

Blurred Image Enhancement Using Contrast Stretching, Local Edge Detection and Blind Deconvolution

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Abstract

Blurring of image is common problem while taking picture of an object in motion or due to shooting situations. Various methods have been proposed to enhance the blurred image. Here contrast stretching is used for obtaining deblurred image. In the proposed method local edge detection is applied on original as well as contrast stretched image. The set of edges obtained from both the images are fused in order to get sharper edges. The original image and contrast stretched image is converted into gray scale image from RGB image before applying local edge detection to avoid detection of false edges. Since image distortion information is unknown, so on the obtained fused image blind deconvolution is applied to get deblurred image.

Keywords: Blur image enhancemen; local edge detection;contrast stretching; image fusion.

1. Introduction

Edge detection is one of the common tools for feature detection and feature extraction of an image (Marr et al, 1980; Martin et al, 2004; Papari et al, 2011). It is a process of identifying the point in the digital image so that it can be modified in more sharp output. It has a wide application in the field of image retrieval (Moreno et al, 2009), object recognition (Olson, 1997) and object tracking (Sullivan, 2002). Theoretically the output of an ideal edge detection algorithm is an object boundary having continuous contours. It is very difficult to detect object boundary which become more complex if image is noisy or blurry (Umgaugh, 2005).

Blurring of image is degradation which can occur in many situations due to unavoidable image conditions (Banham et al, 1997; Gonzalez, 1992; Tikhonov, 1977). The degradation model can be expressed as

$$G(x, y) = n(F(x, y) * H(x, y)) \quad (1)$$

Where * denotes the two dimensional convolution. "n" is the impulse noise. F(x,y) and G(x,y) are original and degraded image respectively. H(x,y) is point spread function (PSF). In matrix form equation 1 is represented as

$$G=n(hF) \quad (2)$$

Here h is degradation matrix originated from H(x,y) and is in BCCB(Block circulation with construction) form. G and H are represented in lexicographical order.

Image deblurring is a deconvolution problem with convolution kernel. Here degradation function is assumed to be known. There are many techniques like Lucy Reichardson deconvolution and Wiener filtering which are used for restoring the image. It is an inverse problem and ill posed because of blur image nature h.

For enhancing the blur image mostly indirect methods have been studied. But if direct method like edge detection is used then the results can be significantly improved as well as method of enhancement will be simpler (Tong, 2004).

Here the proposed method is focused on edge detection at stretched contrast levels and finally doing the fusion of all the detected edges in order to get maximum possible edge, followed by enhancement of blur image using those edges.

2. Related Works

TONG et al (2004) have used edge to detect the blurring for the image taken by digital camera using Harr wavelet transformation. Here enhancement is done through sharpening using edge. Edge is also used by Marziliano (2002) for measuring extent of blurring. Chung et al (2004) have used standard deviation of gradient magnitude is used along edge direction for blur measure.. Rupali and Sangeeta (2011) have used Canny edge detection for restoration of blurred image. Tico (2009) have proposed an image enhancement algorithm using fusion of two images. This method can deal with blur from object as well as camera motion. Tang et al (1994) proposed an enhancement method for image for which noise information is unavailable. Instead of PSF, statistical and multidirectional approach is applied for enhancement. Wang et al (2010) have used non-linear method for improving quality of blurred image. Here opportunity cost is used for simulation and identification of suitable enhancement parameter.

3. Proposed Method

In order to get de-blurred image, the proposed method is first normalized the blurred using contrast stretching. Then obtained image and original image are converted into gray scale. Local edge detection is applied on both images to get maximum edges. The set of edges obtained from these two images are merged into one by taking intersection. On the obtained image blind convolution is applied to get the de-blurred image.

3.1 Algorithm

- a. Perform contrast stretching on pixel P of image using function

$$P_{out}=(P_{in-c})((b-a)/(d-c))+a \quad (3)$$

Where P_{in} is original pixel, c and d are original lowest and highest pixel intensity value respectively, a and b are specified lowest and highest pixel intensity value.

- b. Convert pixels of original and contrast stretched image to gray scale using following equation on each image

$$Gray = (Red + Green + Blue) / 3 \quad (4)$$

- c. Apply local edge detection on both images to find all possible edges.
 d. Take fusion of set of edges obtained from these two images.
 e. Apply blind deconvolution to get de-blurred image.



Fig. 1: Original Blurred Image



Fig. 2: Contrast stretched Image.

3.1 Contrast Stretching

Contrast stretching is a simple image enhancement technique that changes the range of pixel intensity values. The purpose of this method is to bring the pixel intensity into desired range. For contrast stretching a new upper and lower pixel value is needed to be specified over which image is to be normalized. Generally they are the maximum and minimum pixel values that image type allows. This is the first step of proposed method. Equation 3 explains the method of contrast stretching. Figure 2. Shows the contrast stretched version of Fig. 1.

3.2 Gray Scale conversion

A grayscale image is an image which contains only intensity value. Here in order to convert the image into gray scale average of red, green and blue component is taken. Equation 4 describes the conversion of RGB pixel into grayscale pixel. Fig. 3 and Fig. 4 are the grayscale version of original and contrast stretched image respectively.



Fig. 3: Grayscale of original Image **Fig. 4:** Grayscale of contrast stretched image.

3.3 Local Edge detection

For detecting edges neighboring eight pixel intensity is being considered. This method is applied on both grayscale images so that all possible edges could be identified. Fig. 5 and Fig. 6 shows edges for Fig. 3 and Fig. 4 respectively.



Fig. 5: Local edge detection on original image



Fig. 6: Local edge detection on contrast stretched image

3.4 Fusion of images

In order to get only true edges, fusion of edges for contrast stretched and original image is taken. The resultant image containing only true edges is shown in Fig. 7.



Fig. 7: Fusion of edges from two image



Fig. 8: Enhanced Image.

3.5 Blind deconvolution

Using blind deconvolution it is possible to get the deblurred image without knowing the degradation filter. Even additive noise and PSF are also not required to get the enhanced image. Fig. 8 is the final enhanced image obtained by applying the proposed method.

4. Conclusion

The proposed work is a very efficient way of enhancement of blurred image. The fusion of set of edges for original and contrast stretched image have shown an efficient way of finding true edges. It also shows importance of contrast in edge detection. It is clear that at different level of contrast the set of edges identified by local edge detection is different. The blind deconvolution method used here does not require any previous information regarding noise to enhance the image. Even the information like degradation filter, additive noise and PSF are not required. For future work, the RGB component level optimization can be done while removing the blurriness of the image.

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