Motion blur remover using total variation constrained least squares method with user configurable PSF and blind PSF estimation

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Abstract— **removal of blur from the blurred images, which is commonly preliminary step for de-blurring process, has become one of the most growing research areas of these days. Now days scholars have proposed new methods or improved blur detection algorithms which are based on blind de-convolution, point spread function (PSF) and many more. Motion blur retains some information about motion, based on which motion may be recovered from blurred images. This is a difficult problem, as the situations of motion blur can be quite complicated, such as they may be space variant, nonlinear, and local. A motion blur is characterized by its point spread function (PSF) whose parameters are closely related to the motion. The simplest motion blur is the space-invariant linear motion blur, which has been studied extensively. In practice, however, as motion can be quite complex, motion blurs can be much more complicated than this simple case. For example, the blur can be space-variant, nonlinear, local and multiple. The purpose of this paper is to extend the work area of already work done.**

Index Terms— **Blur detection, blind de-convolution,point spread function.**

I. INTRODUCTION

De-blurring from a single image has been an ill-posed and challenging problem due to the large number of unknowns in the estimation process. The unknowns are the type of blur, the extent of blur and the noise, which degrade the image further. A great amount of literature exist on the subject motion blur remover, this technique is discussed regularly in the various conferences and publications on computer science. In addition to this a growing number of special issues and conferences are dedicated to remove the blur from the images which are taken and slightly blurred due to camera shake or low light condition of a scene. The articles are selected for this issue present new approaches and ideas for the detection of blur. Blur is the degradation of sharpness and contrast of an image which cause loss of high frequency [1]. For the de-blurring process we generally apply some algorithm which estimate the blur and then recover the image into its possible and probable condition. Several methods are used to recover the blur from the image and some method are used which are sometimes hard-coded and sometime user configurable. In which we use a function called point spread function (PSF).

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blurs can be much more complicated than this simple case. For example, the blur can be space-variant, nonlinear, local and multiple.

We can remove blur by applying these approaches:

(i) At first we have to estimate that how the image is blurred (the blur kernel or the point spread function)
(ii) After it we have to restore the natural looking image by using de-convolution.

Blur detection method can be applied as initial stage for de-blurring when the machine vision of manufacturing line is out of focus or due to rapid movement of the inspected product. Some of the restrictions are there in the blur detection technique that's why many researchers research so many algorithms to detect more blur from the image [2]. Some of them are belongs to variant methods, point spread functions and de-convolution methods. Based on analysis on the past researches on the blur detection methods, blur detection can be classified in to some categories, which are:
i) De-blurring using Gaussian method
ii) De-blurring using blind de-convolution method
iii) Using motion de-blurring method

For linear and shift-invariant motion-blurring, the blurred image g(x, y) may be written as the convolution of the scene f(x, y) and the point spread function (PSF) h(x, y):

$$g(x, y) = \iint_{-\infty}^{\infty} f(\xi, \eta) h(x - \xi, y - \eta)\, d\xi\, d\eta + n(x, y),$$
(1)

where n (x, y) represents additive noise. A Fourier trans- form of Eq. (1) gives

$$G(u, v) = F(u, v)H(u, v) + N(u, v), \qquad \textbf{(2)}$$

where G(u, v), F(u, v), H(u, v), and N(u, v) are respectively the transforms of g(x, y), f(x, y), h(x, y), and n(x, y). When the noise term is negligible, a restoration of f(x, y) may be obtained by an inverse transform of G(u, v)/H(u, v). This restoration technique is often called the inverse filter.

II. RELATED WORK

Restoration of blurred images is a vital problem especially in tracking and identification of criminals. The available image can be used to identify a human face or a moving vehicle's number plate taken in hit and run situation or in a bomb blast site. To restore a blurred image successfully, blurring function needs to be estimated accurately. Blurring function is referred to as Point Spread Function (PSF) which is the

response of an imaging system to a point source or it can be said as the impulse response of a focused optical system [1]. Existing system used a single hardcoded method to de-blur a natural image. Technologies used in this method are more common but the mathematical approaches are sometimes changed with some more configurations. Technologies which are used in exiting system are motion blue remover, Gaussian blur remover and blind estimation PSF. Along with these techniques only a single technique is used which is generally hard coded and not permitted to change by user.

2.1 Challenges:

The major challenge in de-blurring a natural image is the determination of the unknown parameters like type of blur, extend of blur (PSF) and the approximation of noise. The number of unknowns is more than the number of known parameters making the problem ill posed. Even minor reduction in accuracies in PSF estimation leads to degradation of image quality while de-blurring.

III. METHODOLOGY

Blind single-image de-blurring is a method used to restore a sharp image from an image blurred by camera shakes or object motion under low light conditions. Generally blur occurred due to motion or low light conditions. To solve this problem many researchers do necessary researches and work using blurred images and its mathematic approaches. From the various challenges of photography, one is motion blur. Blur problems are generated from relative motion between a camera and a picture during exposure. While blur can be reduced by using a shorter exposure, this comes at an unavoidable trade-off with increased noise. So blur can be removed computationally. This is the main motive of this research. Now the question is that how to remove blur.

We can remove blur by applying these approaches:
(i) At first we have to estimate that how the image is blurred (the blur kernel or the point spread function)
(ii) After it we have to restore the natural looking image by using de-convolution.

In the complete procedure of this de-blurring the main challenge is to estimate the exact figure of natural blurred images. Another difficulty is that algorithm needs to distinguish the correct image–blur pair from incorrect ones that can also adequately explain the blurred image. De-convolution is also difficult because the algorithm needs to restore high frequency image contents attenuated by blur. In this dissertation, we address a few aspects of these challenges.

3.1 Motion blur remover using Gaussian filter:

To remove blur a technique is used in which a filter is used which is named as Gaussian filter. In this we require the size of this filter in numeric form and a standard deviation sigma value with which a mathematical calculation is done. To remove the blur from an image we use this technique according to which if there is any movement in the filter size of any image then this Gaussian filter will work.

3.2 Motion blur remover using motion de-blurring method:

To remove blur a technique is used in which horizontal length and an angle theta is used at which the image is moved. Motion blur retains some information about motion, based on which motion may be recovered from blurred images. This is a difficult problem, as the situations of motion blur can be quite complicated, such as they may be space- variant, nonlinear, and local.

3.3 Motion Blur remover using blind Point Spread Function:

This is the technique in which blur is removed using a PSF which is a function in which a point spread function size is described and with the use of this size de-blurring is done. It's a unique approach for removing the blur in which we define a function named point spread function. In which a function describes the imaging system to a point source or a point object. So with the help of this PSF motion blur can be removed.

IV. PROPOSED WORK

This paper work started with the approach of estimating the blur parameters using the algorithms discussed below. The algorithm aims at determining the Blur parameters such as length of blur in pixels and the angle of blur in degrees. This algorithm used for estimating the blur parameters, de-blurring of the image using the estimated parameters, its limitations and the proposed Efficient De-blurring Algorithm for natural images.
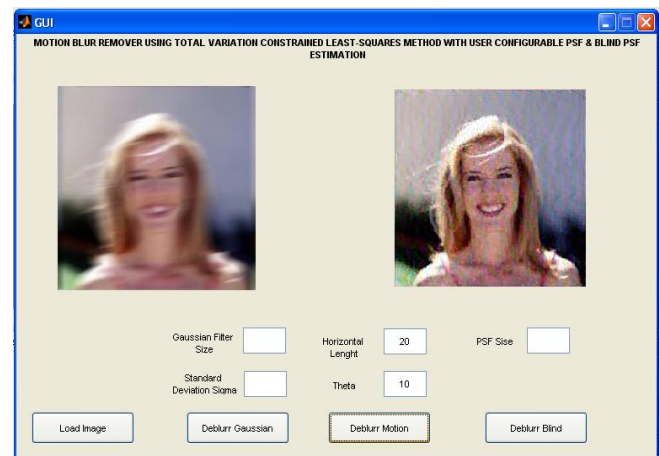
V. RESULTS

Fig: 1 A restoration obtained with measures of de-blurring using motion constraints.

According to these results we deduce that when restoring a real-world motion-blurred image, some exploratory restorations may be carried out using assumed-PSFs, in order to determine the shape and blur extent of the true- PSF, guided by the characteristics of the exploratory restorations obtained. The estimated true-PSF may then be used for the final restoration. On the basis of the results of the

On the basis of the above observations, we propose the following strategy for the exploratory restoration of images which have been motion-blurred with an unknown PSF:

1. Use a forward-ramp for the first trial restoration.
2. If the restoration from (1) shows a smeared-out scene terminated in a strong, clear ghost, use a reverse- ramp for a second trial restoration.
3. If the restoration from (1) or (2) shows a ghost, we may assume a square-pulse or trapezoid true-PSF. Mea- sure the displacement of the ghost from the true scene to obtain the blur extent of the true-PSF. Using a square pulse with this estimated blur extent, another restoration is carried out.
4. If the restoration from (3) shows ringing, try a trape- zoid PSF with the same estimated blur extent. Use a forward- or a reverse-trapezoid PSF depending on whether a forward- or a reverse-ramp was found more appropriate in steps (1) and (2).For more demanding applications, we may use the above procedure to establish the overall structure of the true-PSF and then experiment with fine variations in PSF shapes to obtain a really high quality restoration. An advantage of the above procedure is that the true-PSFs may be determined to reasonable accuracy even if they are not spatially invariant.
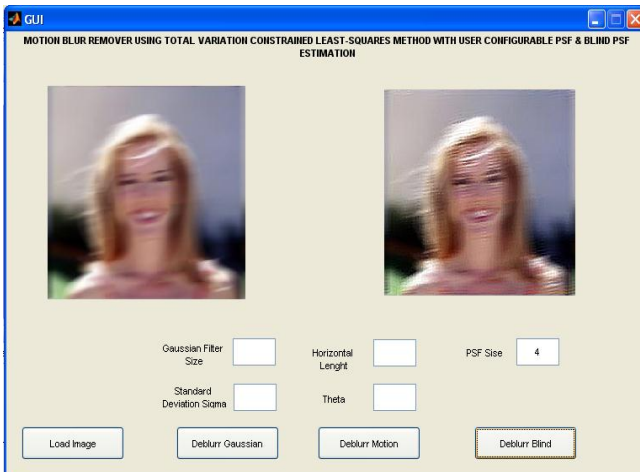

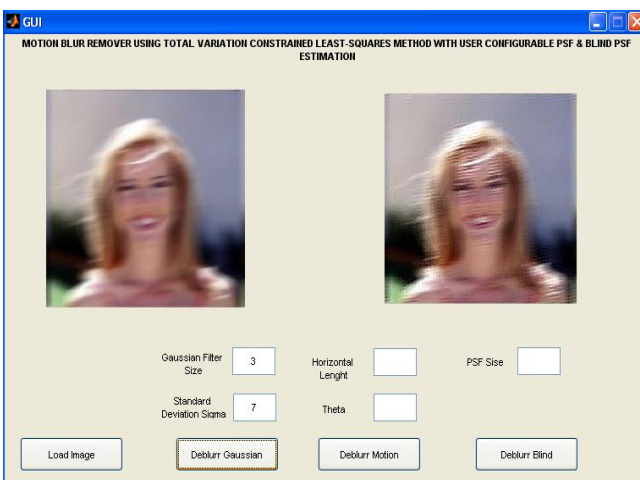Fig: 2 a restoration obtained with measures of de-blurring using the size of PSF Measure

Fig: 3 A Restoration obtained with measures of de-blurring using the Gaussian de-blurring process.

5.1 SOME REAL-WORLD MOTION-BLURRED IMAGES RESTORED:

In this section we apply the restoration procedure to the major three techniques of de-blurring. Blurring was caused by panning the camera when the shutter was being released. The images were digitized with a monochrome video camera with back illumination.

Fig: 4 A motion-blurred photographs taken by panning the camera.

In Fig. 4, the text is badly blurred, but the holes and pins are clearly visible. Figure 5 show the image restored using motion de-blurred process. Pin numbers and texts are clearly visible.
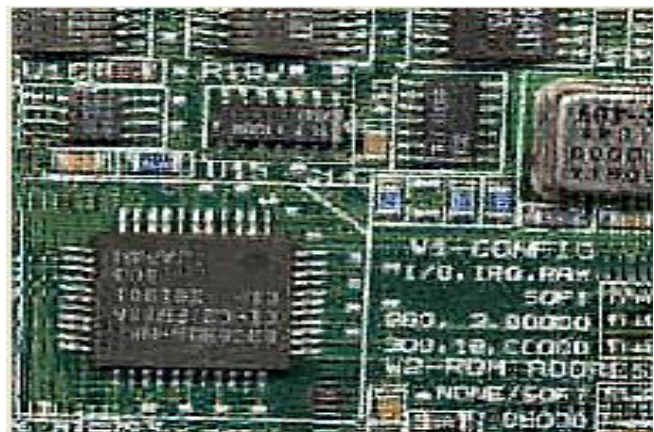

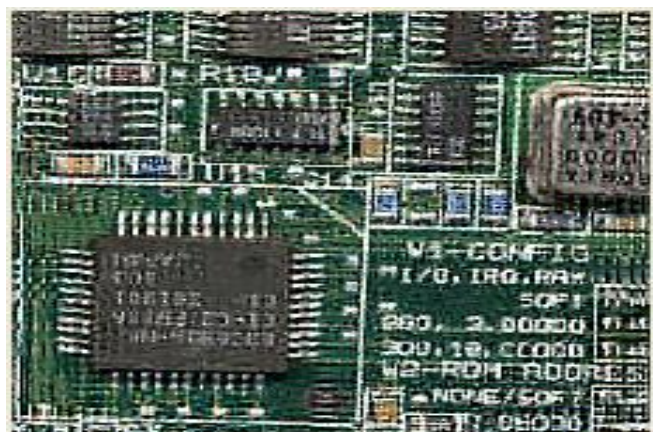Fig: 5 restored image with motion de-blurring process.

Fig: 6 de- blurred photograph of motion blurred photograph taken by camera.

VI.   SUMMARY AND CONCLUSION

A.   Summary

When we took a picture sometimes it shakes due to some motion or low light. Due to this blurring of image occurs. To address this problem, some researches do their efficient work on de-blurring dynamic scenes and prepare an approach that commonly requires accurate motion segmentation. To explore the existing system's approach we differentiate it with the previously done work and the new approach which we are doing. Till yet the de-blurring is done by applying several methods of de-blurring but single approach in single time. We are applying a hardcoded system according to which user can configure the approach for de-blurring.

Estimating the PSF of a real-world motion-blurred image is an essential step in the restoration process. This paper addresses the problem of blind motion de-convolution without assuming that the entire image undergone the same blur. In this we apply the procedure of de-blurring with several techniques. We apply the

B.   Conclusion:

The research includes several concepts of image processing and tools of MATLAB to de-blur the blurred image which is blurred by camera shake. In this research many techniques of de-blurring is used which can be of many procedures. The operated system works in a very fine way and work on the estimation of PSF which is point spread function. Our approach takes advantage of both images to produce a high quality reconstructed image. By formulating the image de-blurring problem using two images, we have developed an iterative de-convolution algorithm which can estimate a very good initial kernel and significantly reduce de-convolution artifacts. No special hardware is required.

ACKNOWLEDGMENT

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