EFFICIENT FACE RECOGNITION METHOD FOR OCCLUDED IMAGES

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ABSTRACT

Face recognition has been a fast growing, challenging for recognizing the face under different illuminations, pose variance, aging, occlusion, facial expression, low resolution etc. and interesting area in real time applications. Like boarder security, airports railway station where the identification and verification of person matters a lot especially when face is occluded. A large number of face recognition algorithms have been developed in last decades. In this paper an attempt is made to review a wide range of methods used for face recognition accurately. For this purpose LOPG with SSR enhancement technique will be included. With the help of automatic face detection misalignment algorithm Voila-Jones.

Keyword: - *Face Detection and Recognition, Occlusion, Viola Jones, LPOG, SSR Enhancement*

1. INTRODUCATION

Face recognition is one of the most popular applications of image processing and analysis. Face recognition is used to consider for the identification of person. In present, face recognition plays a major role in surveillance, personal information accesses, design of human computer interface (HCI), content based image database management, criminal identification and so on.

Occlusion is one of the main performance reduction problems in video surveillance systems. All automated occlusion detection system should accurately monitor occlusion. When the detected objects in a scene come behind another object, some parts in the objects become undetected due to occlusion. Under occlusion human bodies will be overlapped and walking together in a scene. Occlusion can be of three types: self occlusion, inter-object occlusion, back ground occlusion [1]. When some parts of object is occluded, called self occlusion. This will occur frequently. When two or more objects occluded each other, inter object occlusion occurs. Background occlusion occurs if objects are hided due to back ground objects in a scene. There are verities of occlusion detection algorithms to monitor the objects from visual video.

Face recognition algorithm has so much importance in video surveillance [2]. The faces might be masked either purposely using sun glasses or mask unintentionally like scarves or Crowded places. Depending up on the places such as banks, the occlusion may be suspicious. Because of face occlusion, the performance degradation of system will occur. So researches in the last decade have concentrated on improving the performance of the human detection. Face recognition systems in real world applications need to manage a 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 with illumination. 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]

Fig 1: Different types of Occluded face during face recognition [2]

1.1 Applications of Face Recognition

Person Identification: Face recognition system is used to identify people to provide authorization similar to secret identification key or password. This is mainly used to remove duplications in voter registration system, adhaar etc thus providing security to the nation.

Access Control: Face recognition system is mainly used in organizations to control the computer login and to protect the office access, thus providing security to organizations information.

Security: Face recognition system is mainly used in public areas such as bus station, railway station , airport etc to identify terrorist, criminals etc.

Database investigation: Face recognition system is mainly used for searching licensed drivers, missing child and police booking.

Video Surveillance: Face recognition system is mainly used in large organizations and malls to provide protection against terrorist attacks and robbery. The protection is provided with the help of CCTV cameras which is examined in the control rooms.

2. OBJECT DETECTION AND RECOGNITION

Object Detection models are classified in following:

- Feature-based object detection
- Motion-Based Object Detection
- Training Object Detectors and Classifiers

Feature-based object detection is used for object detection by detecting a set of features in a reference image, extracting feature descriptors, and matching features between the reference image and an input. Motion-Based Object Detection is used for motion extraction and segmentation techniques such as optical flow foreground detection to locate moving objects in a scene. In Training Object Detectors and Classifiers training is the process of creating an object detector or classifier to detect or recognize a specific object of interest. The training process utilizes:

- Positive images of the object of interest at different scales and orientations
- Negative images of backgrounds typically associated with the object of interest
- Non-objects similar in appearance to the object of interes

The face recognition methods are classified into the following category:

- Holistic method
- Structural method
- Hybrid method

In holistic method the entire face is considered as input that is the entire face features are considered for recognition. One of the best examples of this type of method is eigenfaces and principal component analysis. In structural method selected local features such as eyes, nose and mouth are extracted for their location and local statistics are fed into the classifier. The structural method is further classified into generic, template based and structural matching method. Hybrid methods are the combination of holistic and structural methods and are generally used for 3D face recognition.

2.1. WORKFLOW OF FACE RECOGNITION

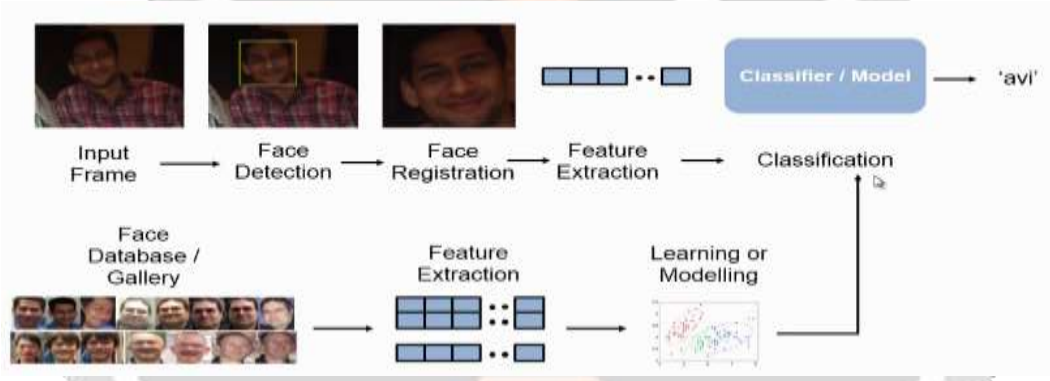


Fig - 2: Face Recognition Work flow[4]

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.

3. RELATED WORK

3.1 Viola Jones Face Detection Algorithm

The Viola Jones object detection framework is that the initial object detection framework to produce competitive object detection rates in period of time planned in 2001 by Paul Viola and Archangel Jones. Albeit it is often trained to discover a range of object categories, it absolutely was motivated principally by the matter of face detection. This face detection framework is capable of process pictures very quickly whereas achieving high detection rates.

Disadvantages: It takes very long coaching time, restricted head poses and we cannot find black Faces or gray scale images.

The characteristics of Viola–Jones algorithm which make it a good detection algorithm are:

- Very high detection rate (true-positive rate) & very low false-positive rate always.
- Real time – For practical applications at least 2 frames per second must be processed.
- Face detection only (not recognition) - The goal is to distinguish faces from non-faces (detection is the first step in the recognition process).

The algorithm has four stages: Haar Feature Selection, Creating an Integral Image, Adaboost Training, and Cascading Classifiers

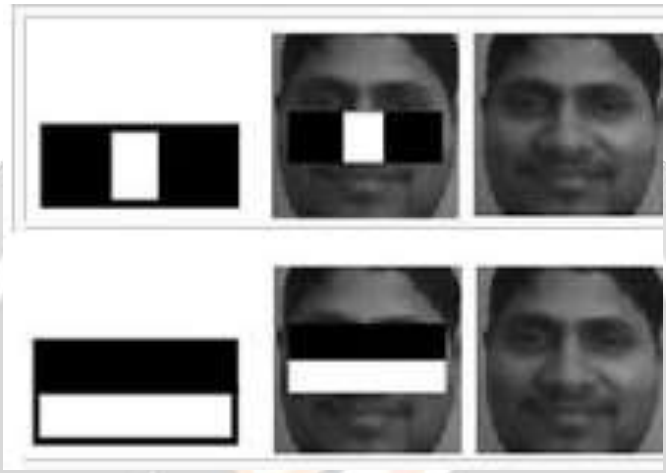


Fig 3: Haar Feature Selection [5]

3.2 Local Binary Pattern (LBP)

This technique is incredibly effective to explain the image texture options. LBP has benefits akin to high-speed computation and rotation changelessness that facilitates the broad usage within the fields of image retrieval, texture examination, face recognition, image segmentation, etc. Disadvantages: It is a planned methodology isn't sensitive to little changes within the Face Localization, and victimization larger native regions will increase the errors. It is inadequate for non-monotonic illumination changes and is solely used for binary and gray pictures. The LBP operator used in order to express the texture of image Evaluation of Histograms Local Features and Dimensionality Reduction for 3D Face Verification patches. LBP has been widely applied with various algorithms of face recognition systems as a local feature extraction method. The LBP description of a pixel image is produced by thresholding the 3×3 neighborhood with the central pixel and devolving the result as a binary code.

3.3 Single scale Retinex (SSR)

Image $I(x,y)$ is the product of two components, illumination $L(x,y)$ and reflectance $R(x,y)$ [11].

$I(x,y) = L(x,y)R(x,y)$

Illumination contains geometric properties of the scene (i.e., the surface normal and the light source position) and Reflectance contains information about the object. Based on the assumption that the illumination varies slowly across different locations of the image and the local reflectance may change rapidly across different location, the processed illumination should be drastically reduced due to the high-pass filtering, while the reflectance after this filtering should still be very close to the original reflectance. The reflectance can be also finding by dividing the image by the low pass version if the original image, which is representing illumination components. Land proposed a technique called retinex, which is a combination of the words retina and cortex. Its try to explain model of the human visual system. The most interesting point for illumination normalization is the assumption that perception depends on the relative or surrounding illumination. It means that reflectance $R(x,y)$ equals the quotient of image $I(x,y)$ and the illumination $L(x,y)$ calculated by the neighborhood of $I(x,y)$. It improves the visibility of dark object while maintaining the visual different of the light area. Single scale retinex algorithm defines a Gaussian kernel to

estimate the neighborhood illumination. Additional the logarithmic transformation is employed to compress the dynamic range. Reflectance image is takes from the form:
$R_{SSR}(x,y) = \log I(x,y) - \log[F(x,y) * I(x,y)]$,Where $*$ denotes the convolution operation and $F(x,y)$ is the surround Gaussian function.

3.4 Local Patterns of Gradients (LPOG)

Feature extraction method named as local patterns of gradients (LPOG) for robust face recognition.LPOG uses block-wised elliptical local binary patterns (BELBP),a refined variant of ELBP, and local phase quantization (LPQ) operators directly on gradient images for capturing local texture patterns to build up a feature vector of a face image. From one input image, two directional gradient images are computed. A symmetric pair of BELBP and a LPQ operator is then separately applied upon each gradient image to generate local patterns images. Histogram sequences of local patterns images' non-overlapped sub-regions are finally concatenated to form the LPOG vector for the given image. Based on LPOG descriptor, LPOG method is faster than many advanced feature extraction algorithms and can be applied in real-world applications.

4. PROPOSED WORK

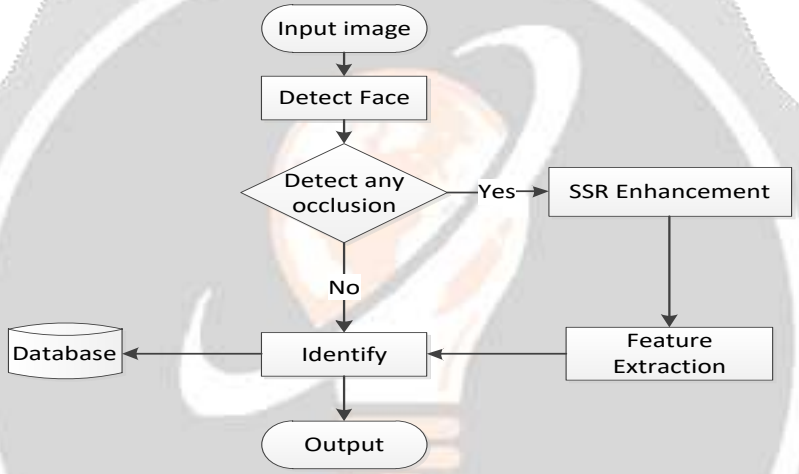


Fig 4: Proposed System Flow graph

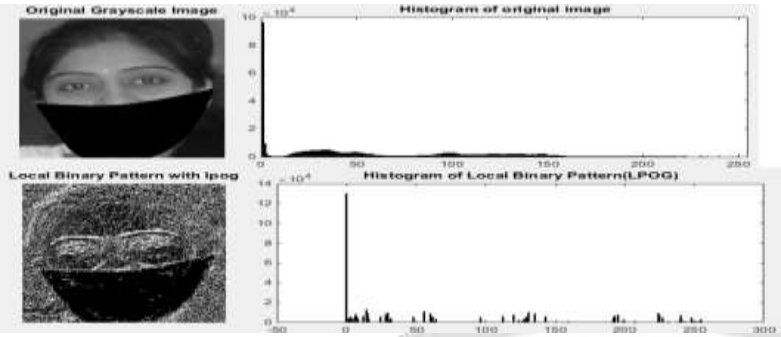
In the proposed work the face recognition is leaded to the recognition problem where one Training face image will be compare to the test Image. For misalignment face image the automatic face detection algorithm voila Jones is used. Then the given test image as input is the occluded one so to detect the occlusion portion and reconstruction purpose the skin color segmentation technique [6] and SSR Enhancement [4] will be use respectively. For the Features extraction the LPOG technique [1] will be used. So get better accurate result.

5. ALGORITHM

Step 1: Take input image as test image from camera or any other equipment or from test dataset ,to identify the image check out either image is occluded or not using skin segmentation and for accurate skin segmented result then apply morphology operation on result so we will get this image result.
Step 2: Then extract only face region to identify face features that are eyes and lip.
Step 3: Find out eyes and lip feature with using thresholding and make circle and rectangular respectively.
Step 4: Calculate distance between eyes and lip and make blob on it Generate histogram of extracted or gated blob with LBP.
Step 5: Enhanced image using SSR Enhancement.
Step 6: Process of LPOG technique is done on every image of training database is done and histogram is created as well as of Test Image.
Step 7: Histogram of original gray scale image and local binary pattern with LPOG algorithm histogram.
Step 8: This Equivalent image is then compared with the test image again for verification.

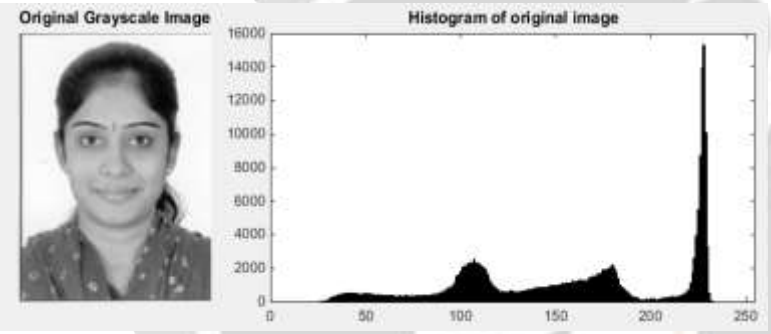
6. RESULTS

The proposed scheme has been experimented with occluded test image compare with train dataset using LPOG and SSR Enhancement and gets maximum percentage of accuracy and feature similarity and structure similarity.



(a) Original Test image and LPOG image with histogram

(b) SSR Enhancement



(c) Match test image with train dataset with histogram gray scale

(d) Final match output from train dataset

Fig 5: LPOG with Histogram Result, SSR Enhancement, Match result with histogram and final output

Experimental Parameters

The proposed scheme has been experimented on different images and its accuracy, structure similarity and feature similarity index is shown in following table Accuracy refers to how closely the measured value of a quantity corresponds to its "true" value. and according to our proposed flow design effective implementation and getting 99% accuracy with trail multiple times execution with 1% false alarm rate. So our system gives 99% accuracy.

Table 1: Parameters metric result of test images

Image Name	Accuracy	FSIM	SSIM
1.JPG	95%	0.6179	0.7366
2.JPG	94.95%	0.6323	0.5278
3.JPG	98%	0.9022	0.8254
4.JPG	99%	0.9350	0.8953
5.JPG	96%	0.7001	0.5911
6.JPG	96.02%	0.9182	0.8877
7.JPG	97%	0.9389	0.9045

7. CONCLUSIONS

Face recognition system is very important in our daily life for security number of challenges face when detect real time face like occlusion, intensity, resolution, skin color, shape. Occlusion, disguise, with makeup face is big challenge in face recognition. The face recognition is having very low accuracy and difficulties when performed on occluded images like occlusion detection and recovery So, the proposed diagram presents the overall solution of the problem statement and make it more robust to recognition the face either in any situation any occlusion exist or without any occlusion exist and classify object accurately using LPOG, SSR Enhancement.

7. REFERENCES

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