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Face Recognition Utilizing Motion Blur, Illumination and Pose

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Abstract: **The existing face recognition techniques cannot deal with non-uniform blurring conditions which arise from tilts and rotations in cameras. Different factors such as exposure time, stability of the platform and user experience affects the degree of blurring. In this paper a method is proposed for face recognition across motion blur, variations in illumination and pose. Images of different persons are collected and stored in the gallery. The probe set is formed using the set of above images with different blur, illumination and pose. One image among the probe set is selected and its blur is estimated using hessian matrix. A threshold value for blur is fixed. If amount of blur is greater than threshold then the estimated blur is applied to the entire gallery. The LBP (local binary pattern) features of the blurred gallery images and the given probe image is extracted and the distance between them is calculated. The gallery face which gives the minimum distance is recognised as the probe face. If the blur is less than the threshold, gaussian filter is applied to the probe image and DCT is calculated. The 3/4th of the probe image as well as all the gallery images are cropped. The HOG of LBP is found out from the cropped probe image. DCT (Discrete Cosine Transform) and HOG (Histogram of Gaussian) of LBP forms the extracted feature set. PCA (Principal Component Analysis) is used to reduce the dimension of the feature set. The feature so obtained is compared with the RDF model of all the gallery images and thus the correct user is found out.**

Index Terms: **Blur estimation, face recognition, illumination, LBP, motion blur, pose**

I. INTRODUCTION

Face recognition software's are used for recognizing persons from images. This could be a difficult task when several factors such as motion blur, changes in illumination, pose etc are considered. Hence it is relevant to develop an efficient system as the existing methods cannot handle it well. The focus of this paper is to develop software that can identify faces across motion blur, changes in illumination and pose.

Nowadays usage of mobile cameras has become an essential part in modern life. The clarity of the images get deteriorated due to factors such as camera shakes, blur etc. The condition gets worse when changes in illumination and pose also affect the images. The blurring or degradation of an image can be caused by many factors such as movement during the image capture process by the camera or when long exposure times are used by the subject, out – of – focus optics, use a wide – angle lens, atmospheric turbulence or a short exposure time which reduces the number of photons captured, scattered light distortion in confocal microscopy. The different types of blur include motion blur, atmospheric turbulence, Gaussian blur, Bokeh etc. There are several different techniques such as front illumination or back lighting, direct or diffuse illumination, bright- field or dark-field illumination.

In order to recognize faces, the spaces between important points of the face were used earlier. For example, the distance between the eyes or measuring different angles of facial features. Face recognition is not an easy task but due to its interesting topics, many researches are being carried out in that field. The most popular methods used for face recognition are:

A. Holistic Matching Methods
B. Feature-based(structural) Methods

A. Holistic Matching Methods:

In holistic method the full face is taken as input data. Some of the popular examples of holistic methods are Eigen faces, principal component analysis, linear discriminant analysis and independent component analysis etc.

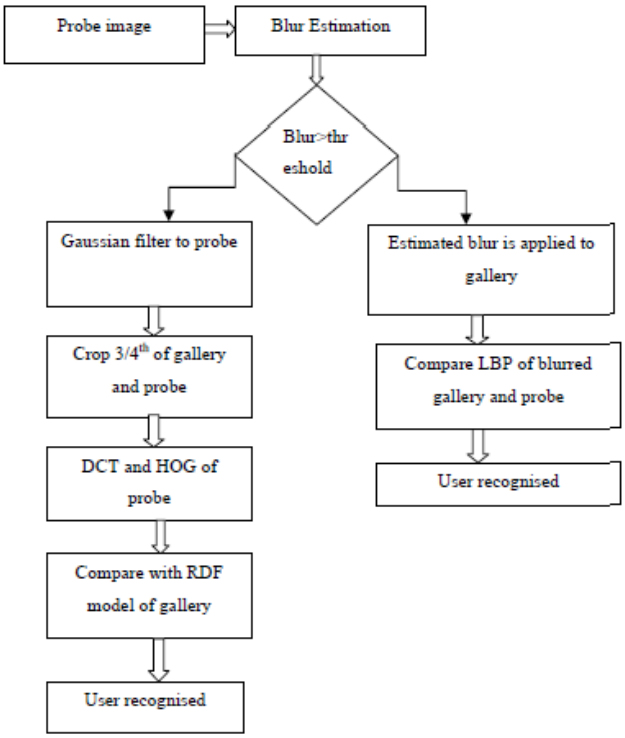

Fig.1. Face Recognition Strategy

B. Feature- based (structural) Methods:

This method is based on the local features of the face such as eyes, nose and mouth. At first the locations of these features are captured and then the information is fed into a structural classifier. A big disadvantage for feature extraction is feature restoring the facial features which are not clear and

Distinguishable, for e.g. while comparing a frontal image with a profile image, head pose is a challenge.

In convolution method, an ortho normal basis function of a renown maximum size is convoluted with an image to create a subspace. The subspaces which are obtained from a clean image and its own corresponding blurred image are same under the ideal case i.e. zero noise. It can also be proved based on some assumptions of the blur kernel properties.

II. LOCAL BINARY PATTERN

It is an efficient operator which is very efficient. It labels the image pixels by applying a threshold to the neighbouring pixels and the result is considered as a binary number. The discriminative power and computational simplicity of LBP has made it a popular approach in many applications. LBP approach unifies the structural and the traditionally divergent statistical models of texture analysis. The real world applications of LBP are due to its important property like robustness to monotonic grey-scale changes due to variations in illumination. Its computational simplicity property is responsible for analyzing images in challenging real-time approach. The LBP feature vector is extracted using the following steps:

The examined window is divided into cells (for example, the number of pixels for each cell is 16x16).

The pixel value is compared to each of its eight neighbours (on its left-middle, left- bottom, right-top, and left-top). The pixels are followed along a circle, i.e. clockwise or anti-clockwise.

- "0" is written for the pixel which is having value greater than the central pixel. "1"is written for the rest of the pixels. An 8-digit binary number is obtained. This binary number is usually converted into decimal form for convenience.
- The histogram is computed over the cell considering the frequency of occurrence of each number. (i.e., each pixel combination which are smaller and those which are larger than the central pixel). A 256-dimensional feature vector represents this histogram.
- Normalize the histogram optionally.
- The histograms of all cells are then normalized (concatenated).Thus a feature vector for the entire window is obtained.
- Now the images can be classified by processing the feature vector and is used for texture analysis and face recognition. In this paper LBP features of all the gallery images and the given probe image is calculated and compared.

III. BLUR ESTIMATION

The blur kernel from the blurred image is calculated with the help of hessian matrix. It is done with the help of convolution and singular value decomposition. The amount of blur in each probe image is also calculated.

IV. BLUR

Blurring is a process in which an ideal image's bandwidth is reduced resulting in the formation of an imperfect image. In image analysis applications which include face recognition, number plate detection etc, it poses an important problem. The two types of blur used for the implementation of this project are.

A. Motion Blur

In a sequence of images such as movie or in a still image, there may occur an apparent streaming of rapidly moving objects. This causes motion blur. It occurs when the exposure of a single image causes changes in the image being recorded due to rapid movement or long exposure.

B. Gaussian Blur

In image processing Gaussian blur occurs when the image is blurred using a Gaussian function. Convolution of an image with a Gaussian function is similar to the application of Gaussian blur. A Gaussian blur is called as a low pass filter. It is due to the fact that the Fourier transform of a Gaussian is also a Gaussian and hence the effect of high frequency components in an image is reduced on the application of Gaussian blur.

V. ILLUMINATION AND POSE

In determining the quality of the captured images, when implementing the solution of an image processing the selection of illumination level is an important factor. It causes a large effect on the image evaluation. The most difficult task in image processing is the selection of best light source for applications but is often neglected due to detriment of the overall system. The evaluation is also affected by the angle of incidence of light on the object. . Here the light source is kept at different portions of the image and thus images with varying illumination are obtained. Also the probe set contains images of persons with different poses which include various facial expressions, pupil positions etc.

VI. RESULT AND DISCUSSION

A gallery is obtained by storing the images of different persons. Using the set of above images with different blur, illumination and pose a probe set is created. A probe image is selected and by using hessian matrix, its blur is estimated. A threshold value is fixed for blur. If the value is greater than threshold then the estimated blur is applied to the entire gallery. The LBP features of the blurred gallery images and the given probe image is extracted and the distance between them is calculated. The gallery face which gives the minimum distance is recognised as the probe. Else the probe image is applied with gaussian and its DCT is calculated. The 3/4th of the probe image as well as all the gallery images are cropped. From the cropped probe image the LBP features and the HOG of LBP is found out. DCT and HOG of LBP forms the extracted feature set. The feature so obtained is compared with the RDF model of all the gallery images and thus the correct user is found out.

Fig.2. Gallery images

Fig.3. A part of blurred probe image set

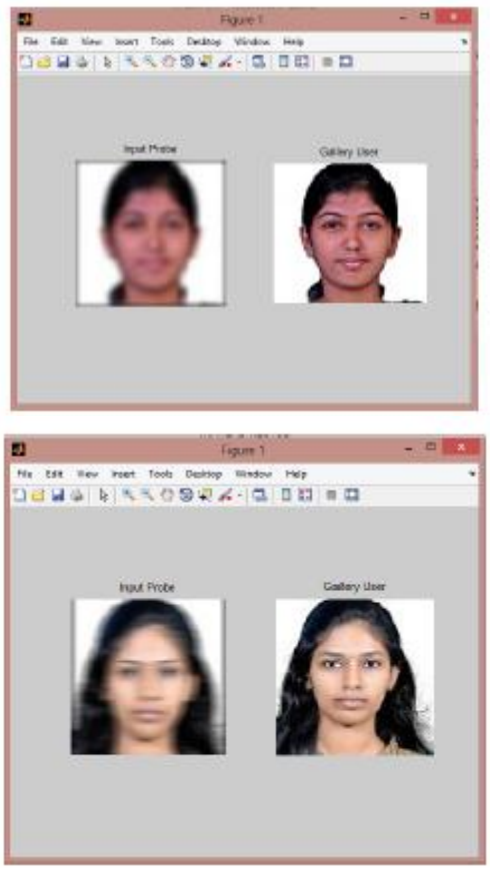

Fig.4. Identification of the blurred image with the corresponding gallery user

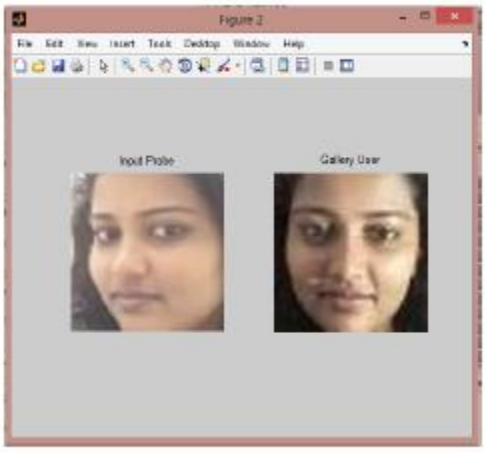

Fig.5. Identification of the image with varying pose and illumination to the corresponding gallery user

VII. SOFTWARE

The software used for implementing this project is Matlab. Matlab is a technical computing environment for high performance numeric computation and visualisation. Matlab integrates numeric analysis, matrix computation, signal processing and graphics into an easy to use environment where problems and solutions are expressed just as they are written mathematically without traditional programming. Here we use Matlab 2013 version for using some advanced features of image processing.

VIII. CONCLUSION

We proved a method to perform face recognition utilizing the effects of motion blur, illumination and pose. We estimated the blur from the given probe image and a threshold value is set. The correct gallery user is identified by using DCT, HOG, RDF model and LBP features. Here the dimension of the feature set is reduced by using PCA. Large changes in facial expressions and pose cannot be handled.

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