A Novel Approach for Blurred and Noisy Face Image Recognition

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Abstract: ***This paper presents the blurred and noisy face image recognition. The main factors that make this problem challenging are image degradation due to blur and noise. Motion blur is simply an undesired effect. Restoration of blur image is very important in many of the cases like identification of criminal face in blurred image. The motion blur can be occurred due by the movement of the object or the camera. The photos captured in cameras make the camera as stationary and the object is in the movement or vice versa, so there is a higher probability of inducing of the motion blur and a noise on the image. In the identification of a person on the event of a crime so, we present the novel approach for the recognition of a person by the estimation of the blur. The features are extracted using the principle component analysis; later face recognition is carried out by matching the obtained features with the database features. The experimental results show the better recognition of a person in the FEI database.***

Keywords: Blur parameters, PCA, PSF, Hough transform, Eigen vectors

1. Introduction

Due to its many potential applications, face recognition has become one of the most active topics in computer vision research [1]. For recognizing faces that are degraded due to the blur using de-blurring of facial images. The main issue is how to infer a Point Spread Function (PSF) representing the process of blur on the faces. The kind of blur contains the out-of-focus and motion blur. The out-of-focus blur will be induced due to the wrong adjustment of the camera calibration. The noise consists of the salt and pepper noise and Gaussian noise. The image will loss the information that it contains due to the affect of blur and noise factor.

The face image which is blurred and noisy will be not possible for the efficient recognition of the face images, so the removal of the blur and noise across the face images it is possible to improve the performance in the recognition of the face images. In the case of the motion blurred face images blur occurs mainly due to the variation in the length of the pixel and direction of the pixel. By calculating these parameters efficiently it is possible to remove the blur completely. The most common blur appear due to the camera shaken.

Blur affects the face recognition system by making two or more persons to appear has same which will became bottleneck in the face recognition system and also the presence of blur will differs the facial appearance of a person. The presence of noise causes the unknowing effect which has also degrades face recognition system. First applying the filters for the removing of the noise and then

De-blurring of the image by estimating the length and direction of the blur will provide the better performance in the removal of these image degrading functions. The restoration of the image includes the reconstruction of the image from the degraded image. Artificially blurred copies of the original sharp target images registered for identification. Now most of the de-blurring methods observe image as the de-convolution of the sharp images with the blur kernel. Learning prior information derived from a training set of blurred faces to make the problem more tractable [2].

2. Literature Survey

The later works that had been proposed consists of only estimating of these parameters and including this in the filters but not at all used for the face recognition system. Motion blur occurs due to the fact that there is a movement of the object or the camera or both. Motion blur is simply an undesired effort, restoration of blur image is very important in many of the cases [3].

Image restoration improves the quality of the digital image. In order to ease restoration the blur and the noise present in the image should be balanced. PSF can be equalized to the exposure time and noise which introduces with mean and standard deviation. The image can be analyzed and restored using LPA-ICI algorithm and also restoration can be done using wavelet transform [4]. In the presence of the blur, noise and motion, how the face recognition technique will work is compared by comparing the various techniques such as PCA, FLD, SUD, DCT, DWT and WPD. From this we came to know that presence of blur, noise and motion will have adverse effect on the face recognition system so there is need of removing all these factors which will degrade the image [5]. Frame work can be done for the blurred image. Classification can be done based on the adaptive dictionary are proposed. For the given blurred image, instead of doing de-blurring the semantic category of the image is determined by the blur incentive sparse co-efficient which is calculated depending on the adaptive dictionary [6].

Understanding the type of blur is very important in the unconstrained visual analysis. This problem is addressed by the fusion of image formation models and different geometrical tools. The space spanned by blur versions of an image and then under certain assumptions provides different geometrical analysis of that space. The direct recognition of blurred faces by viewing the subspaces as a point on the Grossmann manifold [7].

The facial de-blur can also be performed using the subspace analysis then making face image ready for recognition [8]. The faces that are degraded by blur, for the recognition of those faces the main issue is to infer a point spread function (PSF) representing the process of blur on faces. The PSF from a single facial image which is an ill posed problem. This method uses the learned prior information derived from the training set of a blurred faces. The feature space which contains blurred faces degraded by the same PSF is similar to one another. There will be statistical model that uses prior knowledge of predefined PSF sets in this feature space. The input image which is blurred is compared with the each model and the closest match is selected for the PSF inference. The input image is de-blurred corresponding to that model and ready for recognition.

For the blur removing it is essential it is essential to understand the image degrading process. Degrading function may be due to improper opening and closing of shutter, atmospheric turbulence. In the blur removal process blur should be detected first. The motion blur detection contains haar wavelet transform (HWT) [8]. The fundamental principle behind haar wavelet transform approach is examining the edge sharpness level to arrive at the decision. It detects blurred face image by analyzing four steps of edges namely roof, Dirac, A-step and G-step.

The blurred face image can be recognized by using the set theoretic characterization [9]. This includes the recognition of faces from the remotely acquired face images. Blur and appearance variation are included due to illumination and pose. The set of all images obtained by blurring a given image forms convex set. Based on the set-theoretic characterization, a blur robust algorithm has been proposed whose main step includes the solving the simple convex optimization problems. If any parameter form of blur kernel is available then it can be easily incorporated in this algorithm.

3. Problem Definition

The face images which are captured while in motion causes motion blur. This blur is due to movement of a camera or object and also it includes the noise. Recognition of these persons became a huge task. There will be miss match of a person due to the present of blur and noise. The PCA which is used for face recognition will be not efficient in the present of these parameters. So, there is a need to remove the blur and noise for the face recognition.

4. Methodology

The proposed system consists of first de-noising of the image. The noise that is present may be salt and pepper noise or the Gaussian noise. The next step consists of de-blurring which includes motion blurring or due to camera shaken blur. The face image which is free from blur and noise is obtained. The face recognition is carried out by using the principle component analysis. The below figure shows the stages of the proposed system.

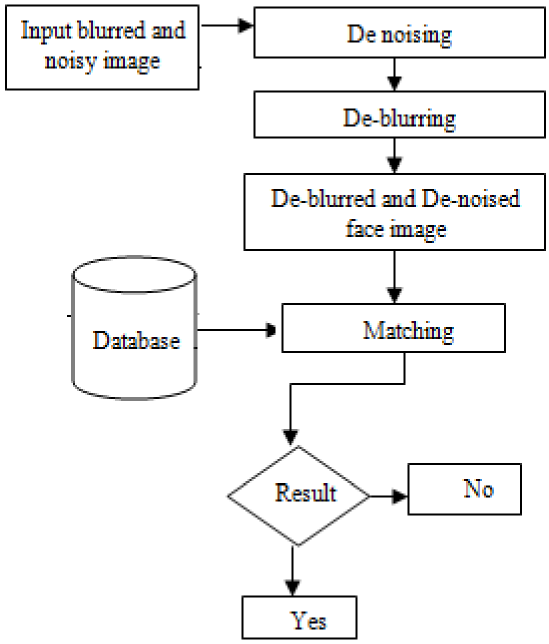


Figure 1: Block diagram of the proposed system

The input image is degraded due to blur and noise the image degradation model is given below

$g(x,y) = f(x,y) * h(x,y) + n(x,y)$

Where g(x,y) is the degraded image in spatial domain, f(x,y) is the uncorrupted original image in the spatial domain, h(x,y) is the point spread function that caused the degradation and $n(x,y)$ is the additive noise. In order to develop reliable blur detection, it is essential to understand the image degradation process.

5. Image Restoration

The image restoration has two sections image de-noising and image de-blurring. The effectiveness of any restoration algorithm depends upon the amount of blur and noise present in the image.

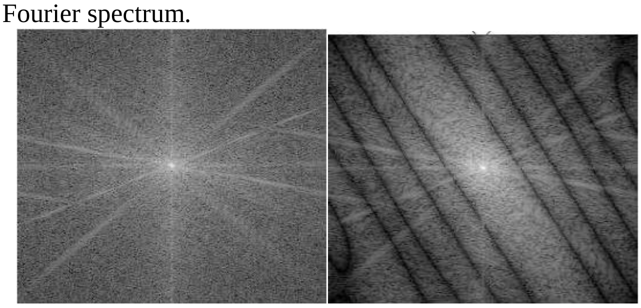
5.1 De-Noising

The noise we will deal here is salt and pepper noise and Gaussian noise which will degrade the image quality. A median filter is used which is a square matrix of odd order. It eliminates salt and pepper noise from the image resulting in a smooth output. The noise appears at the boundary pixel values only. The median filter improves PSNR quality of the image. If the salt and pepper noise present in the image contains more variance, if the image is not free from the noise by passing the median filer through the image in only one iteration, then the median filter is passed through the image two are more times for the better removal of the salt and pepper noise.

The Gaussian noise can be removed by using the wiener filter. The Wiener filtering is optimal in terms of the mean square error. In other words, it minimizes the overall mean square error in the process of inverse filtering and noise smoothing. The Wiener filtering is a linear estimation of the original image. The approach is based on a stochastic framework. It is easy to see that the Wiener filter has two separate parts, an inverse filtering part and a noise smoothing part. It not only performs the de-convolution by inverse filtering but also removes the noise with a compression operation.

5.2 De-Blurring

The de-blurring is performed by the estimation of the blur parameters such has blur angle and blur length. So, before we need to convert the image into frequency domain. By converting the image we can estimate the parameters in the Fourier spectrum.

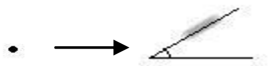


(a) **(b)**

Figure 2: (a) Fourier spectrum of image without blur. (b) Fourier spectrum of the image with motion length 10 pixel and motion orientation 30°.

5.2.1 Estimating Blur Angle

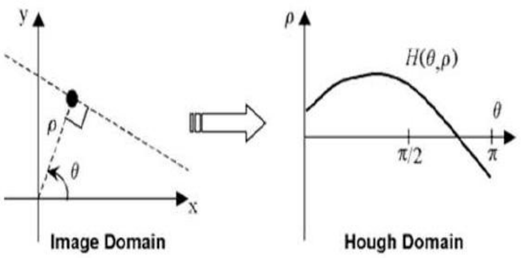
For the estimation of the direction of the variation pixel value in the blur image the image will be converted into the frequency. So, the estimation of blur angle fall in the estimation of the lines that appears in Fourier spectrum.



The hough transform is applied to find the global parameters such has lines, curves, ellipse in the image space. Lines can be easily detected in the hough transform as a represent of points in the fourier spectrum which is based on the polar representation of the lines.

$P = x\cos\theta + y\sin\theta$

Where (x,y) are Cartesian co-ordinates, θ is the angle between perpendicular and the origin, *p* is the length of perpendicular.



Algorithm: Estimate motion blur angle.

1. Convert RGB image into grayscale image.
2. Perform median filtering over the image.
3. Compute Fourier transform F (u,v) of the image.
4. Compute log spectrum of F (u,v).
5. Compute inverse Fourier transform of log spectrum.
6. Compute edge map of cepstral.
7. α min and α max be the minimum and maximum values in the motion blur angle.
8. Initialize the accumulator array A(r,α) to zero.
9. Repeat for each edge point (xi, yi) Repeat for α = αmin to αmax

{ r = xi cos α + yi sin α

A(r,α) = A(r,α) + 1

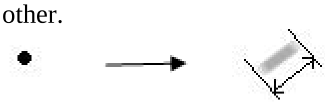
α = α +1

}

10. Find the peak in the accumulator array which is perpendicular to the origin forms the motion blur angle.

5.2.2 Estimate Blur Length

The image obtained in the Fourier spectrum consists of the dark lines. The distance between these dark lines form the blur length of a pixel. When the motion length increases the parallel dark lines in the Fourier spectrum get nearer to each other.



Algorithm: Estimate motion blur length.

1. Convert RGB image into grayscale image.
2. Perform median filtering over the image.
3. Compute Fourier transform F (u,v) of the image.
4. Compute log spectrum of F (u,v).
5. Compute inverse Fourier transform of log spectrum.
6. Rotate the Cepstral by the estimated angle in the inverse direction.
7. Convert 2-D matrix to 1-D matrix by taking the average of the columns.
8. Rotate the Cepstral by the estimated angle in the inverse direction.

4.2.3 Lucy-Richardson technique

The blur length and blur length which is calculated is used in the proper filter. Lucy-Richardson filter is used here.

$$C_i = \sum_j p(i,j)u_i$$

Where p(i,j) forms the PSF estimation of a blurred image and ui is the pixel value at location i in the blurred image.

Lucy–Richardson de-convolution is an iterative procedure for recovering a latent image that has been blurred by a known point spread function. It takes the blurred input image, blur angle, blur length, number of iterations as input and gives the de-blurred image as output. Non-point sources are effectively the sum of many individual point sources, and pixels in an observed image can be represented in terms of the point spread function.

The point spread function is estimated for the motion blur using blur angle and blur length. Convert the obtained point spread function to optical transfer function of desired size. The estimate is first initialized to the blurred image. Then the estimate is converted into the frequency domain. The optical transfer function is multiplied with the estimate in the frequency domain. Ratio of blurred image and estimate of the de-blurred image is calculated. The correction vector is calculated by multiplying the optical transfer function with the ratio which is converted in the frequency domain.

Multiplying correction vector & estimate to find next estimate to get the de-blurred image. The good estimated image is obtained by increasing the number of iterations since it is a iterative approach. The number of iterations to get a good restored image is 100 which are known by the surveying for the number of images.

6. Face Recognition

"Face Recognition" generally involves two stages:

1. Face Detection: where a photo is searched to find any face, then image processing cleans up the facial image for easier recognition.
2. Face recognition: where that detected and processed face is compared to a database of known faces, to decide who that person

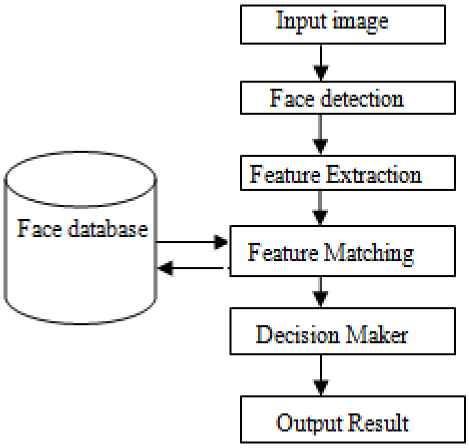


Figure 3: Face recognition system

PCA has been extensively employed for face recognition algorithms. It not only reduces the dimensionality of the image, but also retains some of the variations in the image data. Face image onto a feature space that spans the significant variations. The significant features are known as eigenvectors (principle component) of the set of faces they do not necessarily correspond to the features such as eyes, ears and noses. So to recognize a particular face it is necessary only to compare these weights to those individuals.

7. Results and Discussion

The input image is selected which is having both blur and noise in the single image.

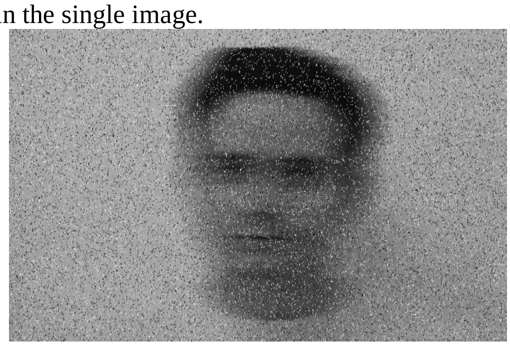


Figure 4: Input blurred and noise image

The above figure shows the input image which contains blur and noise in the image.

Figure 5: De-noised image

The image which is free from noise. This will help in the better removal of blur from the image.

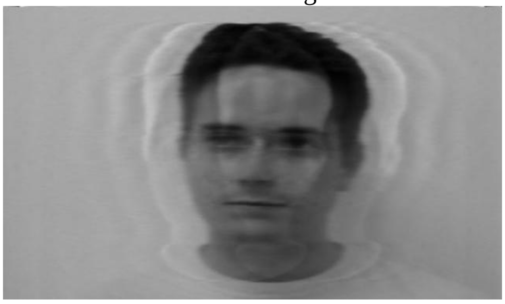


Figure 6: The estimated blur angle=10, blur length=46

The blur angle and blur length will be estimated for the blurred image. Later incorporating these parameters on Lucy Richardson the blur can be removed efficiently.

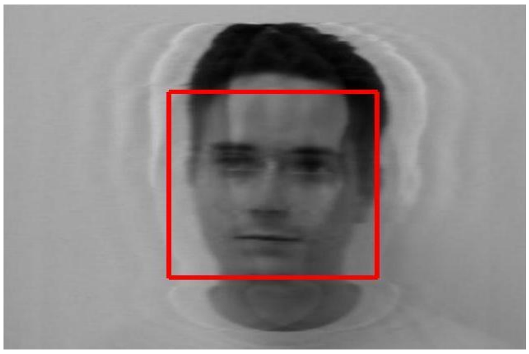


Figure7: The detected face part

The face detection consists of first the detecting the face in the frame. It makes the efficient face recognition cropping the face that has been detected makes the better recognition of a person.

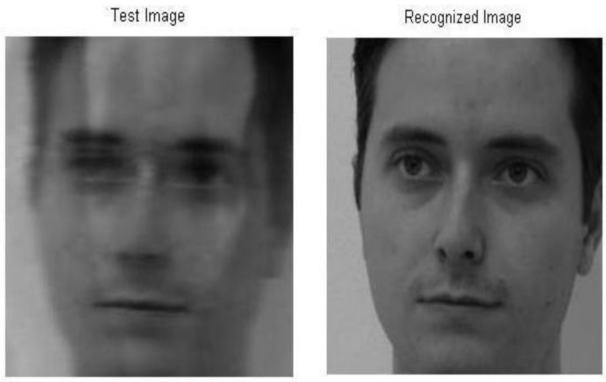


Figure8: Input face image and recognized face image

The experimental results show the distinct advantage over the principle component analysis method which is used directly for the blurred and noisy face image recognition. Here blur and noise will be not removed the PCA is directly used for the face image recognition. By removing noise over the image and by estimating blur angle, blur length and incorporating these parameters in the Lucy Richardson filter will remove the blur efficiently. Now by applying PCA to the resultant image shows the distinct advantage over the traditional method of applying PCA directly to the blurred and noisy image.

8. Conclusion

The line orientation is estimated properly in the frequency domain. The good estimation of the direction of variation of pixel and length of variation of pixel can remove the blur efficiently and also by extracting the features will provide the better results over all the traditional methods.

9. Future Scope

The future work includes using random transform for the estimation of line orientation. By using this we can estimate the blur angle and blur length efficiently which increases the efficiency of face recognition system. And also the random transform method has its own advantage over the Hough transform. By extracting more features for face recognition in principle component analysis the efficiency of the face recognition can be increased.

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