: Here are the calculation values in pixels of the present image. The value at any location (x, y) in the integral image is the summary of the values of the image pixel upper and left side of position (x, y) defined as in equation (1):

$$ii(x, y) = \sum_{x' \le x,\ y' \le y} i(x', y') \qquad \ldots\ldots\ldots (1)$$

Where ii (x, y) is the integral image and i (x, y) is the original image.

- Haar features: We can calculate the results of any Haar feature when we multiply weights by calculated region of any individual rectangle. A Haar feature classifier computes the value of a feature using the integral of rectangular image. Several Haar feature classifiers compose a stage [7].

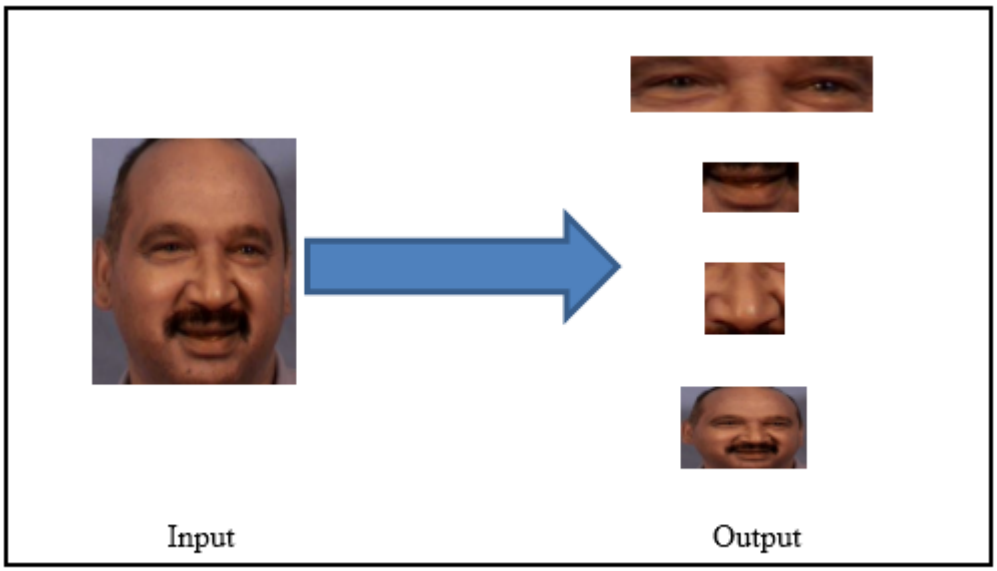

Figure (1): Face Haar-Like Features

- Cascade Classifier: Calculation completely removes face postulants quickly using a cascade of stages. The cascade removes postulants by making exacting requirements in each stage with former stages will be much more difficult for a postulant to pass. Postulants exit the cascade if they pass all stages or fail any stage. A face is detected if a candidate passes all stages. This process is shown in Figure (1).Where T and F are the abbreviation of True and False respectively [8].

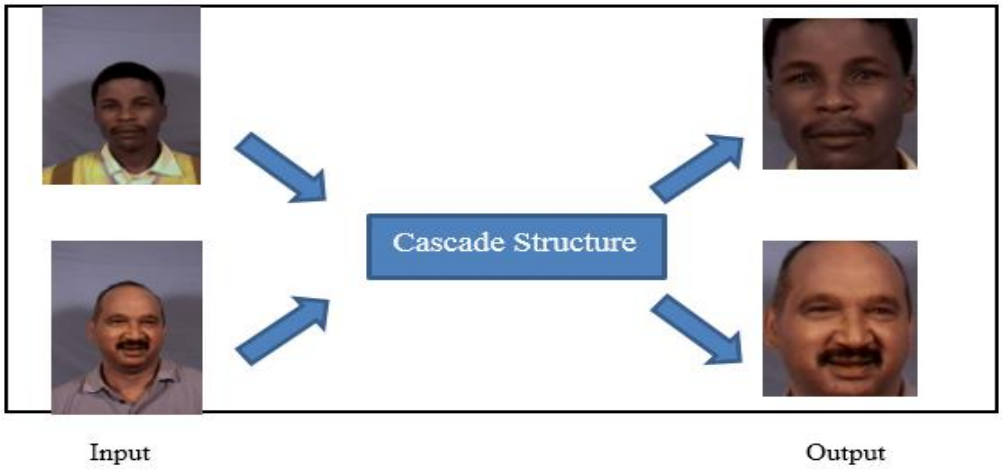

Figure (2): Cascade Structure Viola-Jones Algorithm

2.2 Supporting Vector Machines

Support Vector Machines SVM belong to kernel methods [9] and play a main role in present machine learning algorithms. SVM is a new way to classify both linear and nonlinear data. SVM algorithm can be described as follows: Nonlinear mapping is used to convert the original training data to a higher dimension. The new dimension limits to the decision to separate twins from one category to another. SVM finds the data separated from two categories, this over plane is overloaded with support carriers, "drill" and "support vector" margins. The SVMs can do either prediction or recognition [10]. The easiest case of a two-class problem which used the classes is detachable linearly. Let the dataset D given as $(x1, y1), (x2, y2)\ldots (X \mid D \mid, y \mid D|)$, where xi is a set of exercises with associated class descriptions, y_i. Each yi can take one of two values, either $+1$ which corresponds to the categories by the computer buys = Yes or -1, which corresponds to the computer buys = not, respectively. Let's watch an example based on two inputs, A1 and A2. From 2-D data is linearly separated because a straight line can be depicted to discriminate each class $+1$ from each of the class-1 multiplier. An infinite number of separation lines can be drawn; the best one is that the target can be found, that is, one that will have a minimum error rating on an unprecedented seasoning. There is a technical problem with SVM technique for a maximum over plane margin [11].

So, hyper plane with greater margin is expected to be more precise to classify the seasoning of the future data from hyper plane with a smaller margin. This is why SVM is looking for an

excessive plane with a larger margin, this is, maximum marginal hyper plane (MMH). The unofficial definition of the margin that the shortest distance from an excessive plane to one side of its margin equals the shortest distance from the excessive plane to the other side of its margin, the hyper plane can be separated.

$$W.X + b = 0 \qquad \ldots\ldots\ldots (2)$$

Here W is the weight vector, which is W = {w1, w2 … wn}; n is the number of features; and b is the numerical, often denoted to as bias. it only two possible superclass separation and associated margins. The best one is the one who has larger margin should have greater circular accuracy. The sides of the margin can be shows as [12].

3. The Proposed System

The proposed system consists of training and testing phases as illustrated in Figure (3). In training phase several algorithms have been used to create dataset which will be used in the testing phase to decide right faces, the training phase is based on the following stages:

- In Preprocessing stage used many methods to enhance the input images through applied convert color image to grayscale and Histogram Equalization.
- In Detection faces stage used Viola and Joins to detect multi-face in each input image
- In Feature extraction stage, features vector in this stage well be extracted

  In testing phase, all stage which applied in training phase is used this phase>

4. Face Image Data Set.

MUCT database (figure.4) (MUCT stands for "Marlboro University of Cape Town") are used to consider system performance. In the MUCT database, 240 images of each person 12 pose variation image consist of lighting ,dark, smile, anger, skin black , and rotating , used in training phase 8 image each of person and testing phase 4image of person. The system display that increasing the many of training images can increase the recognition rate. The Viola– Jones method is used to detect the face on each database. This method has improved a high detection rate and all images have been detected and cut into databases. After being classified as "unknown," facial images can be added to a library (or to a database) with their element vectors for subsequent comparisons.

4.1 Training stage

The result of training phase include four dataset which content feature vector four face , nose , mouth and eye segments .each dataset was used separately in the testing phase to demonstrate the possibility of testing each segment of the face has been extracted.

This phase consist of the stages: read image, image converting, histogram equalization, face detection, feature extraction, each stage include many steps was it will explain in the following:

4.1.1 Read image

The RGB color image is read as JPG image with resolution (70wight * 70high), these image taken 24 bit\ pixel, the image data is separated into three band are Red, Green and Blue.

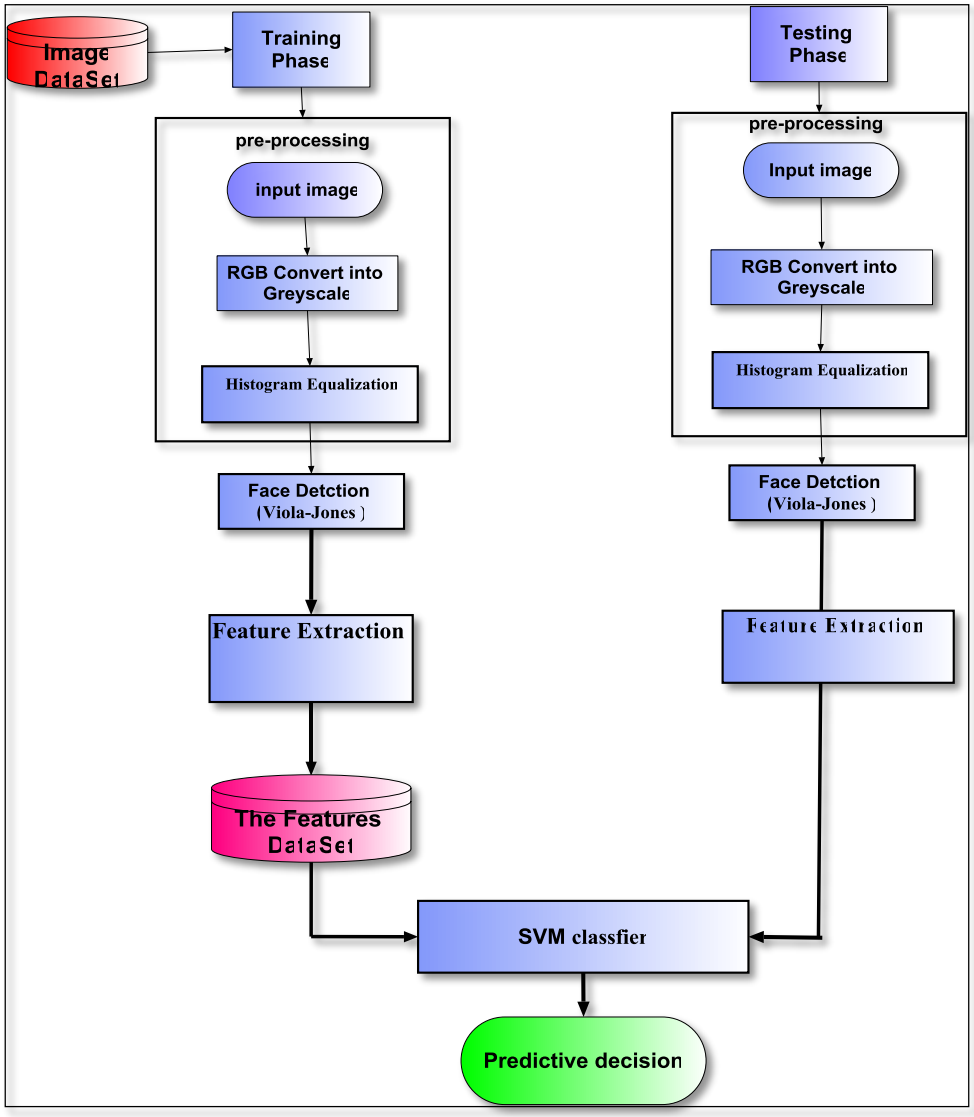

Figure (3): Proposed Face Recognition System

4.1.2 Image Converting

The color image in converted to grayscale by using question:

$$\text{Grayscale value} = 0.2125R + 0.0715G + 0.722B \quad \ldots\ldots(4)$$

4.1.3 Histogram equlization

Histogram Equalization is usually performed on low contrast images to improve image quality and face recognition performance. It changes the dynamic range (contrast range) of

the image then so a result, some important facial features become more apparent [22].

The Histogram Equalization can be expressed mathematically as follows:

Sk = T (rk) =$\Sigma n1kj=0/n$ ..... (5)

Whereas k=0, 1, 2... L−1.

Figure (4): (MUCT) Database Face Images

Here in Histogram Equalization (5) 'n' is the total number of pixels in an image, 'nj' is the number of pixels with gray 'rk' level, and 'L' is the total number of gray levels in the face image. The end result afterwards applying histogram equalization according to a pattern rear image is shown of Figure (5) Histogram Equalization. The Histogram Equalization on the left is from the original face image (between 6−250) and one on the right is after applying the Histogram Equalization. Figure (5) Image graph before and after Histogram Equalization.

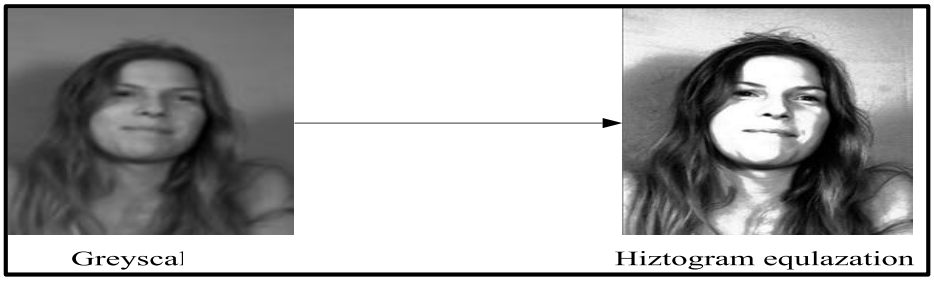

Figure (5): Histogram Equalization

First Phase: segment dataset into four segment consist of face, eye, noise and mouth

- **Face segment image**

Figure (6): Face Segment Image

- **Eye segment image**

Figure (7): Eye Segment Image

- **Mouth segment image**

Figure (8): Mouth Segment Image

- **Noise segment image**

Figure (9): Noise Segment Image

5. Support Vector Machine (SVM) Algorithm

The support vector machine (SVM) is the best class of algorithms for face image analysis. The data in raw representation have to be explicitly transformed into feature vector representations via a

user–specified feature map. The training phase of face images are of the contain the value attribute which represent feature vector in addition the face image class attribute value for a many number of person. In order to learning, these pervious values are used as input to face recognition classifier model. In testing phase, the new testing person is depending on the face recognition classifier model. In this research, testing of implementation of face recognition classifier model carried out by using the SVM recognition classifier algorithm depend on the training of faces that used 160 images while the testing phase, the implementation of face recognition model is used to evaluate the new face images of the person which does not used in the training set. The face recognition classifier model presents the final decision, which means that the face recognition model tested image to recognized face of person.

In proposed system, many important steps should be considered before applying the face recognition process. After obtaining the feature vector of face image recognition to recognized face of person into known or unknown

6. Result

The proposed system implemented on OPEN–CV C++ and JAVA language software and under Microsoft Windows environment. The databases (MUCT) is used to evaluate the system performance. In MUCT database, 240 images of four segments to training and testing images for each segment is used. Viola–Jones method is used for face detection on each database In this thesis the method of viola and jones was adopted

because it is characterized by speed processing and high accuracy by applying more than one algorithm In this thesis, this method was used for 160 images as training samples to detect four segment of the face in addition to detection more than one face in the same image as Detect of face region ,Detect of eye region ,Detect of mouth region ,Detect of noise region and Detect of multi-face in the same image .

The table (1) shows the accuracy rate of face detection step for each segment of training phase where 240 images dataset:

- Total number for eye segments detected is 151 images out of 160 images which gave accuracy rate 94.375%.
- Total number for mouth segments detected is 160 images out of 160 images which gave accuracy rate 100%.
- Total number for face segments detected is 160 images out of 160 images which gave accuracy rate 100%.
- Total number for nose segments detected is 160 images out of 160 images which gave accuracy rate 100%.

Table 1: The Accuracy Rate of Face Detection for Training Phase

Dataset	Detection	Eye Segment	Mouth Segment	Face Segment	Nose Segment
240	Training	151	160	160	160
	Rate% Detection	94.375%	100%	100%	100%

The table (2) shows the accuracy rate of face detection step for each segment of testing phase where 240 images dataset:

- Total number for eye segments detected is 66 images out of 80 images which gave accuracy rate 82.5%.

- Total number for mouth segments detected is 80 images out of 80 images which gave accuracy rate 100%.
- Total number for face segments detected is 77 images out of 80 images which gave accuracy rate 96.77%.
- Total number for nose segments detected is 75 images out of 80 images which gave accuracy rate 93.75%.

Table 2: The Accuracy Rate of Face Detection for Testing Phase

Dataset	Detection	Eye Segment	Mouth Segment	Face Segment	Nose Segment
240	Testing	66	80	77	75
	Rate% Detection	82.5%	100%	96.25%	93.75%

The table (3) shows the rate of detection step for proposed system computed by using equation (1) the rate was (96.77%).

$$\text{Total detection} = \left(\left(\frac{rat\ of\ eye + rat\ of\ mouth + rat\ of\ nose + rat\ of\ face}{4}\right)/240\right) \ldots\ldots (1)$$

The table (3) shows the accuracy rate of total face detection step for proposed system where 240 images dataset:

- Total number for eye segments detected is 217 images out of 240 images which gave accuracy rate 90%.
- Total number for mouth segments detected is 240 images out of 240 images which gave accuracy rate 100%.
- Total number for face segments detected is 237 images out of 240 images which gave accuracy rate 98.75%.
- Total number for nose segments detected is 235 images out of 240 images which gave accuracy rate 97.91%.

Table 3: The Accuracy Rate of Total of Face Detection for Proposed System

Dataset	Eye Segment	Mouth Segment	Face Segment	Nose Segment	Total Accuracy rat
240	217	240	237	235	96.77%
	90%	100%	98.75%	97.91%	

It is the most important step that affects the performance of a pattern recognition system. there are many algorithm in face recognition, in thesis getting on 19 features of each image of each person total of features are 3040 in feature extraction of each image of the person after done used support vector machine (SVM) is used to classification training group of face images is contained attribute value represented by eigenvector image class for a large number of people. To learn these attributes are considered as input to face classifier model. Testing the new person depending on face classifier mode.

7. Conclusions

The suggested system is used to classify the face image whether it is (known or unknown). This system has a vital role in surveillance and many authentication systems. The main conclusions of the proposed system is that the face image recognition is a full–face display of the digital image by applying the Voila–Jones algorithm that is used to detect face image and it is a fast method. The algorithms which are used for feature selection methods in this research are reduced the numbers of features and increase the rate of recognition. In conclusion, the obtained results for face image recognition based Voila –Joins with SVM is 96.77% of total accuracy which indicate a high percentage of accuracy.

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