ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 6, Issue 5, May 2019

Blur video restoration using Blind Deconvolution Method

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Abstract: Instability in the atmosphere and incompatibility camera settings leads to blurring of video. Closed circuit television [CCTV] is most commonly used for security purpose in homes, banks, hospitals, business, criminal investigation and colleges. Usually these cameras have resolution of 704x480 and 720x480. Even IR cameras are playing important role in industries these days. The IR cameras usually have a low resolution mostly 160x120 and 320x240 for technical reasons. In this case Image Processing is one of the boons for business, engineers, forensics and medical field to extract the required values from the image data. This paper introduces an effective method to deblur low resolution images. Blind Deconvolution method is applied to low resolution images. Then, restored gray images are converted into RGB images and write each RGB frame into the videoobject to make a video. The experimental results depict a high resolution video which is the sharpen form of low resolution video.

Keywords: Blind Deconvolution method, Point Spread Function (PSF), MSE, PSNR, Lucy-Richardson algorithm, Gaussian Filter.

1. INTRODUCTION

In today's modern growing technology people are growing with smart creatures. People use Smart phones and cameras to take photo in different moments and areas. Poor handling of camera, quality of lens, subject motion and lack of focus leads to blurring of video. This type of video has no significance and visually undesirable. Therefore it needs to be restored. If the video is blurring it has no scope in nature. Unknowingly captured videos may use in forensic field to detect criminals. Blur video has no worth in those fields. Scanning of internal organs in medical field has huge scope to find the hazardous. In all these case deblurred videos have their own significance. If the blur information is unknown, then Point Spread Function (PSF) needs to be calculated [1]. To get the quality image than blur image, PSF is initialised with respect to input image. PSF set iteratively until image is restored. More PSF iteration leads high quality image i.e. with less noise. Resulted image of PSF has ringing effect with noise is reduced by applying filtering techniques.

To response to this problem, we are proposing a method to deblur video. It has three steps, i.e. pre-processing, deconvolution, and restore the video. First video is read into the workspace and convert it to frames. It is followed by applying a Blind Deconvolution method to deblur each frame. To reduce the ringing effect sobel edge detection applied and filtering function used to filter the frame. Deblurred frame is converted into colour frame. Each colour frame is sharpened by using sharpening function and is writes into the video object to make a video. To know the quality of Deblurred video Mean Square error and Peak Signal Noise ratio calculated. Result of the proposed method has been compared with Lucy-Richardson deconvolution method [5] and is work efficiently. This work is developed using Matlab.

Rest of the paper organised as follow section II explains the Blur Model and Blurring of image. Some of the papers and techniques referred to implement the proposed method are list in section III. Section IV depicts the Algorithm of the proposed method. Experimental results and conclusion explain in section V and VI respectively.

II BLUR MODEL

Unknown uniform linear blur PSF is used if the blur of image is due to the motion of object. Therefore to set initial PSF blur image is produced and it is articulate as,

$$b = m * s + n \quad (1)$$

where b is the blurred image, m is the input image, * is the Convolution operator, s is the uniform blur kernel and n is the unknown noise. This Blur model is used to deblur frame in this paper.

Restoring image is based on blind deconvolution and non-blind deconvolution method. If the image is restored with single image and unknown PSF, it is blind deconvolution method. Non blind deconvolution method involves restore the image using known PSF. In this paper we used blind deconvolution method to restore the image. In this

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 6, Issue 5, May 2019

method PSF is alternatively estimated to know the optimised PSF to deblur image. Finally we deblur the image applying non-deconvolution method using optimised PSF.

III LITERATURE REVIEW

There are some non-blind and blind deconvolution exists to deblur the images. Weiner filter and Image filtering are most common used techniques, but they have their own merits and demerits. In this paper video is deblurred using Blind Deconvolution Method is efficient method compare to other methods.

Punam Patil & R.B.Wagh [3], in their paper ― "Implementation of Restoration of Blurred Image Using Blind Deconvolution Algorithm" used Blind deconvolution technique for restoring the image. They establish that Gaussian filter is the efficient method to produce a blurry image in a short period of time. The main goal of this work is to the deblur image by applying Gaussian filter which produce the high blurred image. Canny edge detection is used to remove the Gaussian noise which makes ring effect in image then Blind Deconvolution algorithm is used to deblur the image when no information about the noise and blurring is known.

Pratiba Sharma & Jitendra Kumar [2], in the paper titled "Blind Deconvolution Deblurring Technique in Image Processing" state that Advantage of using Blind Deconvolution Algorithm is to dabbler the degraded image without prior knowledge of PSF and additive noise. It is able to recover images which have suffered a wide range of degradations. The advantage of the proposed Blind Deconvolution Algorithm is to dabbler the degraded image without prior knowledge of PSF and additive noise. But in other algorithms, blurring parameter must to process the image.

Minu Poulose [7] gives information of Blind Deconvolution method in the paper "Literature Survey on Image Deblurring Techniques". He explains that blind deconvolution method simultaneously restores the point spread function and input true image (input image). This starts with initial estimation of PSF and true image and it is cylindrical in nature. Firstly we will find the PSF estimate and it is followed by image estimate. This cyclic process is repeated until a predefined convergence criterion is met. The merit of this method is that it appears robust to inaccuracies of support size and also this approach is insensitive to noise.

Dongqing Xu [8] in their paper "The Image Restoration Method Based on Image Segmentation and Multiple Feature Fusion" they consider the local correlation of natural image, uses Mean Shift clustering segmentation algorithm to separate the original input image, limits the search scope in the related texture region to find the best matching block; at the same time for finding matching algorithm of the most suitable texture block, through the analysis of image texture feature, the structure characteristics and the distance between repair block and similar block.

IV PROPOSED METHODOLOGY

Blurred video is deblurred by using blind deconvolution method. The proposed method has 3 steps. It begins with pre-processing step. Here video is read into the workspace and frames are extracted from the video. It is followed by applying blind deconvolution method to each frame in the video. Restored frame is converted into color image and sharpen using sharpen function. Finally sharpen frames writes into the video object to reconstruct deblur video.

The steps of the proposed algorithm are explained below.

A. The proposed algorithm for deblur the video

Step 1: Read the blur video as input.
Step 2: Find number of frames in a video as nframes.
Step 3: for k=1: nframes do
i. Convert k to gray scale image.
ii. Apply blind deconvolution method to k.
iii. Convert deblur image into color image.
iv. Sharpen the deblur image.
v. Write sharpen into the video object
Step 4: Display the deblurred video.

The above steps are explained below in detail.

B. Pre-processing Stage

The aim of the Image pre-processing is removal of noise and to alter the quality of the image or improve the clarity of the image to suit for the purpose [3]. Number of frames present in input video calculated using NumberOfFrames function. Properties of video like frame rate, width, height, video Format and BitsPerPixel.

The following steps are involved in the pre-processing stage.

1. RGB to Grayscale Conversion: In 'gray' color all the red, green and blue color have the similar intensity. Grayscale means image has shades of gray. RGB images need to convert into gray scale which contains grayscale values [10]. Gray images have the pixel value ranges from 0 to 255 where 0 indicates pure black color and 255 indicates pure white color and in between values represent intermediate colors.

ISSN (Online) 2394-2320

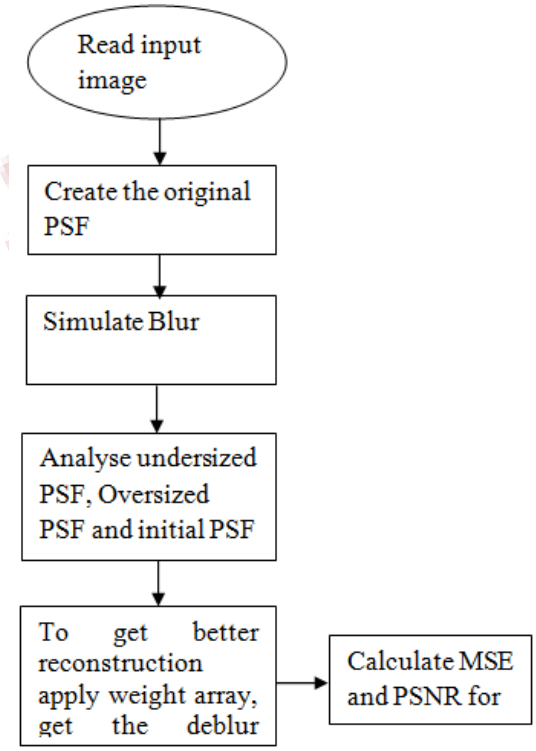
International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 6, Issue 5, May 2019

2. Noise Removal using filtering: When RGB image converted into grayscale some noise in the form of salt and pepper creeps into the image [10]. This noise removed using filtering. Thus filtering is a technique to discard the noise present within the image. During filtering pixel values are exchanges between neighbour pixels.

C. Blind Deconvolution Method

Blind deconvolution is the deconvolution without explicit knowledge of the impulse response function used in the convolution. This is usually achieved by making appropriate assumptions of the input to estimate the impulse response by analysing the output. Blind deconvolution is not solvable without making assumptions on input and impulse response. Most of the algorithms to solve this problem are based on assumption that both input and impulse response live in respective known subspaces. However, blind deconvolution remains a very challenging non-convex optimization problem even with this assumption.

The below flow diagram shows steps in Blind deconvolution method.



In image processing, blind deconvolution is a deconvolution technique that permits recovery of the target scene from a single or set of "blurred" images in the presence of a poorly determined or unknown point spread function (PSF). Regular linear and non-linear deconvolution techniques utilize a known PSF. For blind deconvolution, the PSF is estimated from the image or image set, allowing the deconvolution to be performed. Blind deconvolution can be performed iteratively, whereby each iteration improves the estimation of the PSF and the scene, or non-iteratively, where one application of the algorithm, based on exterior information, extracts the PSF. Iterative methods include maximum a posteriori estimation and expectation-maximization algorithms. A good estimate of the PSF is helpful for quicker convergence but not necessary.

Deblur image obtained from the blind deconvolution method converted into color image. To enhance the contrast of the image sharpening function used to sharpen the image. Sharpen image writes into the video object to make the deblur video. Two error metrics used to measure the quality of the deblurred video with blur video are Mean Square Error and Peak Signal Noise ratio. High PSNR value indicates image contains lees noise.

V RESULTS AND DISCUSSION

To start processing the blur video first application is run in Matlab. Blur video browse and loaded into the application. Now the loaded video is ready for processing. The below Figure 1 shows the subplot containing the loaded input video, corresponding Grayscale video and deblur video. Mean Gray Levels and PSNR graph of the blur video and deblur video is depicted in the subplot.

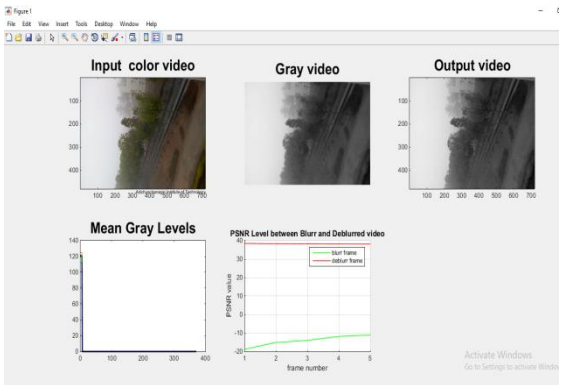


Figure 1: Input blur video (a), Grayvideo (b), Deblur video (c), Mean gray levels plot (d) and PSNR comparison graph (e).

ISSN (Online) 2394-2320

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)
Vol 6, Issue 5, May 2019

MSE and PSNR value of the blur video and deblur video is shown in below figure 2.

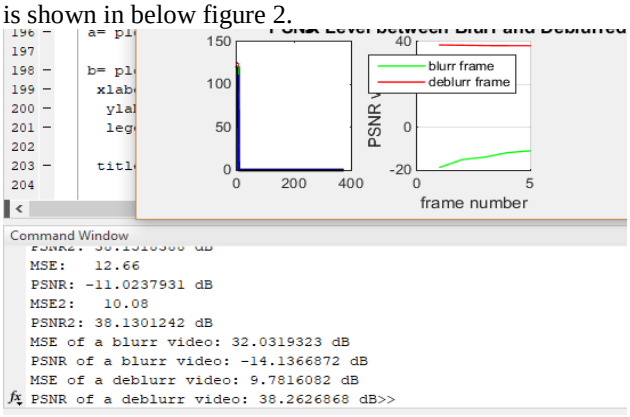


Figure 2: PSNR value of blur and deblur video.

This PSNR value shows deblurred video has less noise compare to blur video. Usually PSNR with >35dB considers image is of good quality i.e. image less degraded.

VI CONCLUSION

Restoration of blur image using Blind Deconvolution method technique used in this work. Blur video is deblurred using blind deconvolution method which is applied to each frame extracted from the input video (blur video). Deblur image converted into color video and sharpened. MSE and PSNR calculated to know the quality of the deblur video and compare with the PSNR of the blur video. It shows that MSE is minimum and PSNR is maximum for the deblur video as desired condition. In future quality of the video can be improved more by applying new filtering techniques.

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