Robust Component Based Face Recognition with Occlusion for JPEG Frames: A Survey

[1] Alpa k. Rupala, [2] Prof. Narendra Limbad
[1]Student of Gujarat Technological University,
[2]Assistant Professor at L. J. Institute Of Engineering & Technology,
[1]Department of Computer Engineering,
[1]L. J. Institute of Engineering and Technology, Gujarat Technological University, Ahmedabad, Gujarat, India
[1]alpa1992@gmail.com, [2]limbad.narendra09@gmail.com

Abstract— **Face recognition is growing in many fields like Biometrics. But it also has some significant challenges for recognizing the face under different illuminations, pose variance, aging, occlusion, facial expression, low resolution etc. Face recognition is practically used in security systems for law enforcement situation at places like boarder security, airports railway station where the identification and verification of person matters a lot specially when face is occluded. This paper is mainly focusing on the occluded face verification. For this purpose the LPOG technique, which is the combination of BELBP and LPQ will be used. With the help of automatic face detection misalignment algorithm Voila-jones. SSRC the classification technique which is better than other state-of-arts techniques will be used for classification.**

Index Terms— Biometric, Component Based, Face Identification and Verification, Features extraction, LPOG, Occlusion, Robust Face Recognition.

I. INTRODUCTION

Face recognition is one of the most popular applications of image processing and analysis. Face recognition is the one form of biometrics. Biometrics (Bio=Pertaining to biology & Metric's=Science and art of measurement) is the one branch of practical science where the physical characteristics of the human body are considered for the identification of person. Some of the biometrics areas are iris recognition, fingerprint recognition, face recognition, hand gesture recognition, age estimation [2]. In present, face recognition plays a major role in surveillance, personal information accesses, and improved human machine interaction. Face recognition systems in real world applications need to manage an extensive variety of difficulties like pose variance, Facial expression, occlusion, variations of illumination, Low resolution [5]. In this paper the main focus is on the occlusion. For example Faces are effectively occluded by facial accessories (e.g., sunglasses, scarf, cap, cloak), objects before the face (e.g., hand, food, cellular telephone), extreme illumination (e.g., shadow), self-occlusion (e.g., non-frontal pose) or poor picture quality (e.g., blurring) [3].

- **The Face Recognition can be divided in two Problems** [8]**:**
  1. **Identification (one – to- one matching):** When presented with a face image of an unknown individual along with a claim of identity, ascertaining whether the individual is who he/she claims to be.
  2. **Verification (one – to –many matching):** Given an image of an unknown individual, determining that person's identity by comparing (possibly after encoding) that image with a database of (possibly encoded) images of known individuals.

- **Application areas of Face Recognition:** [9][10][16]
  - **Entertainment:** Video game, virtual reality, training programs, Human-robot-interaction, human-computer-interaction
  - **Smart cards:** Drivers' licenses, Immigration, national ID, passports, voter registration, Welfare fraud
  - **Information security:** Access control, personal device logon, desktop logon, Application security, database security, file encryption, Intranet security, internet access, medical records, Secure trading terminals
  - **Law enforcement and surveillance:** Advanced video surveillance, missing children, CCTV control, Portal control, post event analysis, Shoplifting, suspect tracking and investigation, Witness faces reconstruction, video indexing.

The rest of this paper is organized as follows. Section II describes the details of Face Recognition Approaches. In Section III the generic Framework of FR system is represented. Section IV gives the detail of literature survey and some action plan based on survey. Finally, some conclusions are presented in section V.

II. BACKGROUND THEORY

Face Recognition Approach:
The research on face recognition categorizes it into the following approaches: [8-9] [14] [16]

1. Feature-based approach
2. Holistic or global approach
3. Hybrid approach

- **Feature-based Approach:** In feature-based approach, local features on face such as nose and eyes are segmented and then given to the face detection system to easier the task of face recognition[8]

- **Holistic or global approach:** In holistic approach, the whole face region is taken as an input in face detection system to perform face recognition[8]

- **Hybrid Approach:** In hybrid approach, both local features and the whole face are used as the input to the face detection system. It is more similar to the behavior of human being to recognize the face[8]

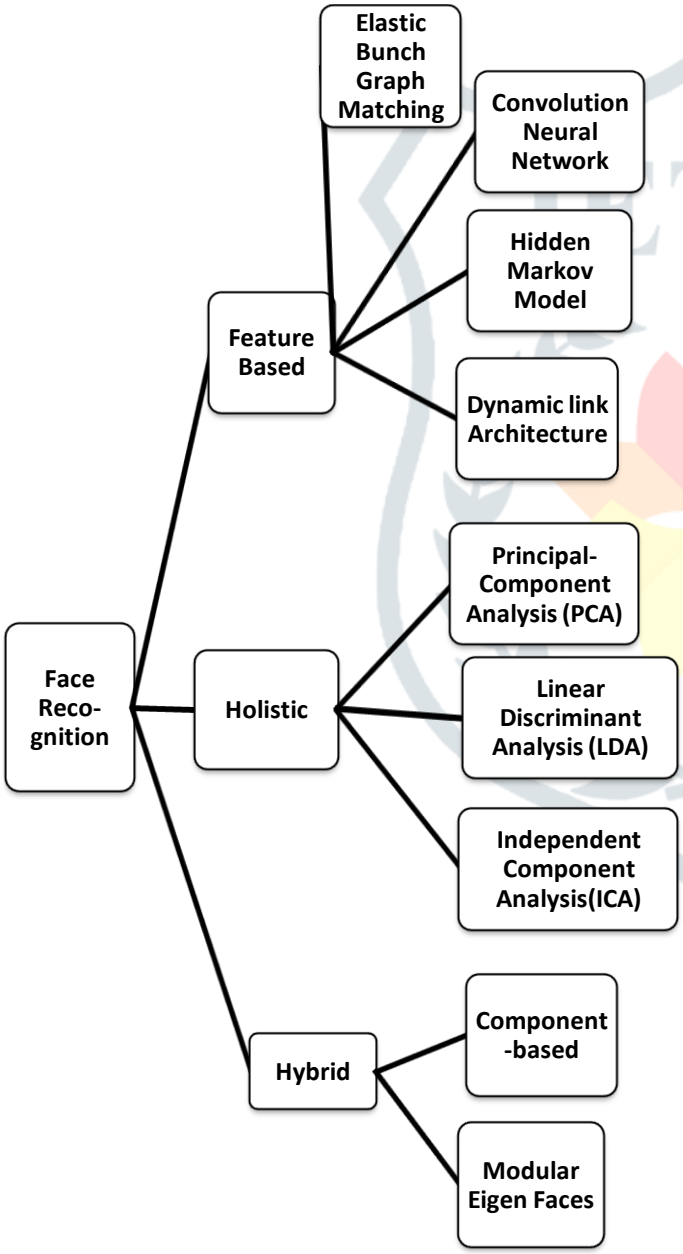

Fig 1: Face Recognition Classification of Approaches

Elastic Bunch Graph Matching: It is an algorithm which recognizes faces by matching the probe set represented as the input face graphs, to the gallery set that is represented as the model face graph. EBGM is the concept of nodes; each node of the input face graph is represented by a specific feature point of the face. [14]

Convolution Neural Network: It is biologically inspired and based on the functionality of neurons. The perceptron is the neural network equivalent to a neuron. Just like a neuron sums the Strengths of all its electric inputs, a perceptron perform a weighted sum on its numerical inputs. Using these perceptrons as a basic unit, a neural network is formed for each person in the database. [8]

Hidden Markov Model: In this technique Faces were intuitively divided into regions such as the eyes, nose, mouth, etc., which can be associated with the states of a hidden Markov model. Since HMMs require a 1 D observation sequence and images are 2D, the images should be converted into either 1D temporal sequence or 1D spatial sequence. [8]

Dynamic Link Architecture: DLAs use synaptic plasticity and are able to form sets of neurons grouped into structured graphs while maintaining the advantages of neural systems. [16]

Principal-Component Analysis (PCA): It is a mathematical procedure that performs a dimensionality reduction by extracting the principal components of the multi-dimensional data. The scheme is based on an information theory approach that decomposes face images into a small set of characteristic feature images called 'Eigenfaces', which are actually the principal components of the initial training set of face images. [8]

Linear Discriminant Analysis (LDA): LDA is widely used to find linear combinations of features while preserving class separability. Unlike PCA, LDA tries to model the differences between classes. As an input, LDA takes in a set of faces with multiple images for each individual. These images are labeled and divided into within-classes and between-classes, then matrix is calculated and optimal projection is chosen. [8]

Independent Component Analysis (ICA): It aims to transform the data as linear combinations of statistically independent data points. Therefore, its goal is to provide an independent rather that uncorrelated image representation. ICA is an alternative to PCA which provides a more powerful data representation. It's a discriminant analysis criterion, which can be used to enhance PCA. [8]

Component Based: It decompose a face into a set of facial components such as mouth and eyes that are interconnected by a flexible geometrical model. The motivation for using components is that changes in head pose mainly lead to changes in the positions of facial components which could be accounted for by the flexibility of the geometric model. [16]

Modular Eigenfaces: It uses both global eigenfaces and local eigenfeatures. The concept of eigenfaces can be extended to eigenfeatures, such as eigeneyes, eigenmouth, etc. Using a

limited set of images recognition performance as a function of the number of eigenvectors was measured for eigenfaces only and for the combined representation. [16]

III. Generic Framework of Face Recognition

We can show the face recognition in mainly three steps

1. Face Detection
2. Features Extraction
3. Classification

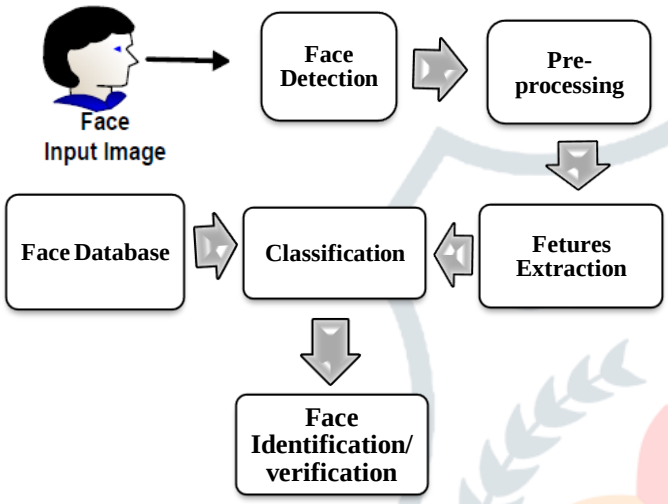

Fig 2: Generic Framework of Face Recognition

Face detection: It is combination of two processes. One is finding the face from the image and another one is processing of detected face image like cropping face, resizing, normalization, and sampling etc.

Features Extraction: It is the process of Extracting the features of the face image and making the compact set of interpersonal discriminating geometrical or/and photometrical features of the face. After getting the features the dimensionality reduction techniques (like PCA, LDA) need to be used for the better comparison.

Classification: Classification is the actual recognition process. Where the features are compared with the already having face database for the identification purpose. For the verification purpose we need to check the normalized training face image with already having face database images one by one till getting the correct match or end of the database images.

IV. Literature Survey

There have been many researchers who have attempted in Face recognition System. Huu-Tuan Nguye et al. [1] created the Local Pattern of Gradient (LPOG) Technique which is the combination of Block wised Elliptical Local Binary Pattern (BELBP) and Local Phase Quantization (LPQ), as the researchers only focused on the face identification and stated that this technique can be lead to the face verification purpose also. And they also stated that this technique can be lead to the misalignment face Images where the face is detected automatically by some automatic face detection algorithm. Some reviews are presented in Table I.

Table I. Analysis of different approach of Face Recognition

Researchers	Year And Public-ation	Method Used	Database Used	Advantages	Disadvantages
Huu-Tuan Nguye, and Alice Caplier [1]	2015 IEEE	LPOG (BELBP+LPQ) WPCA KNN	FERET, AR, SCFace	More fast More efficient and robust	Requires High Computation Done on Identification only
John Solder, Carlos Alberto Ramirez Behaine, and Jacob Scharcanski [2]	2015 IEEE	OLPP +SVM	PUT, FEI, FERET, Yale, ORL	It can handle Noisy, Non Linear and high dimensional data	Low Accuracy with Gray scale images
Kathryn Bonnen, Brendan F. Klare Anil K. Jain [12]	2013 IEEE	Component Base (Active Shape Model) MLBP	PCSO LFW AR, FERET	More Robust and accurate on Pose variation and occlusion	Misalignment of Component can be lead to wrong result, New technique of effectively align and extract component need to be used
Mehedi Hasan Foisal Hossain [6]	2014 IEEE	Skin Color Segmentation Morphology Technique	Own database	Easy More Efficient	High Quality Image is required
Xiao-Xin Li Dao-Qing Dai Xiao-Fei Zhang Chuan-Xian Ren[11]	2013 IEEE	Structure sparse error coding	AR Extended Yale B	More accurate when high level occlusion and low feature dimensions	Not optimal
Weihong Deng Jiani Hu Jun Guo [15]	2012 IEEE	Extended Sparse Representation Based Classifier (ESRC)	AR FERET	more accurate when number of training images decreases	universal intraclass variant dictionaries for unconstrained face recognition is not optimal
Bindu A C N Ravi Kumar [13]	2013 IEEE	Inpainting Algorithm	Own Database	very effective for heavily occluded images with 90% occlusion	response time drastically reduced by reduce in the database size
Kanokmon Rujirakul, Chakchai So-In, Banchar Anonkijpanich [7]	2014 IEEE	Weighted Histogram Equalized PEM-PCA	Senthil Jaffe FEI	higher accuracy and lower complexity compared to a traditional PCA	Lower number of cores yield more computational time
Sandesh V Khamele, Shyamal G Mundada [4]	2015 ijarcce	INPAINTING Fast Weighted-Principal component analysis (FWPCA)	own database	save processing time	For Major Occlusion requires more computation

So the objective of this work is to find the limitation of recent work which could be carried out further for the future. As per this the suggested Flow work is given below.

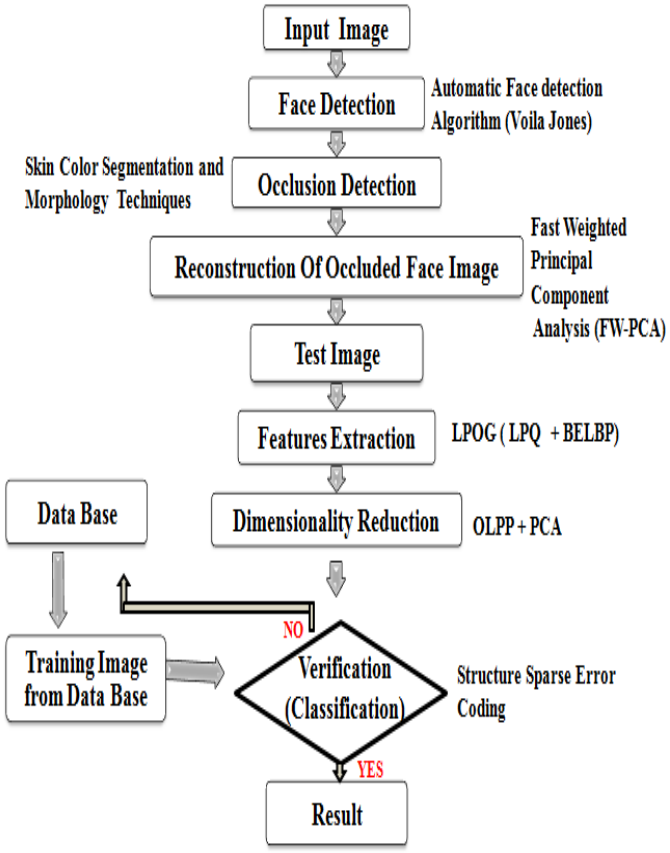

Fig 3: Proposed Flow Diagram

In the proposed work the face recognition is leaded to the verification problem where more than one face image will be compare to the test Images. For misalignment face image the automatic face detection algorithm voila Jones is used. Then the given test image as input is the occluded one so to detect the occlusion portion and reconstruction purpose the skin color segmentation technique [6] and fast weighted PCA [4] will be use respectively. For the Features extraction the LPOG technique [1] will be used. Orthogonal Locality Preserving Projections (OLPP) will be used as the dimensionality reduction. Then at the end the classification will be done by Structure Sparse Error Coding (SSEC) [11].

V. Conclusion

The proposed paper briefly discussed a critical survey of existing literature on Face Recognition System. Face recognition system is very important in our daily life. In this paper there is presented the different type of approaches of face recognition. Table I provides the different researchers research on Face Recognition System with some of the face recognition algorithms and techniques along with their advantage and disadvantage in tabular form.

References

[1] Nguyen, Huu-Tuan, and Alice Caplier, "Local Patterns of Gradients (LPOG) for Face Recognition", Information Forensics and Security, IEEE Transactions on (Volume:10 , Issue: 8), ISSN :1556-6013, INSPECAccessionNumber: 15232971, DOI: 10.1109/TIFS.2015.2426144 ,pp: 1739 - 1751 , IEEE, Aug. 2015

[2] Soldera, John, Carlos Alberto Ramirez Behaine, and Jacob Scharcanski, "Customized Orthogonal Locality Preserving Projections With Soft-Margin Maximization for Face Recognition" , Instrumentation and Measurement, IEEE Transactions on (Volume:64 , Issue: 9), ISSN :0018-9456, DOI:10.1109/TIM.2015.2415012, pp: 2417 – 2426, IEEE, Sept. 2015

[3] Sheethal Rao K, Steven L Fernandes, Patel Haniben, Prajna, Pratheek,Rakshan V Devadiga, Shivani Kottary, Surakshitha, Thilak P, " Review on Various State of Art Technique to Recognize Occluded Face Images", 2ND International Conference On Electronics And Communication System, ISBN: 978-1-4799-7224-1, DOI: 10.1109/ECS.2015.7124977, pp: 595 – 601, IEEE, Feb. 2015

[4] Sandesh V Khamele, Shyamal G Mundada, "An Approach for Restoring Occluded Images for Face-Recognition", International Journal of Advanced Research in Computer and Communication Engineering (Volume:4, Issue: 5), ISSN : 2278-1021, DOI: 10.17148/IJARCCE.2015.45122, pp: 571-575, IJARCCE , May 2015

[5] Jyoti Reddy, Rajesh Kumar Gupta, Dr. Mohan Awasthy , " A Survey: Face Recognition by Sparse Representation International Journal of Engineering and Applied Sciences (Volume-2, Issue-2) ISSN: 2394-3661,pp: 27-29, IJEAS , February 2015

[6] Md. Mehedi Hasan, Md. Foisal Hossain, "Facial Features Detection in Color Images Based on Skin Color Segmentation", 3rd INTERNATIONAL CONFERENCE ON INFORMATICS, ELECTRONICS & VISION ISSN : 978-1-4799-5180-2/14, pp: 1-5, IEEE , 2014

[7] Kanokmon Rujirakul, Chakchai So-In and Banchar Anonkijpanich, "Weighted Histogram Equalized PEM-PCA Face Recognition", International Computer Science and Engineering Conference (ICSEC), ISBN: 978-1-4799-4965-6, DOI: 10.1109/ICSEC.2014.6978185, pp: 144 – 150,IEEE, Aug. 2014

[8] Deepali H. Shah1, Dr. J. S. Shah2 and Dr. Tejas V. Shah, " The Exploration of Face Recognition Techniques", International Journal of Application or Innovation in Engineering & Management (Volume 3, Issue 2), ISSN 2319 – 4847, PP- 238-246, IJAIEM, February 2014

[9] Ms. B. Saranya Bargavi, Ms C. Santhi, " Global and Local Facial Feature Extraction using Gabor Filters", International Journal of Science, Engineering and Technology Research

(Volume: 3 ,Issue: 4), ISSN: 2278 – 7798, pp: 1020-1023, IJSETR, April 2014

[10] Kaushik R. Makwana, "A Survey on Face Recognition Eigen face and PCA method", International Journal of Advance Research in Computer Science and Management Studies (Volume: 2, Issue: 2), ISSN: 2321-7782, pp: 287-291, IJARCSMS , Feb.2014

[11] Xiao-Xin Li, Dao-Qing Dai, Xiao-Fei Zhang, and Chuan-Xian Ren, "Structured sparse error coding for face recognition with occlusion", Image Processing, IEEE Transactions on (Volume:22 , Issue:5), ISSN :1057-7149, INSPEC Accession Number:13370726, DOI: 10.1109/TIP.2013.2237920, pp: 1889-1900, IEEE, May 2013

[12] Kathryn Bonnen, Brendan F. Klare, Anil K. Jain, "Component-Based Representation in Automated Face Recognition", Information Forensics and Security, IEEE Transactions on (Volume:8 , Issue: 1) , ISSN : 1556-6013, DOI: 10.1109/TIFS.2012.2226580, pp: 239 – 253, IEEE, Jan. 2013

[13] Bindu A, C N Ravi Kumar, "Novel Inpainting Algorithm for Heavily Occluded Face Reconstruction", Advances in Computing, Communications and Informatics (ICACCI), 2013 International Conference on, ISBN: 978-1-4799-2432-5, DOI: 10.1109/ICACCI.2013.6637458, pp: 1822 – 1826, IEEE, Aug. 2013

[14] M. Parisa Beham, S. Mohamed Mansoor Roomi, "A Review Of Face Recognition Methods", International Journal of Pattern Recognition and Artificial Intelligence (Volume:27, Issue: 4), DOI: 10.1142/S0218001413560053, pp: 1356005- (1 -35), IJPRA, July 2013

[15] Weihong Deng, Jiani Hu, and Jun Guo, "Extended SRC: Undersampled Face Recognition via Intraclass Variant Dictionary", Pattern Analysis and Machine Intelligence, IEEE Transactions on (Volume:34 , Issue: 9), ISSN : 0162-8828, DOI: 10.1109/TPAMI.2012.30, pp: 1864 – 1870, IEEE, Sept. 2012

[16] W. Zhao, R. Chellappa, P. J. Phillips, And A. Rosenfeld, "Face Recognition: A Literature Survey", ACM Computing Surveys, Vol. 35, No. 4, 3,ISSN: ACM 0360-0300/03/1200-0399, pp. 399–458,ACM, Dec. 2003