Image Deblurring By Using Blind Deconvolution Method

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Abstract— Motion blur is the amount of noise between the original image and the acquired image. Blurring of image occurs due to misfocus of camera lens or atmospheric turbulence and it degrades the quality of image to increase its sharpness, we are using image deblurring by using blind deconvolution method and PSF is used here to increase the sharpness of the image.

Key words: Image Restoration, Convolution, Deconvolution, PSF (Point Spread Function), Blind Deconvolution

I. INTRODUCTION

In image in science, image processing is any form of signal processing for which the input as an image and the output may be either an image or set of characteristics or parameters related to the image. Sometimes, the image may be corrupted. Such degradations may be either due to motion blur, noise or cameramis-focus .So a classical research area called image restoration came into existence. This refer to operation of taking a corrupted image and estimating a clean original image by removing distortions. Some of the methods involved are usage of Inverse Filters, Wiener Filters, Iterative Filters and Blind Deconvolution. The technique being implemented here is Blind Deconvolution. In Blind Deconvolution the blurring parameter or object is unknown. Blurring is a form of bandwidth reduction of the image due to imperfect image formation process

II. PROBLEM STATEMENT

Captured images are more or less blurry due to lot of interference in the environment and camera. The blurringcauses by certain reasons like out of focus motion of an object or camera. Thus some information of images is lost.

III. PROPOSED SYSTEM

When we use camera, we want the recorded image to be a faithful representation of the scene that we see but every image is more or less blurry. Thus image deblurring is fundamental in making pictures sharp and useful.

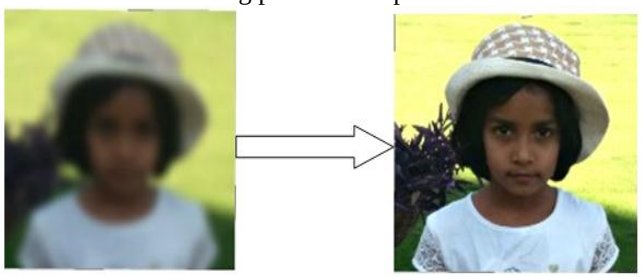
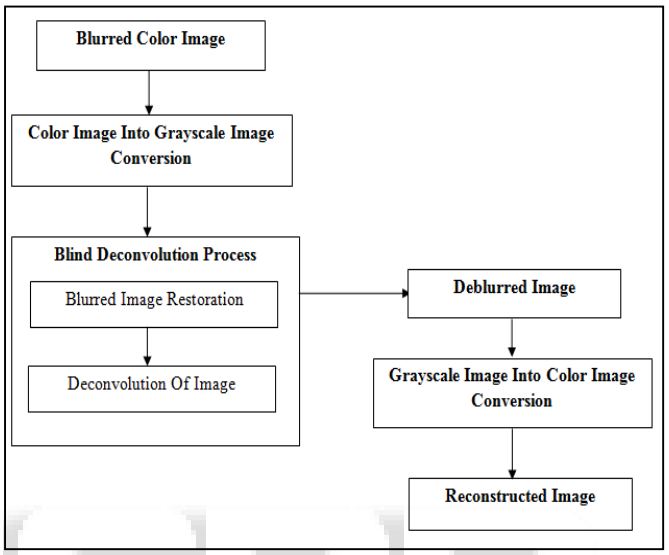


Figure – (a) Figure – (b)

Fig (a) shows a blurry image that is we do not get detailed information of the person existing in the image and it is due to misfocus of the camera or motion of the object. Our proposed system "Image Deblurring Using Blind Deconvolution" helps us to overcome all the drawbacks as a result we get detailed image (Deblurred Image) as shown in Fig (b).

IV. BLOCK DIAGRAM AND DESCRIPTION



Figure(c) – Block Diagram Of Image Deblurring.

V. DESCRIPTION

1) Blurred Image

Input given to our system is blurry colored image .Generally main causes of degradation are camera-misfocus , noise and relative object-camera motion , random atmospheric turbulence. Random variation of brightness or color information in the image is called noise it can be produced by sensor or digital camera. Degradation occurs at the moment of image acquisition and transformation of the image from one device to another device. Blurring Degradation can be space invariant or space-in variant. Blurring is form of bandwidth reduction of the image due to imperfect image formation process.

2) Color Image into Grayscale Image Conversion

Color images are based on the fact that a variety of colors can be generated by mixing the three primary colors Red, Green and Blue in proper proportion. In color images, each pixel composed of RGB value and each of these colors require 8 bits for its representation. Hence each pixel is represented by 24 bits [R(8 bits), G(8 bit), B(8 bits)].

Color images can be easily converted to grayscale images using the equation

$X = 0.30R + 0.59G + 0.11B$....."(2.1)",

OR

$X = R + G + B \setminus 3$..... "(2.2)",

3) Image Restoration

Image restoration is the operation of talking a corrupt or noisy image and estimating the clean ,original image. Corruption may come in many forms such as motion blur,noise and camera mis-focus i.e. degradation.Image restoration is

performed by reversing the process that blurred the image and such is perform by imaging a point source and use the point source image which is called the Point Spread Function(PSF)to restore the image information lost to the blurring process.

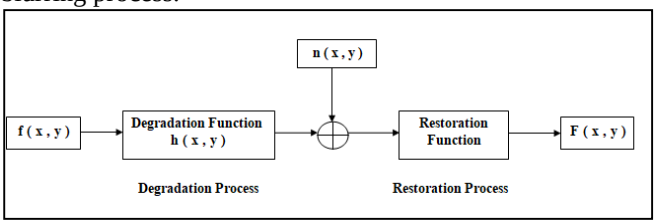


Figure (3.1) – Image Degradation and Image Restoration Process

Shown above figure (3.1) is a typical degradation model with additive noise present.

Where ,

$f\ (x, y)$ = Original Image

$g\ (x, y)$= Degraded Image

$n\ (x, y)$= Additive Noise

$h\ (x, y)$ = Spatially Invariant Point Spread Function (PSF)

$F\ (x, y)$ = Reconstructed Image.

Therefore,

In Spatial Domain

$g(x, y) = f(x, y) * h\ (x, y) + n(x, y)$ ....."(3.1)",

Where,

* indicates convolution representation

Now equation (3.1) shows the original image gets convolved with the degradation function $h(x, y)$ and noise gets added to it.Hence to remove this degradation function (convolution) we need to apply inverse filtering (de-convolution) to the degraded image.

In Frequency Domain

After taking Fourier transform of the above equation

$G(u, v) = H(u, v)\, F(u, v)\ N(u, v)$ ..."(3.2)",

4) Convolution

Convolution is a mathematical operation on two functions f and g producing a third function that is typically a modified version of one of the two original functions, giving the area overlap between the two functions as a function of the amount that one of the original functions is translated. It has applications that include probability, statistics, computer vision, image and signal processing, electrical engineering and differential equations.

The convolution of f and g is written $f * g$, using an asterisk or star. It is defined as the integral of the product of the two functions after one is reversed and shifted. it is a particular kind of integral transform

$(f * g)(t) \stackrel{\text{def}}{\equiv} \int_{\infty}^{-\infty} f(\tau)\, g(t - \tau) d\tau$ ..... "(4.1)",

OR

$(f * g)(t) \stackrel{\text{def}}{\equiv} \int_{\infty}^{-\infty} f(t - \tau)\, g(\tau)\, d\tau$ ..... "(4.2)",

While the symbol t is used above, it need not represent the time domain. But in that context, the convolution formula can be described as a weighted average of thefunction $f\ (\tau)$ at the moment t where the weighting is given by $g(-\tau)$ simply shifted by amount t. As t changes, the weighting function emphasizes different parts of the input function.For functions f, g supported on only $[0, \infty)$ (i.e., zero for negative arguments), the integration limits can be truncated, resulting in

$(f * g) = \int_0^t f\ (\tau) g\ (t - \tau)\, d\tau$ ..... "(4.3)",

5) Deconvolution

Deconvolution is an algorithm-based processused to reverse the effects of convolution on recorded data. The concept of deconvolution is widely used in the techniques of signal processingand image processing.In general, the objective of deconvolution is to find the solution of a convolution equation of the form

$f * g = h$ ..... "(5.1)",

Usually, h is some recorded signal, and $f$is some signal that we wish to recover, but has been convolved with some other signal g before we recorded it. The function g might represent the transfer function of an instrument or a driving force that was applied to a physical system.

6) Point Spread Function (PSF)

The Point Spread Function (PSF) describes the response of an imaging system to a point source or point object. A more general term for the PSF is a system's impulse response, the PSF being the impulse response of a focused optical system. The PSF in many contexts can be thought of as the extended blob in an image that represents an unresolved object. In functional terms it is the spatial domain version of the optical transfer function of the imaging system. That means the wave propagated from a point source or point object is known as the PSF.

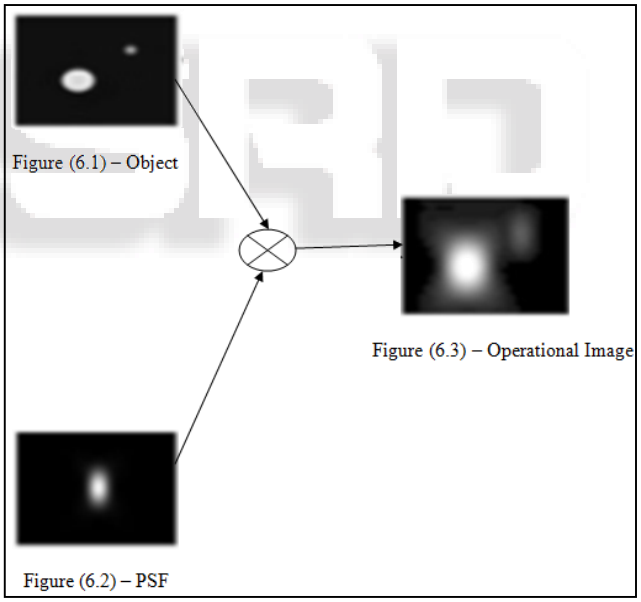


Figure (6.4) - Image Formation With A Point Spread Function (PSF)

The degree of spreading (blurring) of the point object is a measure for the quality of an imaging system.

$g(n1, n2) = d(n1, n2) * f(n1, n2) + w(n1, n2)$..... "(6.1)",

Where,

$g\ (n1, n2)$ = Degraded Image

$d\ (n1, n2)$ = Original Image

$f(n1, n2)$ = Point Spread Function (PSF)

$w\ (n1, n2)$ = Noise

Based on the PSF the restoration algorithm are classified into two types such as Non-Blind Deconvolution and Blind deconvolution.

7) Blind Deconvolution

Blind deconvolution method as its name indicates it works blindly means it is useful where no information about point spread function or blur operator (PSF) is present. This method using a deconvolution function for the purpose of deblurring. It will restore the image and the resulting PSF simultaneously. In this method, initial guess about PSF parameters is using for the purpose of deblurring. It is an iterative method means it will use many iteration in the deconvolution function to deblur the image. Blind deconvolution method is mainly of two types one is projection based and second is maximum-likelihood method.

8) Grayscale Image IntoColor Image Conversion

Grayscale is a range of shades of gray without apparent color. The darkest possible shade is black, which is the total absence of transmitted or reflected light. The lightest possible shade is white, the total transmission or reflection of light at all visible wavelengths. Intermediate shades of gray are represented by equal brightness levels of the three primary colors (red, green and blue) for transmitted light, or equal amounts of the three primary pigments (cyan, magenta and yellow) for reflected light.In the case of transmitted light (for example, the image on a computer display), the brightness levels of the red (R), green (G) and blue (B) components are each represented as a number from decimal 0 to 255, or binary 00000000 to 11111111.For every pixel in a red-green-blue (RGB) grayscale image is,$R = G = B$. The lightness of the gray is directly proportional to the number representing the brightness levels of the primarycolors.Black is represented by$R = G = B = 0$ or $R = G = B = 00000000$ and white is represented by $R = G = B = 255$ or $R = G = B = 11111111$. Because there are 8-bits in the binary representation of the gray level, this imaging method is called 8-bit grayscale.

Grayscale images can be easily converted to Color images using the equation

$$Grayscale\ Image = ((0.3 * R) + (0.59 * G) + (0.11 * B))$$

9) Reconstructed Image

Reconstructed image is the output of our proposed system in this image we get detailed and feature extracted image. Also we are able to identify the person or object existing in that image and texture, edges of the captured image.

VI. FLOWCHART

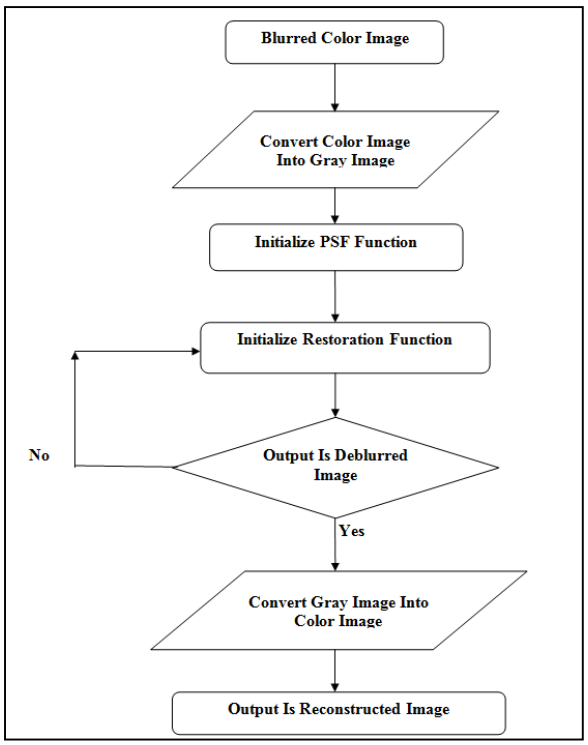


Figure (d) – Flowchart Of Image Deblurring By Using Blind Deconvolution Method

VII. APPLICATIONS

1) Biomedical Field

Deblurring is used in biomedical application for diagnosis of different disease and it is also used to improve the appearance of hazardous disease producing cells in our body Ex-cancer cells.

2) Agricultural Field

In agricultural field or farming the plants leaf or the crop get affected due to different pests or natural diseases .Deblurring helps to verify the crop diseases.

3) Military Applications

In military or defence application it is used to deblurred the capture surrounding images and its helps to take precaution before cure .so to avoid any attacks from enemies.

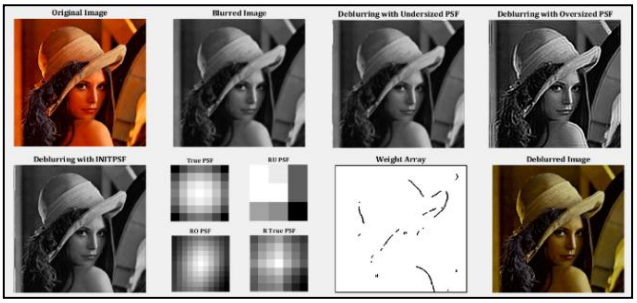
4) Video Processing

As video consist of 25 frames per second which is given as input with high speed so increases the performance of all that frame using deblurring.

5) Astronomy

Viewing distant star fields using ground based telescopes.

VIII. RESULT



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IX. CONCLUSION

The advantage of our proposed Blind Deconvolution Method is used to deblur the degraded image (blurred image) without prior knowledge of PSF and Additive Noise. It increases the speed of deblurring process that is reducing the number of iterations used for deblurring the image for achieving better quality image.Thusour proposed system is beneficial in gaining detailed information of the image and reduce amount of blurry part and noise in image. Further it increases quality of an image.

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