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A Study of Face Databases used as Benchmarks in Face Recognition

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ABSTRACT: Face recognition has become one of the robust means of authentication and hence lots of research has been carried on in this regard. For any face recognition system, the availability of a standard database consisting of appropriate face image samples is very important, since it serves as a benchmark for testing and comparing the results directly for the face recognition algorithms. From the last few decades, the creation of face database by proper acquisition of face images, has been an interesting research topic among research community. While there are many face databases available, the appropriate choice should be based on the task given (age, lighting, poses, expression, etc.). This paper makes a scrutinizing study of the existing face databases. The aim here is to give a clear picture to the researchers regarding the selection of the face databases to build effective face recognition systems.

KEYWORDS: Face recognition, face database, benchmark, face recognition algorithms, authentication.

1 INTRODUCTION

Face recognition has gained wide acceptance in the research community [1]. Face recognition algorithms are being developed on a large basis and testing their effectiveness is a major concern to researchers in the field. To make the algorithms efficient, it is mandatory to report their progress using standard benchmarks. This is facilitated by face databases and there are many well-established face databases to assess the performance characteristics of face recognition algorithms [2-6].

However, the efficiency of these databases is highly dependent on the a few factors. Collecting a large amount of sample patterns is as important as developing recognition methods for pattern recognition applications. The database should be a rich collection of images with many variations with respect to lighting, poses, expressions, accessories, background, etc. A detailed study of the face databases focusing mainly on facial expressions has been studied in [7]. This paper deals with a study of few of the challenging databases that have been served as a benchmark for face recognition systems.

1.1 AR FACE DATABASE

The database was created by Aleix Martinez and Robert Benavente in the Computer Vision Center (CVC) at the U.A.B. in the year 1988. It was the first database to include occlusions. The total number of subjects used here is 126 with 4000 total images. It provides provision for variation in illumination, frontal poses, expression, scarves, eye glasses, etc. [8]. The size of the RGB colour images is 768 × 576 pixels. In a 2-week interval, the subjects face images were captured twice by subjecting them to 13 different conditions. Fig. 1. shows samples taken from the AR Face Database.

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Fig. 1. Images from AR Face Database.

1.2 INDIAN MOVIE FACE DATABASE (IMFDB)

The database was designed as a benchmark for face recognition algorithms in unconstrained settings. This database consists of 34512 faces of 100 known Indian actors. The images were collected from around 103 Indian movies. Totally 67 male and 33 female actors with at least 200 images per actor was taken. It involved selection of images manually with variations in pose, scale, expression, age, illumination, etc. It provides details in terms of pose, age, gender, amount of occlusion, expressions [9]. Fig. 2. shows the face images of Amitabh Bachchan taken from IMFDB.

Fig. 2. Sample images from IMFDB

1.3 YALE DATABASE

The database contains 165 grayscale images of 15 individuals in GIF format [10]. Per subject there are 11 images. The variations considered here with respect to configuration and facial expressions are w/glasses, w/no glasses, center-light, left-light, right-light, happy, sad, sleepy, wink, normal and surprised. In a period of 10 years, the performance has been increased from 58.14% [11]-99.3% [12].

1.4 LABELED FACES IN THE WILD (LFW)

This database was developed by Tamara Berg, David Forsyth, and the computer vision group at UC Berkeley [13], [14]. It was shown here that the database of face images could be built by harvesting large sets of imperfect data from the web. It was basically built by analyzing the associated captions and pictures, and then the images were clustered by identity. It had achieved a labelling accuracy of 77%. The database contains more than 13000 images taken from around 1680 subjects covering major ethnicities of the world [15]. Fig. 3. shows the images of Bill Gates taken from LFW database.

Fig. 3. Images from LFW database

1.5 KOREAN FACE DATABASE

This database contains the facial images of subjects from Korea by subjecting the data acquisition phase to variances in expressions, illumination and pose [16]. Eight lights and seven cameras were used and the subjects were imaged in the centre of an octagonal frame. The background selected was a blue screen. Totally 52 images were taken for each subject. Expressions that were taken into consideration were happy, anger, neutral, blink and surprise. It used two types of illumination-incandescent lights and fluorescent. Fig. 4. shows samples from Korean face database with two types of illumination.

Fig. 4. Images from Korean Face Database

1.6 THE JAPANESE FEMALE FACIAL EXPRESSION (JAFFE) DATABASE

The database comprises of 219 images taken from ten female subjects [17]. The database was developed by Michael Lyons, Miyuki Kamachi, and Jiro Gyoba. The six basic expressions- surprise, sadness, disgust, anger, happiness, and fear were considered. Even neutral face was used. For the sake of less intricacy, only Japanese female models were taken as subjects. To expose all the regions dealing with expression, the hair was tied at the back. To create illumination on the face, tungsten lights were used. Fig. 5. shows the face images of taken from JAFFE database.

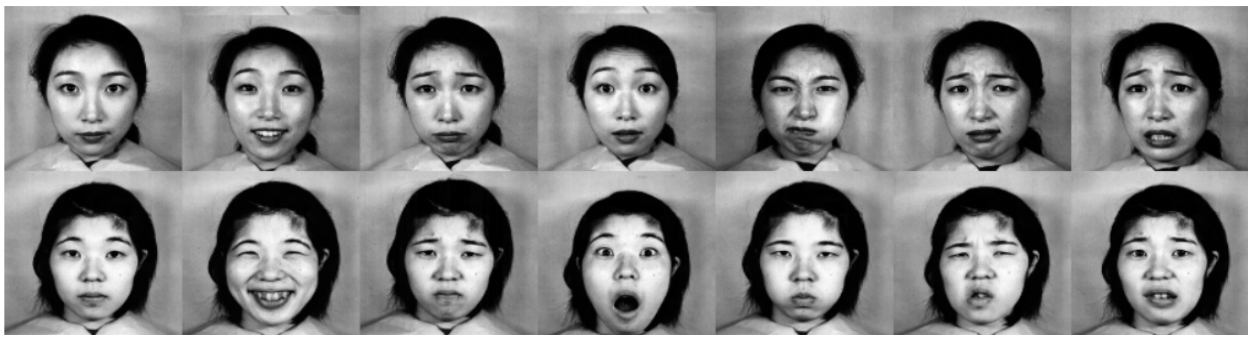

Fig. 5. Images from JAFFE database.

1.7 BIOID FACE DATABASE

The database consists of 1521 gray level images of 23 different persons, with a resolution of 384 X 286 pixels [18]. The important characteristic of this database is that it includes realistic images as background, for example home or office settings. These backgrounds change for each image with difference in lighting, expression and pose. It has manual marking on each eye in the image. Fig. 6. shows face images taken from BioID face database.

Fig. 6. Images from BioID Face Database

1.8 MIT CBCL FACE DATABASE

The database comprises of 4,548 non-faces and 2,429 faces images in the training set and 23,573 non-faces and 472 faces in the test set [19]. The resolution used is 19 X 19 in grayscale PGM format. The database was developed on October 15, 1989 at the MIT Media Laboratory. 16 males (mostly graduation students) were selected as subjects for the data acquisition. The subject was asked to sit on a couch and was digitized 27 times, by subjecting him to variances in camera zooming, lighting and head orientation.

1.9 FERET DATABASE

This database was designed to foster face recognition with the collected images directly supporting both the algorithm development and the FERET evaluation test [20, 21]. FERET program was sponsored by the Department of Defence (DoD) Counterdrug Technology Development Program Office. From August 1993 and July 1996, the database was collected in 15 sessions. It included 1199 subjects and 365 duplicate set of images. By July 1996, the database contained a total of 14216 images. Here the term 'duplicate' refers to the subject whose image was already contained in the database. 13 conditions with variations in illumination, occlusion and expressions were taken into consideration. The images were captured in sets of 5 to 11. Two frontal views were taken. During the second iteration, the subject was requested for a different expression. Fig. 7. shows images taken from FERET database.

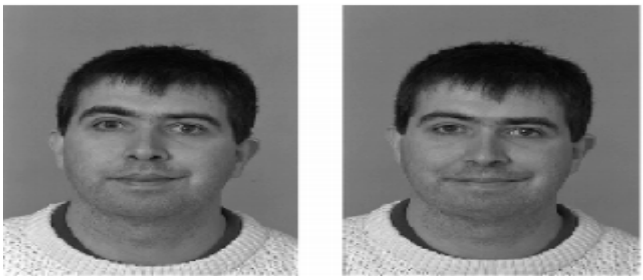

Fig. 7. FERET Database

1.10 NIST MUGSHOT IDENTIFICATION DATABASE

This database consists of 1573 subjects with 78 females and 1495 males. It contains views from both the front and side profile [22]. This database is being distributed for testing and development of the mugshot identification systems. The database has 131 cases with two or more front views and 1418 with only one front view, separating front views and profiles.

Profiles have 1268 cases with only one profile and 89 cases with two or more profiles. Cases with both profiles and fronts have 89 cases with two or more of both profiles and fronts, 27 with one profile and two or more fronts, and 1217 with one profile and only one front. Algorithm run using this set of images can be found in [23].

1.11 AT & T FACE DATABASE

This database contains images of 40 subjects, with 10 images per subject, totaling to 400 images. Each face image is of 112 X 92 pixel size [24]. Variations in the faces are with respect to open/closed eyes, presence and absence of glasses, smiling/ no smiling. The images were taken against a dark homogenous background. There were few variations in scale. There was also some tolerance for some side movements for subjects which is the unique feature for this database. Fig. 8. shows images taken from AT & T face database.

Fig. 8. AT & T face database

1.12 PLASTIC SURGERY FACE DATABASE

This database consists of real world faces of 900 subjects [25]. The images are taken before and the after the surgery totaling to 1800 images. For every subject, there are two frontal face images with variation in illumination and neutral expressions. The database comprises of 519 image pairs with respect to local surgeries and 381 cases of global surgery. Various types of facial surgeries have varying effects on the facial features. The database contains images that cover a variety of cases such as brow lift, Rhytidectomy (face lift), Blepharoplasty (eyelid surgery), Rhinoplasty (nose surgery), skin peeling and Blepharoplasty (surgery of the eyelid).

1.13 INDIAN FACE DATABASE

This database was created by Vidit Jain and Amitabha Mukherjee [26]. The data samples were acquired in February 2002, from IIT Kanpur. Totally 61 subjects (242 females, 422 males) were selected, totaling to 664 images. The subjects are in frontal, upright position. The background selected is bright and homogeneous. The variations include: emotions-smile, neutral, sad and laughter; poses-looking left, looking front, looking up and looking right. Gender classification using PCA method has been done on the samples taken from this database [27]. Fig. 9. Shows samples taken from the Indian Face Database.

Figure 9. Images from Indian Face Database

1.14 CAS-PEAL FACE DATABASE

This database has been built under the sponsors of National Hi-Tech Program and ISVISION by the Face Recognition Group of ICT, CAS and ICT. It's a Chinese face database [28]. The acronym PEAL stands for Pose, Expression, Accessory and Lighting.

The variations in image acquisition are with respect to the following criterion: expression, pose, lighting and accessories. Totally 1040 subjects (445 females, 595 males) were selected and the database has 99,594 images. To acquire varying images with poses in one shot, 9 cameras were spaced equally in a horizontal semicircular manner with height and radius being 1.1 meters and 0.8 meters respectively (Fig. 10). 18 images were captured in two shots by asking the subjects to look up and down. 15 lighting directions, 6 accessories (3 caps and 3 glasses) and 5 expressions were taken into consideration. Age and time were considered during data acquisition. Also open mouth and surprise were included in the database. Fig.11. shows the images taken with respect to pose from this database.

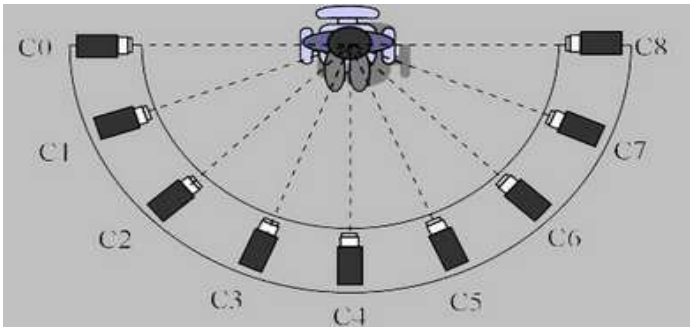

Fig. 10. The positioning of 9 cameras in image capturing in CAS-PEAL database.

Fig. 11. Images from CAS-PEAL database taken with 9 cameras at one shot.

2 CONCLUSION

Face databases which have been served as benchmarks for face recognition algorithms have been studied. Most of the databases discussed here are freely available. The reader is expected to get an insight of the existing face databases which are vital for the working of all the face recognition algorithms. Proper selection of available face databases is thus a critical issue in the testing phase of face recognition program.

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