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Performance Evaluation for the Age Dependent Face Recognition System

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ABSTRACT: Face recognition is the ability to establish a subject's identity based on facial characteristics. Face recognition has a wide range of applications, including Human-Computer-interaction, Driver's license, National ID, Passports, Voter registration, Security system, Personal device logon, Desktop logon, Information security, Database security, Internet access, CCTV control and Suspect tracking and investigation. A face recognition system based on the age prediction is developed in this research. The system consists of two stages; age prediction and face recognition. In age prediction stage, eigenvectors and eigenfaces are calculated from the input image. New faces are projected onto the space expanded by eigenfaces and represented by weighted sum of the eigenfaces. These weights are used to identify the age of the faces. In face recognition stage, the predicted image will be searched to a certain age group of the database and all images within this age group would be considered as potential matches for the final level recognition.

The age dependent face recognition system is developed based on 11 individual aging classes, which yields a great reduction time complexity in search space than searching the entire database. The algorithms that have been developed are tested on AT&T, Yale, MORPH and FG-NET Face Databases.

The goals of the system are 1) to create the fast recognition system for the face database 2) to predict how old the person is and to carry out the face recognition system based on this predicted age 3) to stop underage drinkers from entering bars, prevent minors from purchasing tobacco products from vending machines 4) deny children access to adult Web sites by predicting their age. The main advantage of this system is reduction of searching time and it requires small memory usage. According to the experiment result, this system is an effective age dependent face recognition system.

KEYWORDS: Face recognition, age prediction, eigenfaces, face space.

1 INTRODUCTION

In recent years face recognition has received substantial attention from researchers in biometrics, pattern recognition, and computer vision communities. The machine learning and computer graphics communities are also increasingly involved in face recognition. This common interest among researchers working in diverse fields is motivated by our remarkable ability to recognize people and the fact that human activity is a primary concern both in everyday life and in cyberspace. Besides, there are a large number of commercial, security, and forensic applications requiring the use of face recognition technologies. These applications include automated crowd surveillance, access control, mugshot identification (e.g., for issuing driver licenses), face reconstruction, design of human computer interface (HCI), multimedia communication (e.g., generation of synthetic faces), and content-based image database management. Facial scan is an effective biometric attribute/indicator. Different biometric indicators are suited for different kinds of identification applications due to their variations in intrusiveness, accuracy, cost, and ease of sensing.

Face recognition is an important field of biometrics which is of great use in our day to day life. Be it the traditional uses in identification documents such as passports, driver's licenses, voter ID, etc., or its uses in recent years, where, face images are being increasingly used as additional means of authentication in applications such as credit/debit cards and in places of high security. But with age progression the facial features changes and the database needs to be updated regularly of the changes which is a tedious task. So we need to address the issue of facial aging and come up with a mechanism that identifies a person in spite of the aging.

During face recognition step if the face image in the database and the recognize face image is matched then the distance between the class and the face space are the same. If the face image in the database and the recognize face image is not matched then the distance between the class and the face space will be different.

To confirm the effectiveness of the proposed method, the experiment has been done with several real images. In the experiment, the frontal images are selected only to construct the face database. Slight rotation of the image is allowed. The exact angle of acquisition is not known. To ensure that the location of the features can be detected precisely, some constraints are fixed such as not wearing glasses, without beards. All images are taken under good lighting conditions. All images are transformed to the gray scale and file sizes are fixed to 150x150 pixel dimensions in JPEG format.

This system used both the Database Faces of AT&T Laboratories Cambridge and other face database images which are collected from UCSY (University of Computer Studies, Yangon) and the Internet.

2 AGE PREDICTION ACCURACY RESULTS

In age prediction system, the accuracy rate is about 88 percent. The accuracy of the system can be analysed by the variation on the range of the age groups from the Database Faces of AT&T Laboratories and face images database which are collected from UCSY (University of Computer Studies, Yangon) and the Internet. The larger errors occur at age 21 to 25 aging group and age 41 to 45 aging group. However, the overall prediction rate for all the experimental images is 88% by the proposed system. The results shown in Table I are tested using the database and the accuracy rate of the age prediction. Figure 1 shows the accuracy graph of the age prediction results.

Table 1. Overall Age Prediction System Performance for Testing Images

Group	Testing Image	Correctly Predicted	Accuracy	Error
1	10	9	90%	10%
2	10	9	90%	10%
3	10	8	80%	20%
4	10	9	90%	10%
5	10	9	90%	10%
6	10	9	90%	10%
7	10	8	80%	20%
8	10	9	90%	10%
9	10	9	90%	10%
10	10	9	90%	10%
11	10	9	90%	10%

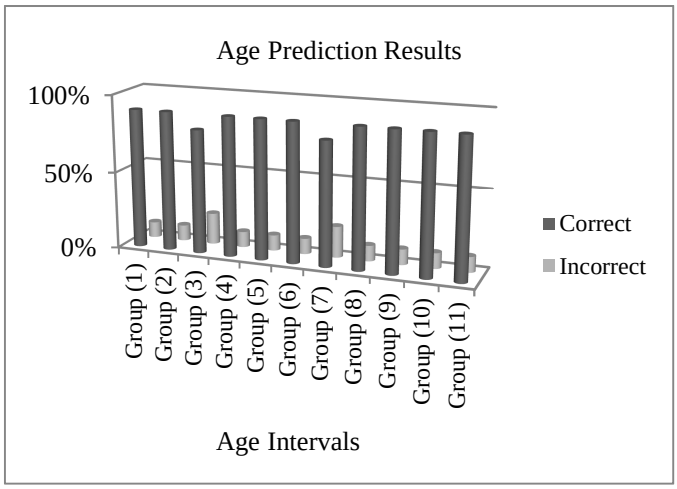

Figure. 1 The Accuracy Graph of Age Prediction Results

3 EXPERIMENTS FOR AGE PREDICTION

In this system, the age groups are divided into 11 classes. The classes are: Class 1 (up to 15 years), Class 2 (16 to 20 years), Class 3 (21 to 25 years), Class 4 (26 to 30 years), Class 5 (31 to 35 years), Class 6 (36 to 40 years), Class 7 (41 to 45 years), Class 8 (46 to 50 years), Class 9 (51 to 55 years), Class 10 (56 to 60 years), Class 11 (more than 60 years).

Step One – Train the system: Twenty (20) images were selected for each class from the face database. The system was trained with these images using eigenface approach described the previous chapter, to derive the Training Feature Vector.

Step Two – Gather the testing images: Ten (10) images were selected for each class from the face database. The images were processed for classification by using the eigenface approach, to derive the Testing Feature Vector.

Step Three: Classification: The PCA (Principle Component Analysis) classifier was used to enhance class separability. The minimum Euclidean distance of the Testing feature vector from the average distance of the three Training feature vectors was computed. The class with the minimum distance was defined as the winner. Thus the image was labeled with the age group of that particular class.

4 SYSTEM PERFORMANCE AND EVALUATION

The proposed system is evaluated by two values. The false acceptance rate, or FAR, is the measure of the likelihood that the proposed face recognition system will incorrectly accept an access attempt by an unauthorized user. FAR typically is calculated as the ratio of the number of false acceptances divided by the number of identification attempts. Figure 2 shows the accuracy rate of the system.

The false rejection rate, or FRR, is the measure of the likelihood that the proposed face recognition system will incorrectly reject an access attempt by an authorized user. FRR typically is calculated as the ratio of the number of false rejections divided by the number of identification attempts. The accuracy is the ratio of the number of correct recognition divided by the number of identification attempts.

FAR (False Accept Rate) is defined as follows:

$$FAR = \frac{no\_accept}{no\_test} \times 100\% \quad (1.1)$$

FRR (False Reject Rate) is defined as follows:

$$FRR = \frac{no\_reject}{no\_test} \times 100\% \quad (1.2)$$

Accuracy is calculated as:

$$Accuracy = \frac{no\_true\,\mathrm{Re}\,sult}{no\_test} \times 100\% \quad (1.3)$$

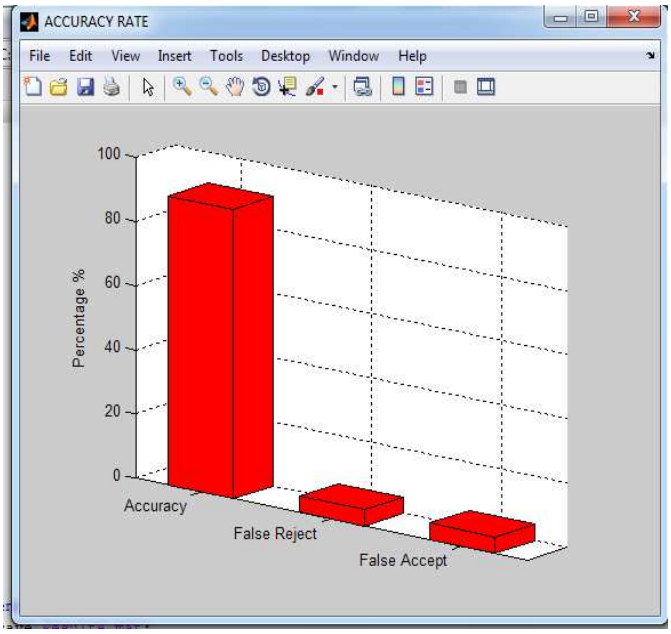

Figure. 2 The Accuracy Rate shows the System Accuracy

1. The no_test is denoted as the total number of tests.
2. no_accept is denoted as the number of false accepted times.
3. no_reject is denoted as the number of rejected times.
4. no_trueResult is denoted as the total number of genuine matches.

For example, if "Htet Htet" enters "MaMa's" predicted age, presents her recognition data, and successfully matching as MaMa. This is classified as **False Acceptance**. The probability of this happening is referred to as **False Acceptance Rate** (FAR) [stated as: percentage, fraction]. If "Htet Htet" enters her predicted age, presents her data to a face recognition system, and fails to match. This is classified as **False Rejection**. The probability of this happening is the **False Rejection rate** (FRR). This is because two people have similar enough biometric characteristics (a face) that the system finds a high degree of correlation between the users' template.

5 CONCLUSION

This system presented the age dependent face recognition system that combines age prediction and face recognition. A two steps operation is used for this system, where the first step performs a prediction based on 11 individual aging classes and the second step performs the face recognition based on predicted age. The age prediction errors were due to the poor quality images, the lighting condition, and the large variation of pose and so on. The range of five-year age groups was used for age prediction. The complexity and processing time will be reduced by searching the matched face from predicted age group instead of searching the face from the database which contains 11 age groups. Experimental results show that both face recognition and age range estimation may be effectively performed with low computational effort.

The accuracy of eigenface is also satisfactory (over 90 %) with frontal faces. The recognition errors (nearly 10%) were due to the variation of pose, lighting, and so on. But most errors were caused due to the large changes of pose. The advantage of the eigenface method is the system's speed and efficiency. The eigenface approach reduces the amount of data.

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