

Robust Component Based Real Time Face Recognition with Occlusion for JPEG Frames

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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 especially when face is occluded. This paper is mainly focusing on the Real Time 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 Viola-jones. SSRC the classification technique which is better than other state-of-arts techniques will be used for classification.

Keyword: Biometric, Component Based, Face Identification and Verification, Features extraction, LPOG, Occlusion, Robust Face Recognition,

1. 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:

1. **Verification (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. [8]
2. **Identification (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. [8]

❖ Application areas of Face Recognition:

- **Entertainment:** Video game, virtual reality, training programs, Human-robot-interaction, human-computer-interaction. ^{[9][16]}
- **Smart cards:** Drivers' licenses, Immigration, national ID, passports, voter registration, Welfare fraud. ^{[9][16]}
- **Information security:** Access control, personal device logon, desktop logon, Application security, database security, file encryption, Intranet security, internet access, medical records, Secure trading terminals. ^{[9][16]}
- **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. ^{[9][10][16]}

The rest of this paper is organized as follows. Section 2 describes the details of Face Recognition Approaches. In Section 3 the generic Framework of FR system is represented. Section 4 gives the detail of literature survey and some action plan based on survey. Finally, some conclusions are presented in section 5.

2. BACKGROUND THEORY

Face Recognition Approach:

The research on face recognition categorizes it into the following approaches: ^{[8-9][14][16]}

1. **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]
2. **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]
3. **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]

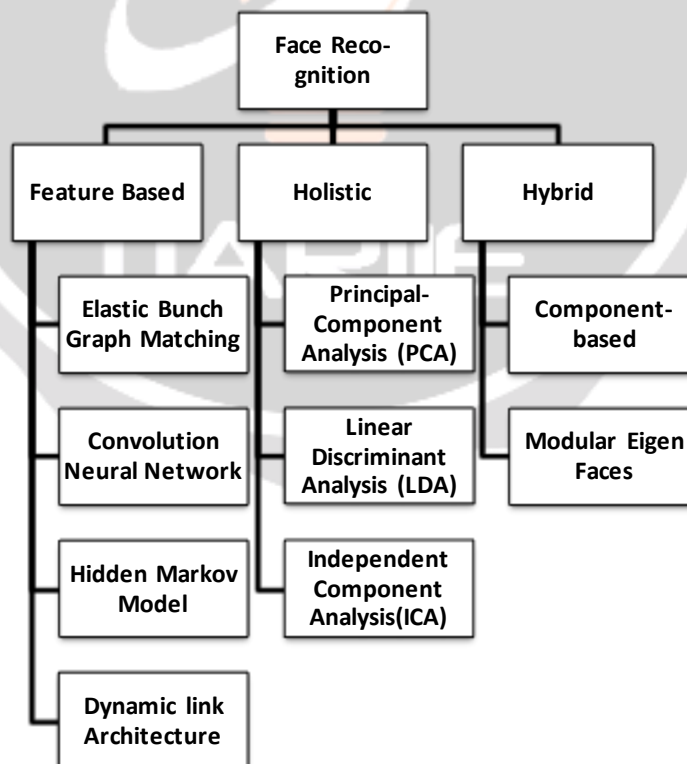


Fig -1: Face Recognition Classification of Approaches

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 than 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]

3. GENERIC FRAMEWORK OF FACE RECOGNITION

We can show the face recognition in mainly three steps

1. Face Detection
2. Features Extraction
3. Classification

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

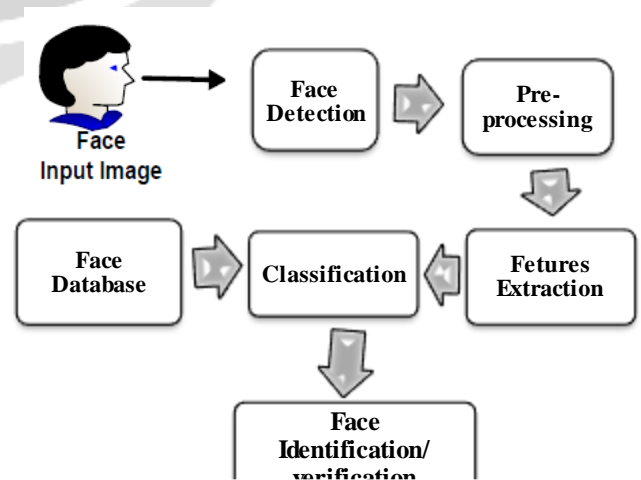


Fig -2: Generic Framework of Face Recognition

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 match or end of the database images.

4. 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 wise 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 -1: Analysis of different approach of Face Recognition

Researchers	Method Used	Database Used	Advantages	Disadvantages
Huu-Tuan Nguye, and Alice Caplier ^[1]	LPOG (BELBP+LPQ) WPCA KNN	FERET, AR, SCFace	More fast More efficient and robust	Requires High Computation, May not Robust for verification and misaligned Images
John Solder, et al. ^[2]	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]	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]	Skin Color Segmentation Morphology Technique	Own database	Easy More Efficient	High Quality Image is required
Xiao-Xin Li et al. ^[11]	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]	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]	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, et al. ^[7]	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]	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.

5. PROPOSED SYSTEM

In the proposed work (shown in Fig -3) the face recognition is led to the verification problem where one real time Unoccluded Training face image will be compare to the real time occluded test Image. For this purpose the Test image needs to be processed. To detect the face from the Test image, the misalignment algorithm Voila Jones is used. To detect the occlusion and differ the occluded and unoccluded portion of the face image The Skin Color Segmentation and Morphology Techniques^[6] are used. Then the given test image as input is the occluded one so to detect the occlusion portion and reconstruction purpose fast weighted PCA^[4] is used. For the Features extraction the LPOG technique^[11] is used then 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] If the Training image and Test image matching then it will give the appropriate Result.

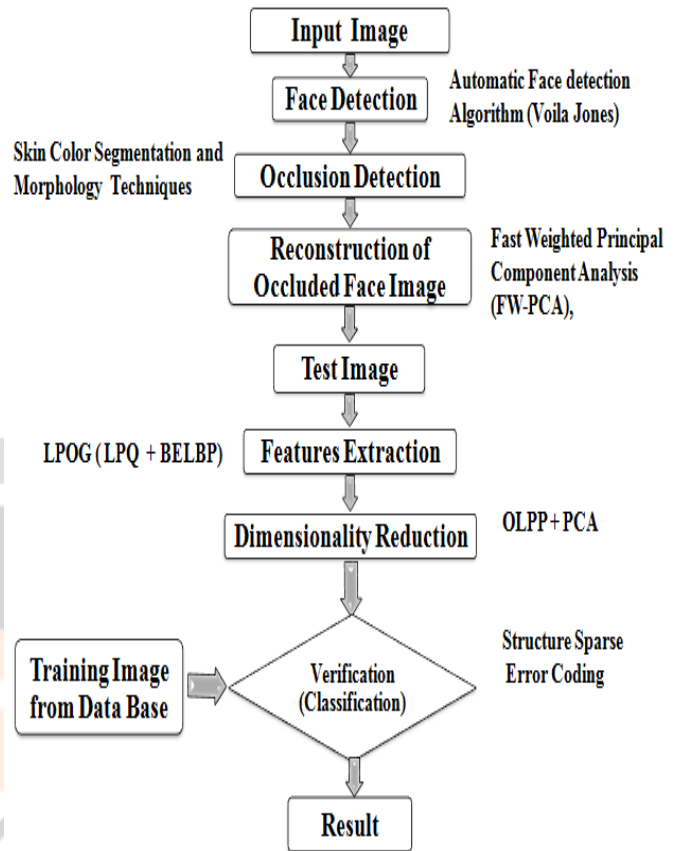


Fig -3: Proposed Flow Diagram

6. RESULT ANALYSIS

For implementation of proposed Flow work has been experimented through matrix laboratory software (MATLAB), which is running on laptop with a 2 GHz Core2duo with 2GB RAM and Windows 8 Operating System.

For experiment the 5 different people’s samples are taken for the 5 times with the same intensity value. And the result of face detection, occlusion detection, verification rate and speed is given below.

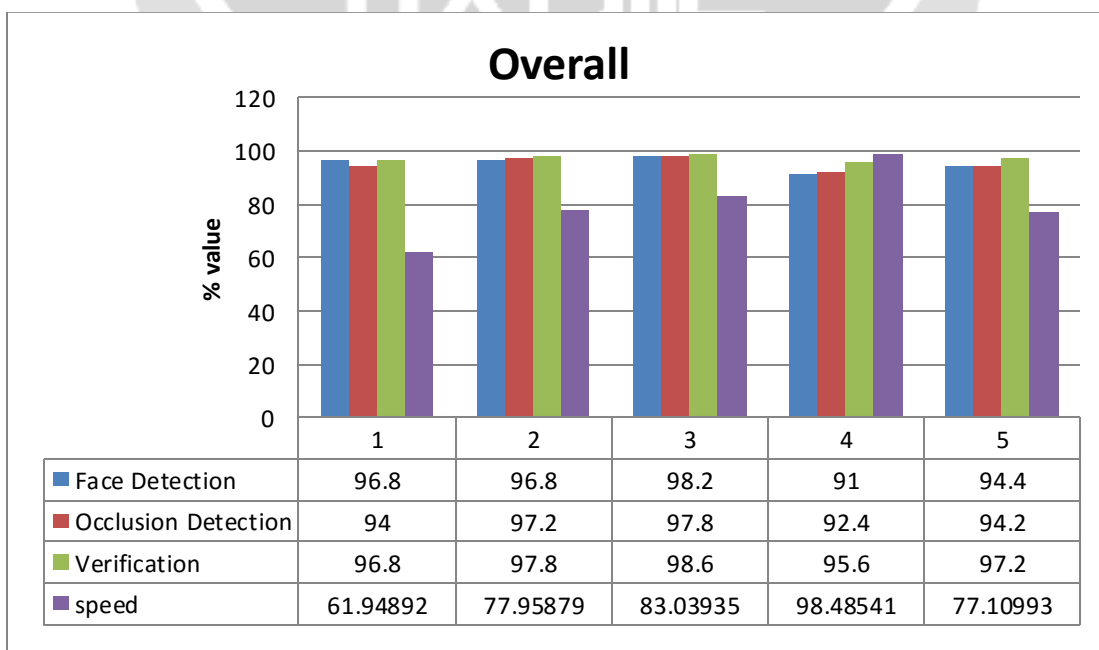


Fig -4: Result analysis of 5 different samples

By this Result we can say that overall face Detection rate is 95.44%, Occlusion Detection Rate is 95.12 % and Verification Rate is 97.20% and the speed of the overall system is 79.70848 sec.

7. 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. The experiment is done on 5 different samples of different person in real time environment with Unoccluded training image and Occluded test image and this experiment result is shown in Fig-4 which shows that the proposed system gives the approx 98% accuracy even in real time environment.

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