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PERFORMANCE EVALUATION FOR FACE DATABASE

人脸数据库的性能评估

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Abstract

The growing interest in the database generated many techniques in this area and the Intelligent Systems Laboratory Where graphical models were used in the theoretical developments of computer vision and reasoning, and their application in various fields. Our proposal provides a database of the face under the circumstances of the real, without knowing the people who are taking pictures of them. The present study focuses on the which recording images and places them in the database through active inference and effective reasoning. We are interested in active reasoning because it manages sensor algorithms and guidance unit until the visual translation process is completed.Thus, this sophisticated capture technique processes each frame whenever a face or eye is selected. We are developing a face detection and eye identification process by building a facial recognition algorithm using databases collected from previous experiments. This procedure was applied to a database of a previous set of 40,000 images for 40 people, which illustrates how difficult it is to identify faces. This paper includes a detailed research methodology. In Section 3, face evaluation is discussed, depending on key characteristics within a specific protocol, followed by a definition of the most accurate performance criteria for face verification, and identification through statistical measures. The evaluation protocols in our paper provide researchers the means to recognize faces using modern methods. The results obtained were mentioned in the figure and indicated the strength of the technique used.

Keywords: Face Evaluation, Recognition, Evaluation Metric, Evaluation Protocol

摘要 对数据库的兴趣日益浓厚，在此领域产生了许多技术，而智能系统实验室是最佳指南。在计算机视觉的理论发展，使用图形模型的潜在推理以及这些理论在不同领域中的应用中，这项研究的重点是在不知道图像所针对的人的情况下，在实际情况下提供面部数据库。采取。本研究着重于以下记录图像，并通过主动推理和有效推理将它们放置在数据库中。我们对主动推理很感兴趣，因为它可以管理传感器算法和控制，直到视觉翻译过程完成为止。因此，无论何时选择面部或眼睛，这种复杂的捕获技术都会处理每个帧。我们正在通过使用从先前实验收集的数据库构建面部识别算法来开发面部检测和眼睛识别过程。此过程已应用于 40 个人的先前 40,000 张图像集的

数据库中，这说明了识别面部的难度。本文包括详细的研究方法。在第 3 节中，将讨论人脸评估，具体取决于特定协议中的关键特征，然后定义最准确的人脸验证性能标准，并通过统计手段进行识别。本文中的评估协议为研究人员提供了使用现代方法识别人脸的方法。在图中提到了获得的结果，并表明了所使用技术的优势。

关键词: 人脸评估，识别，评估指标，评估协议

I. Introduction

The definition of people is one of the most important building blocks in facial recognition research. It is a way for researchers to learn about databases, the availability of databases is very important and valuable as databases provide results that provide insight into facial recognition problems. All the displayed databases were grouped under the exact settings and contain one variable source or group in different sources, i.e., illumination, expression, time gap between training, pose, and testing data [1].

As a result of recent trends in facial recognition research, and in addition to binary dimension, a three-dimensional information integration technique has emerged in facial recognition processes to make use of the database [19]; thus, demonstrating a significant evaluation in the experimental method in this paper [2].

II. Related Work

To further identify faces, researchers have compiled databases for many years [3], [4]. It should be noted that some databases are better than others, so each one is designed to test different features for recognition, and each one comes with its own strengths and weaknesses.

Heath et al. [5] and Hoover et al. [6] played a significant role in the technique of the proposed methods for comparing the edge of the detectors in the intensity of the images and the range, leading to facial recognition.

Zhao et al. [7], Makdee et al. [8], and Borga [9] proposed two techniques that enable them to recognize faces through the structural features and the outward appearance. These two approaches were designed based on previous knowledge, which was collected based on the extraction of the feature and its adoption in face recognition - a development of the LDA technology. This technology is useful in removing loud dimensions through searching data with the largest variance causing low dimensional width. The most notable feature of the LDA approach is its ability to find the best vectors for good face distribution within the image area.

The FERET database [10], [11] is one of the largest databases, containing 1199 subjects with up to two light source directions, two expression. his database was obtained using a 15 mm camera.

Here, the picture frame is used to fixed place pictures, and the background reduces its brightness as much as possible. The FERET database includes a total of more than 1,100 images.

The FRGC2.0 database [12] is characterized by its timeliness. It focuses on the three-dimensional appearance, which consists of a two-dimensional and three-dimensional database. It contains a collection of 4007 scans taken from a group of 466 people. The technique was adopted in the scope of its research of a laser series (Minolta Vivid 900/910) to select the data.

The AT & T database, previously known as Olivetti ORL, is one of the most widely used databases, containing 10 different images for every 40 distinct subjects. The images are taken at a different time, with different facial expressions and lighting conditions (eyes closed/open, smile/smile/glasses/without glasses) [13].

The Multi-model BANCA database is part of the BANCA European project. The goal is to provide a secure system with improved schemes for identification and control of access to applications over the Internet. This technology is designed to test multimedia authentication with different devices, cameras, and microphones (low and high quality), subject to several scenarios (controlled, negative, and degraded) [14].

The university for the purpose of conducting a study on facial changes over time on the performance of facial recognition. Notre Dame University collects a large database [15]. The same work was done by the Texas University, where it compiled a large database of video clips and digital photos [16].

The Korean-Face-Database (KFDB) has facial photos of the large numbers of subjects collected in highly controlled condition, PIE CMU [17]. Which produced organizes images with different facial expressions and light position.

III. Methodology

A. Face Evaluation

The main function of the Biometrics Society is to evaluate the performance of experiments. The results obtained from these experiments are below. It is necessary to publish performance results alongside evaluation protocols in order to describe how experiments obtain the data. It is important to include a description of the protocol and all the steps must be well-written so that developers, suppliers, and users can repeat the assessment.

Below we present a description of the main steps of our protocol:

1) Face and Image Processing Tasks

When applying FRBS (Facial Recognition Biometric Systems), it will get two types of images:

a) FRID (Facial Recognition in Documents)

It means how to recognize a face through MRTD (machine-readable travel-documents).

In this domain, FRID is facial data with high spatial resolution, but it is very limited or not present in the time domain. The facial images in the FRID area are usually in the IOD (intra-ocular-distance), at least 60 pixels in the distance. This distance is used to create a canonical model of the face, which was developed by the International-Civil Aviation-Organization. However, it will not be based on more than a limited number of images taken of the same person over a period of time. In this domain, FRID has often extracted facial images already, and the challenge of recognizing the face is the main task, isolated from other problems. This is the opposite of what occurs in the FRIV domain where many other facial functions are performed before facial recognition, such as face detection, tracking, and localization of the eye. Reconstruction is then the best choice for a facial image [18].

b) FRIV (Facial Recognition in Video)

It scans a crowd for a face and is used to recognize a face through TV recordings and video surveillance cameras. These two examples (domains) of images are very different [20]. It should be noted that systems that operate efficiently in one domain may not function as efficiently in the other domain.

In this domain, FRIV deals with the available facial images in the time domain but with less spatial precision, and often the facial image in the FRIV is in the IOD (intra-ocular-distance) or less than 60 pixels, which is the distance used in the model of the canonical face. This is due to the fact that this face usually occupies less than a third of the video image, which is itself small and is 352 × 240 for analog-video and 720 × 480 for digital-video. This is the minimum IOD that automatically detects faces in images [21].

In order to complement the procedures in both fields, the FRBS evaluation of the FRID domain should be carried out, which is often done by testing the system on a fixed image area group with the faces as described above. This is also what happens when the FRBS evaluation is done in the FRIV domain. Despite all of this, we often see tests that have been applied as a great project in real-time video surveillance [22]. Some of this effort to evaluate performance was done using animation and previous data sets [23].

2) Colors and Mode of Use

Facial recognition is not affected by the color of the face, and this is why we see that many countries in the world allow its citizens to use black and white photos for passports and identity cards. However, color plays an important role in recognising a face and eye tracking, and it should be noted that in order to recognise people in video, different video streams must be used.

3) Classification of Systems Performance

It is necessary to classify the performance of biometric systems [24]. This classification follows particular mechanisms in classification, so that it can be cooperative versus non-cooperative, habituation versus non-habituation, overt versus covert, public versus private, or standard versus non-standard. Therefore, in the case of an FRBS evaluation, these characteristics should be followed or noted.

4) Nature of Data Types

To get facial recognition based on two types of data:

b) Closed Data

It is a closed set, so each query is made to a database. This is used when the watch-list is in a negative state registration or in a list of ATM clients or computer users, and this occurs in positive registration situations.

c) Open Data

The data set is open so that the object of the queries may, very likely, not be in a database. This is what happens in monitoring video surveillance.

5) Recognition Tasks

Facial recognition functions can be illustrated by three tasks and FRBS is used:

a) *A Facial Verification*

It means a face validation, or refers to one-to-one or positive verification as it occurs when checking ATM clients.

b) *The Identification of the Face*

It indicated by as or from 1 to N, or as happens in passive identification, such as when suspects are detected on a watch list. Where the face is compared with queries of all the faces in the database to find the best-match (K) and thus identifying the person.

c) *Classification of Faces*

The classification mechanism indicates that a person is marked as returning to a limited number of groups in a particular category, such as when describing a person (male or female), race (European or Asian ...etc) or depending on medical or genetic conditions (Down syndrome ...etc). Biometrics are strict in determining the task of verification and identification, so the results of the classification can be used on the basis of vital measurements, somewhat similar to the height of the person or the weight of the person.

B. Evaluation Metrics

This procedure introduces definitions of the most commonly used performance evaluation criteria for face verification, identification and tracking through statistical measures that encourage comparison of the face recognition model. There are two main mistakes the system can make in its evaluation performance:

1) *False Acceptance (FA)*

Sometimes it called a false match (FM), a positive error (PE) or a first error (FE). When the search data for a person did not take previously seen in the gallery is associated with one or more people in the gallery, FA is the ratio of the number of searches for non-existing candidates, where one or more of the candidates in the exhibition are returned or greater than the threshold, to the number of unrelated searches.

2) *False Rejection (FR)*

Sometimes it is called a false non-match (FNM), a negative error (NR) or a Type 2 false. This occurs when a search for a person's biometric identity does not return a correct identity; false rejection is useful in terms of ratio and threshold, where it can be defined as the number of searches for a match with a registered person outside of R or higher. The workers measure the total number of FA and FR; this is done by applying FRBS to a large set of data of a large number of faces .

Response system factors for verification:

a) *FAR*

It is FA rate with constant FR rate.

b) *FRR*

It is FR rate or true accept rate (TAR) (TAR = 1- FRR), also called true positive or hit rate, at a constant FA rate.

c) *Detection Error Tradeoff (DET) Curve*

It is an average graph for FAR and FRR comparison, which are obtained by system parameters such as the minimum match or threshold of match.

d) *Receiving Operator Characteristic (ROC) Curve*

It is often similar to the DET curve, but it plots TAR against FAR.

e) *Equivalent Error Rate (EER)*

It is the rate at which the errors of rejection and acceptance are equal; which is represented in EER curve and ROC curve. This is a quick method. Some protocols require FAR when FRR is equal to 0.001.

In order to compare the efficiency algorithm with the ROC matrices EER represents the highest level of accuracy, although ROC and DET curves are required. Most of the time they are drawn using a logarithmic axis to better distinguish the system with a similar performance and the size of the database that is relevant to verification and identification. When we returned to the seller's Face Recognition Vendor Test 2002, we found it performed poorly when the size of the database was increased [25]. The size of the database must be mentioned when reporting the performance of the definition of verification.

Some important measures commonly used in identification systems:

a) *Identification Rate or Rank-1*

The number of times the candidate most likely to be correctly identified is selected’

b) *RK (or Rank-k) Identity Rate*

It selects the best candidates that represent k.

c) *Cumulative Matching Characteristic (CMC)*

A characteristic plots the identification rank-k rate against k.

The above measurements should be evaluated with high precision and with many confidence intervals, error margins, error bars, and standard deviations in order to be able to determine the true robustness and improve the performance of any algorithm. It is, therefore, necessary to use the measures in Table 1 so that we can determine if the differences in accuracy and efficiency required between the algorithms are statistically significant.

Table 1.
Measures for determining the statistical significance of the differences in accuracy and efficiency required between the algorithms

Method	Comments
Confidence-Intervals for an area under the curve ROC by Cortes and Mohri [26]	The mechanism of using simple parameters (number of positive and negative examples, error rate)
Confidence-intervals for an area under the curve ROC by Bolle et al. [27].	Rely on a parametric technique that is used to estimate the confidence intervals in ROC on positive and false-positive rate values
ROC curve with error bars by averaging ROC curves by Fawcett [28].	To derive the variance scale multiple test groups are required. Two methods are used to center the ROC curves so that the vertical is at the FPR points installed while the threshold is the sample at the thresholds fixed.
Test the McNemar hypothesis by Yambor et al. [29]	When comparing CMC curves, this gives the possibility of testing a standard statistical hypothesis which will confirm whether there is no significant difference in performance.
Average estimated accuracy and standard error for average by Belhumeur et al. [30].	When cross-checking is used, the mean and standard error are metrics that help distinguish the performance of the algorithm When using cross-validation, the mean and standard-error are measures that help differentiate algorithm performance
ROC curve, which is similar to DET curve, but plots TAR against FAR, by Dmitry O. Gorodnichy [31]	Use the correct weighted scales of compatibility and heterogeneity when comparing performance results obtained in different datasets, provided that the temporal data are available, and this occurs when a person is identified from the video sequence. Here the results of recognition are always integrated over time by accumulating evidence. This should be mentioned in the evaluation protocol

C. Evaluation Protocol

The evaluation protocols enable researchers to compare methods of identifying current faces with advanced methods without the need to repeat previous experiences. Often, certain experimental components cannot be repeated, such as algorithm details, and setting parameters cannot be saved. The major challenge posed by face recognition technology is that the use of isolated test groups fails to solve the problem of incompatibility between the algorithms used and the algorithm parameters implemented for the test data [32]. Isolated test sets also prevent comparison of algorithms. Huang et al. [33] pointed out that providing clear guidance on the use of databases reduces problems in the processing of test data. Such provision for modern databases requires the use of evaluation protocols; the clearer a guideline is, the better the comparison of algorithms. The following evaluation methods are briefly described, together with the proposed evaluation of the facial database:

1) *Example Protocols*

The most suitable protocol for near-infrared face identification. is the FERET [34] protocol, which works on a distance matrix that measures the similarity between each image query and all images in a database. FRVT-2002 [25] addresses the requirement of checking an open group and the problem of identifying a closed group. The cumulative receiver characteristic operating curve (CMC-ROC) is used to compare results. BANCA [13] is an example of a dedicated open protocol use in multimedia databases. The protocol Lausanne XM2VTS [35] is an example of a closed verification group, the person whose face image is missing from the database is marked as a tag.

2) *Large-Scale Evaluation*

This technique involves high-quality assessment that depends on the use of a considerable volume of data in a test. Results are typically obtained via a statistical analysis. The statistical measures employed are as follows:

a) *CMC-ROC Curve*

The CMC curve (Figure 1) is obtained from the results of one or more tests or trials conducted at different times. These tests determine the nuances of recognition rates.

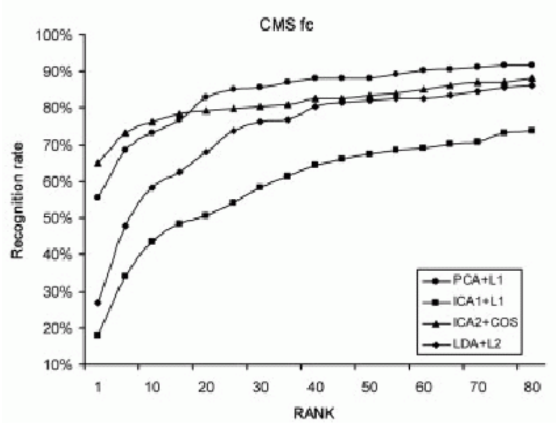

Figure 1. Identification of the performance of many appearance-recognition algorithms from [16], using CMC curves on a database FERET [36]

b) *False Acceptance Average - False Recognition Rate (FAR-FRR) To display the results in a specially designed scenario, such as the verification scenario, FAR-FRR and EER are represented in the ROC curve. As shown in the ROC curves, the multimedia approach achieves 0.019 EER, thus outperforming the SMSS method (Figure 2).*

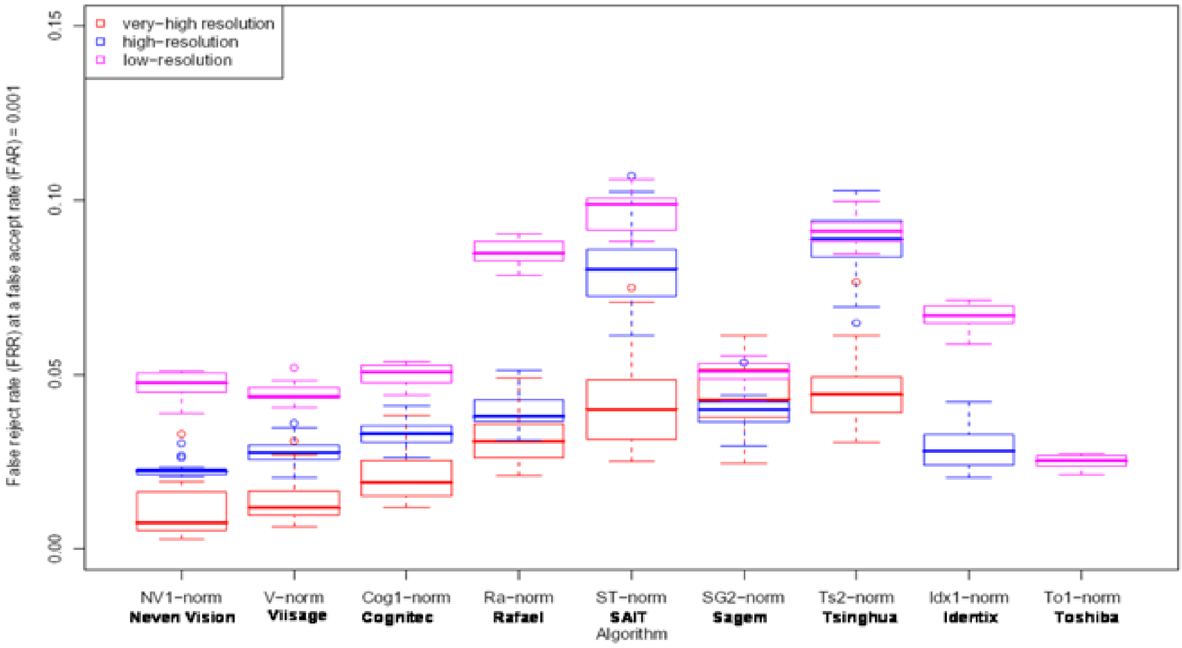

Figure 2. Fixed-FAR-FRR distributions

3) Vector feature

The feature vector is characterized by multidimensional. They can be embedded in faces by extracting and manipulating images for use. These images are then used to recognize faces and store them in a database.

4) The canonical model

This form aims to store facial images in a database. In the incubation phase, where the face image is blocked, the settings are modified and converted to match the direction and size of the standard face model stored in a database used for facial recognition tasks.

5) Time domain

When an image is said to be available in a specific time range, it means that an image was taken some time ago, as is the case with video images, and displays the time resolution. One The facial photo provided as a passport photo is not available in the time range. Sensor data are used to observe what is happening so that sensory data can have high time resolution against their spatial resolution. However, these features cannot be achieved at the same time. For example, the face image in a printable document is in high resolution, while the faces on the TV screen are very low. In biological vision systems, object recognition occurs in the time domain (as with face recognition on television). This task can be accomplished with the same efficiency that was achieved by identifying the object from a high-resolution sample, or it may be more efficient than the last method.

IV. Results and Discussion

For many years, facial databases have been used to recognize faces and improve current facial records. Some results obtained using facial recognition techniques are illustrated in Figure 1, which shows the facial identification results presented in [32]; these results were derived via face recognition techniques based on population appearance: principal component analysis (PCA), independent component analysis (ICA), and linear discriminant analysis (LDA) for obtaining the FERET database using CMC curves. Figures

2 and 3 show the performance evaluation of VERBs, which have been used in tests involving the FRVT2002-FRVT2006 taken from [25], [32], and [37].

Experiments are initiated to obtain data, and a protocol is important, face recognition from videos or photographs is very easy, whereas the automatic recognition of faces on a computer is very difficult. This means that faces are more difficult to identify through automatic recognition than are other features, such as fingerprints, irises, and veins. This complexity is caused by the fact that a human being performs three-dimensional motion that can be seen from multiple angles. Such mobility highlights the need to assess facial recognition systems on the basis of the following factors [18]:

A. Resolution

Different facial images can be taken with varying levels of accuracy. For instance, a facial image scanned from a document is of a high resolution, whereas that captured by a camera is of low resolution.

B. Quality

Motion causes deformities in facial images. Image distortion can also be caused by low contrast and a lack of focus.

C. Head the Person Orientation

If the person is not going to face the camera, it is not reasonable to see the same formula when it is against the camera.

D. Lighting

Here the lighting conditions are affected by changing the location of the source light for the camera and the face to be captured.

E. Facial Expressions

The person must be calm because any movement leads to distorting the image because the nature of the human face constantly displays a variety of facial expressions.

F. The Occlusion

Sometimes the hair will occlude the face. This also occurs when using a cloth, a scarf, a napkin, or eyeglasses.

G. Facial Surgery and Aging

Compared with the iris and fingerprints, the human face changes more with time. In addition to aging, it can changes when surgery is performed, especially cosmetic surgery.

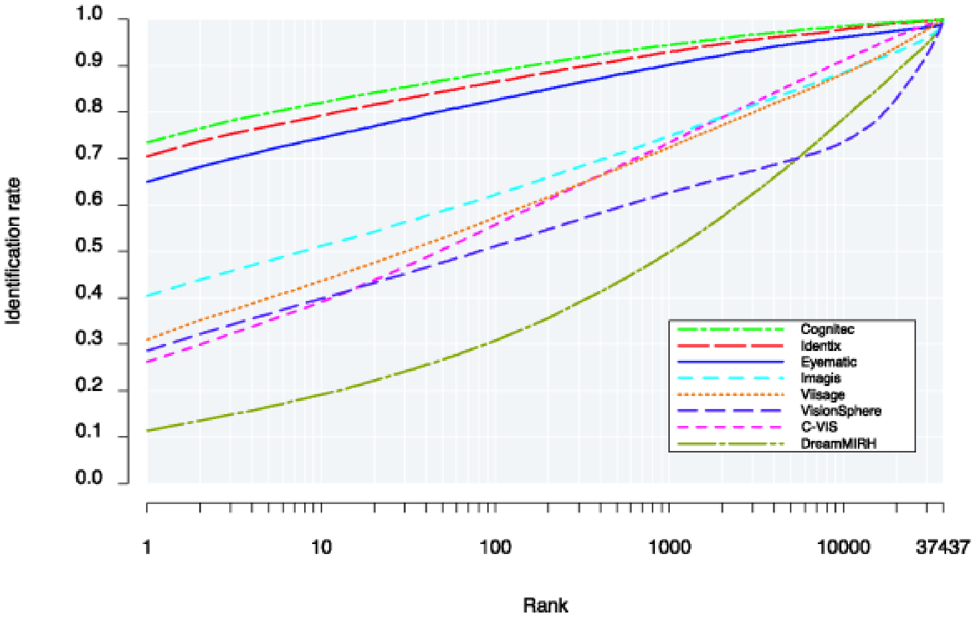

Figure 3. Verification-identification performance of biometrics systems to recognition-commercial faces on the database FRVT which taken from [34], [36], using curves CMC

V. Conclusion

Images of faces are viewed as vectors of high dimensions with a small area. Also, these areas take a small percentage of the space in which a cluster is located. On the other hand, in this smaller region, it happens that different faces occupy different regions. The identification of faces is done by identifying the closest known face to the image area, although some problems occur as a result of slight changes in expression, lighting, or even the direction of the head. This leads to a change in the pixel setting, which is the reason the space changes in the space specified for it in the image.

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