

NORTH-EAST INDIAN FACE DATABASE: ITS DESIGN AND ASPECTS

Kankan Saha¹, Rajib Debnath¹, Mrinal Kanti Bhowmik¹, Debotosh Bhattacharjee² and Mita Nasipuri²

¹ Department of Computer Science and Engineering, Tripura University (A Central University), Tripura, India

² Department of Computer Science and Engineering, Jadavpur University, Kolkata, India
kankansaha@yahoo.com, rajibdebnath.cse@gmail.com, mkb_cse@yahoo.co.in,
debotosh@indiatimes.com, mitanasipuri@yahoo.com

Abstract : The outer shell of human face may seem different in multiple occasions due to its flexibility and three dimensional formation. Researchers are developing robust algorithms efficient for automatic face detection, recognition and expression analysis, even in the presence of the difficulties caused by source of illumination, incidental angle of illumination, facial expression, head orientation, age, occlusion, facial surgery, facial hair, etc. But, to determine the efficiency of these algorithms, it requires to be tested using quality face images of benchmark databases. Here, we have studied some of the recent 2D face image databases with a comparative analysis between them. We have also described a visual face database being developed in the Biometrics Laboratory of Tripura University, India, containing the face images from the north-eastern states of India with variations in expression, illumination, pose etc.

Keywords: 2D face image database survey, face recognition, expression, detection, aging, database creation, North-East Indian face database.

INTRODUCTION

Face recognition is the most important biometric and it continues to be the most popular, rapid rising research area of computer vision. General procedures for this include face detection, normalization, feature extraction, and recognition. With the increase in the development of face recognition algorithms, relatively vast numbers of face databases have evolved. However, many of them are designed for the precise requirements of the algorithm under development. Here, we mainly review the key features (where available) of those databases like number of subjects, total number of images in the database, imaging condition, resolution, image type (visual or thermal); whether the image is color or gray etc. But, not all databases are discussed with the same level of details due to unavailability of information (publicly) for each database.

This paper briefs the creation of a visual face database that is under development in the Biometrics Laboratory of Tripura University, India. It will contain at least 700 individuals' face images of the different tribes and non-tribes of the north-eastern states of India. The database contains eight basic expressions (including

neutral), four different illumination variations and images with glasses; and each of these variations are being clicked concurrently from five different angles to provide pose variation. Objective behind creating this database is to analyze the facial differences of the north-east Indian people and to enrich the face biometric security.

EXISTING DATABASES DESCRIPTION

The development of various face databases is increasing rapidly. Based on the purpose/application, different face databases have emerged, such as: databases for face recognition, expression recognition, face detection, aging database etc.

Face Recognition Databases

The *Facial Recognition Technology (FERET) Database* [1] was collected in 15 sessions between August 1993 and July 1996. It contains a total of 14,051 images that includes 1199 individuals and 365 duplicate sets of images. Two duplicate sets were constructed by capturing images of persons already in the database.

The *Hajj and Umrah Dataset (HUDA)* [2] contains at least 6 images per person of a large number of pilgrims taken in Makkah during the 2011-2012 Hajj and Umrah season. Images are provided with varying poses, expressions, facial details (glasses/no glasses), and illumination against random backgrounds.

The *VADANA: Vims Appearance Dataset for Facial Analysis* [3] contains large number of images for each subject within and across ages with the largest number of intra-personal pairs and variations in illumination, expression, pose. A parallel version with aligned faces was also provided along with relationships between subjects.

The *PubFig Database* [4] is a large, real-world face dataset collected from the internet. The images are taken in completely uncontrolled situations with non-cooperative subjects. Thus, there is large variation in pose, lighting, expression, scene, camera, imaging conditions and parameters, etc.

The *Radboud Faces Database* [5] contains eight (happy, angry, sad, contemptuous, disgusted, neutral, fearful, and surprised) expressions of 67 models with three gaze directions (looking left, frontal, and right) for

each expression, and each picture was taken from different camera angles (180°, 135°, 90°, 45°, and 0°) simultaneously.

The *PIE database* [6] was collected at the Carnegie Mellon University. But, due to some limitations (few subjects, limited expressions, single recording session) they created the *Multi-PIE database* [7], with 337 people using 4 recording sessions over the period of 5 months and with wider range of expressions, poses and illumination.

SCface [8] is a database of static human face images captured in uncontrolled indoor environment using 5 video surveillance cameras from various distances. By placing the camera slightly above the subject's head, real life surveillance scenario is provided; during the recordings subjects were not looking to a fixed point.

The *CAS-PEAL Database* [9] contains 6 expressions (neutral, laughing, frowning, surprise, eyes closed, mouth open), 15 lighting conditions, pose and accessories (3 glasses, 3 caps). Subjects were asked to look up and down for extra recordings with 5 backgrounds. 66 subjects were recorded in two sessions at an interval of 6 months.

The *Korean Face Database* [10] was collected under controlled conditions with varying illumination, pose and expressions. 7 cameras were used for pose variation with 3 different styles (with hair bands, glasses and neutral). 8 lights in 2 colors (fluorescent and incandescent) were used for controlling the illumination conditions.

The *Indian Face Database* [11] contains images of 40 subjects with 11 poses. For some individuals, they included a few additional images, as well. For upright frontal faces, they used different poses (looking front, left, right, up, up towards left, up towards right, and down) and 4 expressions (neutral, smile, laughter, sad/disgust).

Facial Expression Databases

In *USTC-NVIE Database* [12], faces of 215 students (aging from 17 to 31) were captured. Number of subject for images obtained under front, left and right illumination are 103, 99, and 103; while 107 subjects were captured for pose.

The *MUG Facial Expression Database* [13] consists of image sequences of 86 subjects in two parts. First part contains six basic expressions (happiness, fear, anger, sadness, surprise, disgust) and the second part contains laboratory induced emotions.

Face Detection Databases

The *VT-AAST Database* [14] is alienated into 4 parts. First part contains 286 color images (includes 1027 faces) in original format. Part two contains the same set in separate file format. Part three and four provides a set

of corresponding images with manually segmented human colored skin regions in color and gray scale respectively.

The *UCD Colour Face Image Database* [15] (University College Dublin, Ireland) has two parts. Part one contains 94 color images with 299 faces. Second part contains manually segmented faces for each image in part one. Variety of sources (digital cameras, scanned pictures, internet) were used to collect the images.

Face Aging Databases

The *FG-NET Aging Database* [16] is a face image database that contains faces of subjects at different ages. The database was developed to assist investigation on the effects of aging on facial appearance. The database was developed as part of the European Union project FG-NET (Face and Gesture Recognition Research Network).

Details of the databases described above are given in Table 1.

NORTH-EAST INDIAN FACE DATABASE

The NEI face database is a visual face image database, which is still under development. The database is being created with the face images of the different tribe as well as non-tribe people of the seven north-eastern states of India.

Camera and Light Setup Details

Images in this database are taken under strictly controlled conditions of lighting, pose etc. Total 5 cameras with 55 mm lens are being used for providing pose variation. We also use 3 Sempex photo light systems with 100watt modeling bulb for illumination variation. To capture 5 pose images in a single shot, a remote sensor of 16ft range.

The cameras are placed at +50°, +25°, 0°, -25°, and -50° with respect to the subject and the distance from the subject is 4.5 ft. Height of the cameras are adjusted according to the subject's head position. Lights are placed above the head, at an angle of +60°, and -60° with respect to the subject. Side lights are at 4.5 ft distance from the subject, and the top light is at a height of 7 ft from the ground and almost 2.5 ft above the head. Fig. 1 shows the complete setup.

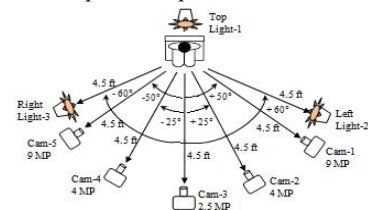


Fig. 1 Top view of camera and light setup for NEI face database.

Database Name/ Year	Total No. of Images/ No. of Subjects	Imaging Conditions (Il: Illumination, Ex: Expression, Po: Pose, Gz: Gaze, Gl: Glasses, Or: Orientation, Oc: Occlusion, Br: Beard, Ms: Mustaches)		Image Resolution	Database Type
FERET Database/ 1996	14,051/ 1,199	Ex/Il/Po/Time	2/2/9-20/2	256 × 384	visual, gray
Hajj and Umrah Database/ 2012	At least 6 images per person/ Too many	Ex, Il, Po/Gl/ Background	variable/yes/ random	variable	visual, color
VADANA Database/2011	2,998/43	Ex, Il, Po, Gl, Facial hair	variable	250 × 250	visual, color
PubFig: Public Figures Face Database/ 2010	58,797/200	Ex, Il, Po, Scene	variable	variable	visual, color
Radboud Faces Database/ 2010	8,040/67	Ex/Il/Po/Gz	8/1/5/3	1024 × 681	visual, color
CMU Multi PIE Database/ 2010	>7,50,000/ 337	Ex/Il/Po	variable/19/ 15	3072 × 2048	visual, color
SCface Database/ 2009	4,160/130	Ex/Il/Po	variable/ uncontrolled (indoor)/9	variable (3072×2048, 680×556, 426×320)	visual, thermal, color
CAS-PEAL Database/ 2003	30,900/ 1,040	Ex/Il/Po/Background/Time /Accessory	6/9-15/21/2-4/2/6	640 × 480 (original), 360 × 480 (cropped)	visual, gray
Korean Face Database/ 2003	52,000/ 1,000	Ex/Il/Po	5/16/7	640 × 480	visual, color
Indian Face Database/ 2002	-/40	Ex/Po	4/11	640 × 480	visual, gray
USTC-NVIE Database/ 2011	-/215	Ex/Il/Gl	6/3/yes	768 × 567	visual, thermal, color
MUG Facial Expression Database/ 2010	-/86	Ex	6	896 × 896	visual, color
VT-AAST Color Face Image Database/ 2004	286/1,027	Or/Ex, Il/Oc/ Hair, Br, Ms, Gl/ Po: Frontal, Intermediate, Profile, Over-Profile	upright and rotated/variable/pres ent/ yes/515, 390, 91, 29	300 × 225	visual, color
UCD Colour Face Image Database / 2003	94/299	Faces of Oc/Br/Gl/Or/ Po: Frontal, Intermediate, Profile	39/18/26/upright: 242, rotated: 50/ 182, 91, 26	variable	visual, color
FG-NET Aging Database/ 2006	1,002/82	Ex, Il, Po/Br, Ms, Gl, Hats	variable/yes	variable (around 400×500)	visual, color, gray

Table 1. Statistics of the various 2D face image databases.

Conditions Used for Database Image Capturing

The 4 illumination conditions (full, half, left light on, and right light on) are controlled by the 3 modeling bulbs. Each light can illuminate at full and half power. The top light always illuminates at full power and the side lights are set as follows: ‘full illumination’ - both lights full; ‘half illumination’ - both lights half; ‘left light on’ - left light full and right light off; ‘right light on’ - right light full and left light off.

We have included 8 expressions (neutral, anger, laughter, sad, surprise, fear, disgust, and closed eye) and 1 faces wearing glasses in full illumination. All 8 expressions are captured in full and half illumination; only neutral faces are also captured in left light on and right light on conditions

Each of the above combination of illumination with the expressions and glasses, faces are captured from the five different viewpoints. Images captured from $\pm 50^\circ$, $\pm 25^\circ$, and 0° viewpoints are of 3696×2448 ,

2464×1632, and 1936×1288 pixels respectively. Fig. 2 shows sample faces in different illuminations, expressions, images with glasses, and with pose variation.

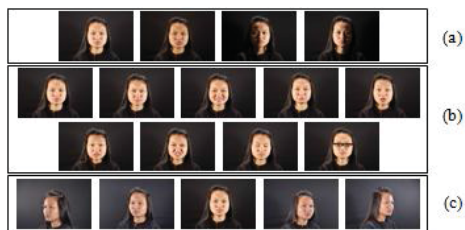


Fig. 2 NEI face database samples of: (a) illumination: full, half, left light on, right light on respectively; (b) expression: neutral, anger, laughter, sad, surprise, fear, disgust, closed eye, with glass respectively; (c) pose: +50°, +25°, 0°, -25°, -50° respectively.

Collection of Face Images

The NEI Face Database will contain the face images of 7 states namely, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, and Tripura. We have already collected images from Mizoram and Assam, and at present capturing is going on in Tripura. For each person, total 95 images have been captured.

We have already captured face images of 292 individuals with a target of 700 individuals to complete. Participants are the tribe and non-tribe students, faculty members and other staffs of various institutes, aging from 18 to 63. Some statistical data are given in Table 2. Some other information such as caste, sub-tribe, and age of each person will also be released with the final database.

State	Total Images	Total Persons	Male	Fem ale	Tribe	Non-tribe
Mizoram	10,640	112	62	50	112	0
Assam	10,165	107	46	61	14	93
Tripura	6,935	73	44	29	34	39
Total	27,740	292	152	140	160	132

Table 2. NEI face database statistics.

CONCLUSION AND FUTURE WORK

This paper describes the design and development of the North-East Indian (NEI) Face Database with detailed description of the setup and imaging condition used in

controlled environment along with a comparative study of the recent 2D face image databases. In future, our aim is to complete the NEI face database by capturing face images of at least 700 individuals and test them for face recognition using various baseline algorithms like Principal Component Analysis, Independent Component Analysis, and Linear Discriminant Analysis etc.

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REFERENCES

- [1] Phillips, P.J., Moon, H., Rizvi, S., and Rauss, P.J.: The FERET evaluation methodology for face-recognition algorithms. *IEEE Transactions on PAMI.* 22(10) 1090–1104, 2000.
- [2] Aly, S.A., Addelwahab, M.M.: Hajj And Umrah dataset for Face Recognition and Detection, *CoRR.* abs/1205.4463, (2012).
- [3] Somanath, G., Rohith, M.V., Kambhamettu, C.: VADANA: A dense dataset for facial image analysis, *First IEEE International Workshop on Benchmarking Facial Image Analysis Technologies* (held in conjunction with the ICCV 2011).
- [4] Kumar, N., Berg, A.C., Belhumer, P.N., Nayar, S.K.: Attribute and Smile Classifiers for Face Verification. *International Conference on Computer Vision*, (2009)
- [5] Langner, O., Dotsch, R., Bijlstra, G., Wigboldus, D.H.J., Hawk, S.T., Knippenberg, A.V.: Presentation and Validation of the Radboud Faces Database, *Cognition & Emotion.* 24(8), 1377-1388 (2010)
- [6] Sim, T., Baker, S., Bsat, M.: The CMU pose, illumination, and expression database. *PAMI.* 25(12), 1615-1618 (2003)
- [7] Gross, R., Matthews, I., Cohn, J., Kanade, T., Baker, S.: Multi-PIE. *Image and Vision Computing*, In: *IEEE International Conference on Automatic Face and Gesture Recognition*, (2008)
- [8] Grgic, M., Delac, K., Grgic, S.: SCface - surveillance cameras face database. *Multimedia Tools and Applications Journal.* 51(3), 863-879 (2011)
- [9] Gao, W., Cao, B., Shan, S., Zhou, D., Zhang, X., Zhao, D.: The CAS-PEAL Large-Scale Chinese Face Database and Evaluation Protocols. *Technical*

Report, Joint Research & Development Laboratory, CAS (2004)

- [10] Roh, M-C., Lee, S-W.: Performance Analysis of Face Recognition Algorithms on Korean Face Database. *International Journal of Pattern Recognition and Artificial Intelligence*. 21(6), 1017-1033 (2007)
- [11] Jain, V., Mukherjee, A.: The Indian Face Database, [http://vis-www.cs.umass.edu/~vidit/IndianFace Database/](http://vis-www.cs.umass.edu/~vidit/IndianFaceDatabase/)
- [12] Wang, S., Liu, Z., Lv, S., Lv, Y., Wu, G., Peng, P., Chen, F., Wang, X.: A Natural Visible and Infrared Facial Expression Database for Expression Recognition and Emotion Inference. *IEEE Transactions on Multimedia*. 12(7) 682-691, (2010)
- [13] Aifanti, N., Papachristou, C., Delopoulos, A.: The MUG Facial Expression Database. In: 11th

International Workshop on Image Analysis for Multimedia Interactive Services (WIAMIS), Italy, (2010)

- [14] Abdallah, A.S., El-Nasr, Md.A., Abbott, A.L.: A New Color Image Database for Benchmarking of Automatic Face Detection and Human Skin Segmentation Techniques: *World Academy of Science, Engineering and Technology*, pp. 353-357 (2007)
- [15] Sharma P., Reilly R.: A Color Face Image Database for Benchmarking of Automatic Facial Detection Algorithms. *Proceedings of 4th European Conference of Video/Image Processing and Multimedia Communications*, (2003)
- [16] FG-Net Aging Database, <http://www.fgnet.rsunit.com/>