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DEBLURRED OF AN DEFOCUSSED IMAGE

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ABSTRACT

An image that is out of focus will appear blurry. These days with Auto Focus, it's unlikely that the whole image will be out of focus. More often than not, you'll see one part of the image crisp and clear, but others are out of focus. A defocused image may occur due to improper focusing of lens. So, a defocused image need to be debluured.Our project finds solution for defocused images. This project uses simple algorithm to deblur a defocused image.

Keywords:- Image Processing, Blur types, Gradient, Defocus.

1. INTRODUCTION

Shooting a real world image with a camera through an optical device gives a 2D image where at least some parts are affected by a blur and noise. Images can be blurred by atmospheric turbulence, relative motion between sensors and objects, longer exposures, out of focus and so on, but the exact cause of blurring may be unknown. Restoration of blurred noisy images is one of the main topics in many processing. The literatures have given good methods to improve image qualities. The purpose of image restoration is to reconstruct an unobservable true image from a degraded observation. An observed image can be written, ignoring additive noise, as the two-dimensional convolution of the true image with a linear space-invariant _LSI_ blur, known as the PSF. Restoration in the case of known blur, assuming the linear degradation model, is called linear image restoration and it has been presented extensively in the last three decades giving rise to a variety of solutions. In many practical situations, however, the blur is unknown. Blurring of an image makes the image unclear. Blurring of an image causes missing of information. Blurring may occur due to improper focusing of lens during image capturing; it may due to relative motion between the target and the sensor (camera) and so on.

Figure 1 "(a)"Normal image **Figure 2"(b)"**focusing pink flower i.e., de-focusing leaves and white Flowers.

2. BACKGROUND

2.1 Image:

An image is used to convey some information. Basically an image is expressed in two dimensional ways. To acquire an image we require an imaging sensor and capability to digitize the signal produced by the sensor. Imaging sensor could be monochrome or color TV camera. During image acquisition there are chances of occurrence of Blurring.

2.1.1Need of images

Various imaging modalities help us to see invisible objects

- Human body
- Far distance (e.g., remote sensing)
- Small size (e.g., light microscopy)

2.1.2 Digital Image Processing

Simply put, the field of digital image processing refers to processing digital images by mean of digital computers. Processing is done for two main reasons:

- Improvement of pictorial information for human interpretation
- Processing of image data for storage, transmission and representation for autonomous machine perception.

2.1.3 Why D.I.P.?

- Reasons for compression
- Image data need to be accessed at a different time or location
- Limited storage space and transmission bandwidth
- Reasons for manipulation
- Image data might experience non ideal acquisition, transmission or display (e.g., restoration, enhancement and interpolation)
- Image data might contain sensitive content (e.g., fight against piracy, counterfeit and forgery)
- Reasons for analysis
- Image data need to be analyzed automatically in order to reduce the burden of human operators.

Digital image processing allows one to enhance image features of interest while attenuating detail irrelevant to a given application, and then extract useful information about the scene from the enhanced image. This introduction is a practical guide to the challenges, and the hardware and algorithms used to meet them. Images are produced by a variety of physical devices, including still and video cameras, x-ray devices, electron microscopes, radar, and ultrasound, and used for a variety of purposes, including entertainment, medical, business (e.g. documents), industrial, military, civil (e.g. traffic), security, and scientific. The goal in each case is for an observer, human or machine, to extract useful information about the scene being imaged. Digital image processing is a subset of the electronic domain wherein the image is converted to an array of small integers, called pixels, representing a physical quantity such as scene radiance, stored in a digital memory, and processed by computer or other digital hardware. Digital image processing, either as enhancement for human observers or performing autonomous analysis, offers advantages in cost, speed, and flexibility, and with the rapidly falling price and rising performance of personal computers it has become the dominant method in use.

2.2 Blurring:

Blurring makes the image unclear and it means presence of unwanted things which we can’t accept. It is most fundamental level is the softening of an image. It is standard procedure to use a very slight blur on photos straight off your digital camera as often they are overly sharp. Sharpness, of course, isn’t a bad thing but it is more beneficially applied at the end of your retouching sessions than at the beginning. The reasons of Blurring may be:

- Movement during the image capture process, by the camera or, when long exposure times are used, by the subject.
- Out-of-focus optics, use of a wide-angle lens, atmospheric turbulence, or a short exposure time, which reduces the number of photons Captured.
- Scattered light distortion in confocal microscopy.

There are many other (more creative) uses of blurring. Here are some examples.

2.2.1. **To Imply Depth**

Depth of field looks best when done in the camera, but when compositing photographs, you canimplydistanceanddepthbyblurringfurtherawayobjects.

Figure 2.2.1 Imply Depth

2.2.2 To Imply Speed

Even if the object in a photo is in perfect focus, applying a direction (or “motion”) blur can imply speed.

Figure 2.2.2 Imply Speed

2.2.3 For An Appealing Background Image

Photoshop offers some interesting blur effects with their “Shape Blur” filter. Look how the martini splashes turn into squares here, which could make for a very nice back ground image.

Figure 2.2.3 Background Image

When we use a 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. Digital image processing allows one to enhance image features of interest while attenuating detail irrelevant to a given application, and then extract useful information about the scene from the enhanced image. This introduction is a practical guide to the challenges, and the hardware and algorithms used to meet them. Images are produced by a variety of physical devices, including still and video cameras, x-ray devices, electron microscopes, radar, and ultrasound, and used for a variety of purposes, including entertainment, medical, business (e.g. documents), industrial, military, civil (e.g. traffic), security, and scientific. The goal in each case is for an observer, human or machine, to extract useful information about the scene being imaged. An example of an industrial application is shown in. Often the raw image is not directly suitable for this purpose, and must be processed in some way. Such processing is called image enhancement; processing by an observer to extract information is called image analysis. Enhancement and analysis are distinguished by their output, images vs. scene information, and by the challenges faced and methods employed. Image enhancement has been done by chemical, optical, and electronic means, while analysis has been done mostly by humans and electronically. A digital image is composed of picture elements called pixels. Each pixel is assigned intensity, meant to characterize the color of a small rectangular segment of the scene. A small image typically has around 2562 = 65536 pixels while a high resolution image often has 5 to 10 million pixels. Some blurring always arises in the recording of a digital image; because it is unavoidable that scene information “spills over” to neighboring pixels. For example, the optical system in a camera lens may be out of focus, so that the incoming light is smeared out. In image deblurring, we seek to recover the original, sharp image by using a mathematical model of the blurring process. The key issue is that some information on the lost details is indeed present in the blurred image—but this information is “hidden” and can only be recovered if we know the details of the blurring process. Mat lab is an excellent environment in which to develop and experiment with filtering.

2.3 Blurring Types:

In digital image there are 3 common types of Blur effects:

2.3.1 Average Blur

The Average blur is one of several tools you can use to remove noise and specks in an image. Use it when noise is pres entire image. This type of blurring can be distribution in horizontal and vertical direction and can be circular averaging by radius R.

2.3.2 Motion Blur

The Motion Blur effect is a filter that makes the image appear to be moving by adding a blur in a specific direction. The motion can be controlled by angle or direction (0 to 360 degrees or –90 to +90) and/or by distance or intensity in pixels (0 to 999), based on the software used.

Figure 2.3.2 Motion Blur

2.3.3Gaussian Blur

Gaussian Blur is that pixel weights aren't equal - they decrease from Kernel center to edges according to a bell-shaped curve .The Gaussian Blur effect is a filter that blends a specific number of pixels incrementally, following a bell-shaped curve. The blurring is dense in the center and feathers at the edge. Apply Gaussian Blur to an image when you want more control over the Blur effect. Gaussian blur depends on the Size and Alfa.

Figure 2.3.3 Gaussian Blur

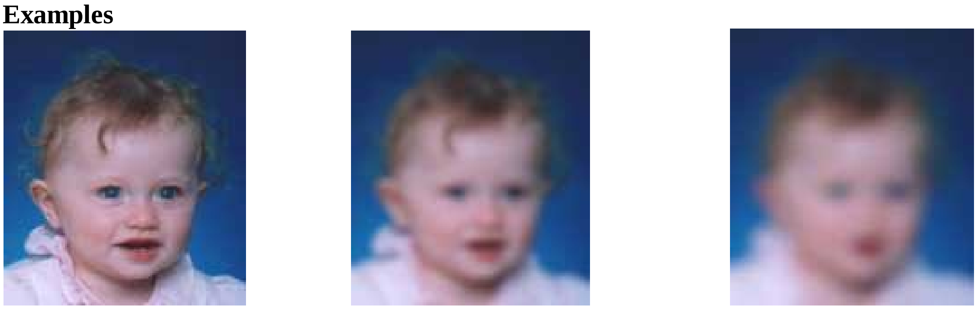
2.3.4. DEFOCUS

An image that is out of focus will appear blurry. These days with Auto Focus, it's unlikely that the whole image will be out of focus. More often than not, you'll see one part of the image crisp and clear, but others (including your subject) are out of focus. To fix focus problems, make sure your camera has your subject in its sights. Based on this model, the fundamental task of deblurring is to deconvolve the blurred image with the PSF that exactly describes the distortion. Deconvolution is the process of reversing the effect of convolution. The quality of the deblurred image is mainly determined by knowledge of the PSF.

2.3.5. Point Spread Function (PSF)

Point Spread Function (PSF) is the degree to which an optical system blurs (spreads) a point of light. The PSF is the inverse Fourier transform of Optical Transfer Function (OTF).in the frequency domain ,the OTF describes the response of a linear, position-invariant system to an impulse.OTF is the Fourier transfer of the PSF. Once the PSF is created, the example uses the **imfilter** function to convolve the PSF with the original image, to create the blurred image.

Defocusing Examples



Original Image Blur width=6 Blur width=12

Figure 2.3.5 Defocussing Images

De-focus of an image can be done by varying amounts of width (up to 20). Informally, an equation is defocusing (or repulsive) if the nonlinearity tends to act to dissipate the solution when it is concentrated, thus (in principle) reinforcing the effects of dispersion. The opposite of defocusing is focusing, though there do exist nonlinear equations which are neither focusing nor defocusing as the nonlinearity exhibits no bias towards helping or hindering the dispersion.

3. GRADIENT

An image gradient is a directional change in the intensity or color in an image. Image gradients may be used to extract information from images. In graphics software for digital image editing, the term gradient is used for a gradual blend of color which can be considered as an even gradation from low to high values, as used from white to black in the images to the right. Another name for this is color progression. Mathematically, the gradient of a two-variable function (here the image intensity function) is at each image point a 2D vector with the components given by the derivatives in the horizontal and vertical directions. At each image point, the gradient vector points in the direction of largest possible intensity increase, and the length of the gradient vector corresponds to the rate of change in that direction. The gradient of the image is one of the fundamental building blocks in image processing. For example the canny edge detector uses image gradient for edge detection.

- Image gradients are often utilized in maps and other visual representations of data in order to convey additional information.

Figure 3 "(a)" Original Image

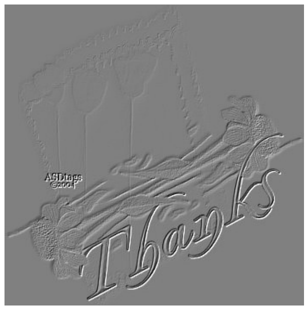


Figure 3"(b)" Gradient Image

- In the above figures, first one is the original image and the second figure is the gradient figure obtained by applying gradient operator.

Image gradients can be used to extract information from images. Gradient images are created from the original image for this purpose. Each pixel of a gradient image measures the change in intensity of that same point in the original image, in a given direction. To get the full range of direction, gradient images in the x and y directions are computed. One of the most common uses is in edge detection. After gradient images have been computed, pixels with large gradient values become possible edge pixels. The pixels with the largest gradient values in the direction of the gradient become edge pixels, and edges may be traced in the direction perpendicular to the gradient direction. One example of an edge detection algorithm that uses gradients is the canny edge detector. In vector calculus, the gradient of a scalar field is a vector field which points in the direction of the greatest rate of increase of the scalar field, and whose magnitude is the greatest rate of change. Consider a room in which the temperature is given by a scalar field, T, so at each point (x, y, z) the temperature is T(x, y, z) (we will assume that the temperature does not change in time). At each point in the room, the gradient of T at that point will show the direction the temperature rises most quickly. The magnitude of the gradient will determine how fast the temperature rises in that direction. Consider a surface whose height above sea level at a point (x, y) is H(x, y). The gradient of H at a point is a vector pointing in the direction of the steepest slope or grade at that point. The steepness of the slope at that point is given by the magnitude of the gradient vector.

3.3 DEBLURRING

The defocused image gets deblurred using the obtained blurring length. Image deblurring (or restoration) is an old problem in image processing, but it continues to attract the attention of researchers and practitioners alike. A number of real-world problems from astronomy to consumer imaging find applications for image restoration algorithms. Plus, image restoration is an easily visualized example of a larger class of inverse problems that arise in all kinds of scientific, medical, industrial and theoretical problems. Besides that, it's just fun to apply an algorithm to a blurry image and then see immediately how well you did. To deblur the image, we need a mathematical description of how it was blurred. (If that's not available, there are algorithms to estimate the blur. But that's for another day.) We usually start with a shift-invariant model, meaning that every point in the original image spreads out the same way in forming the blurry image.

3.3.1. Deblurring Algorithms for Out-of-focus Images

An image that has been subject to the out-of-focus phenomenon has reduced sharpness, contrast and level of detail depending on the amount of defocus. To restore out-of-focused images is a complex task due to the information loss that occurs. However there exist many restoration algorithms that attempt to reverse this defocus by estimating a noise model and utilizing the point spread function. The purpose of this thesis, proposed by FLIR Systems, was to find a robust algorithm that can restore focus and from the customer's perspective be user-friendly. The thesis includes three implemented algorithms that have been com-pared to MAT Labs built-in. Three image series were used to evaluate the limits and performance of each algorithm, based on deblurring quality, implementation complexity, computation time and usability. Results show that the Alternating Direction Method for total variation de-convolution proposed by Tao et al together with its the modified discrete cosines transform version restores the defocused images with the highest quality. These two algorithms include features such as, fast computational time, few parameters to tune and a powerful noise reduction.

3.3 Deblurring Images Using the Blind Deconvolution Algorithm

The goal of image restoration is to reconstruct the original scene from a degraded observation. This recovery process is critical to many image processing applications. Although classical linear image restoration has been thoroughly studied, the more difficult problem of blind image restoration has numerous research possibilities. Our objective in this article is to introduce the problem of blind deconvolution for images, provide an overview of the basic principles and methodologies behind the existing algorithms, and examine the current trends and the potential of this difficult signal processing problem. We first introduce the blind deconvolution problem for general signal processing applications. Blind image restoration is the process of estimating both the true image and the blur from the degraded image characteristics, using partial information about the imaging system. In classical linear image restoration, the blurring function is given, and the degradation process is inverted using one of the many known restoration algorithms. The various approaches that have appeared in the literature depend upon the particular degradation and image models. Unfortunately, in many practical situations, the blur is often unknown, and little information is available about the true image. Therefore, the true image f(x, y) must be identified directly from g(x, y) by using partial or no information about the blurring process and the true image. Such an estimation problem, assuming the linear degradation model, is called blind deconvolution. Experience shows that in practice some information is needed to successfully restore the image. There are several motivating factors behind the use of blind deconvolution for image processing applications. In practice, it is often costly, dangerous, or physically impossible to obtain a priori information about the imaged scene. For example, in applications like remote sensing and astronomy, it is difficult to statistically model the original image or even specific information about scenes never imaged before. In addition, the degradation from blurring cannot be accurately specified. In aerial imaging and astronomy, the blurring cannot be accurately modeled as a random process. Since fluctuations in the PSF are difficult to characterize. In real-time image processing, such as medical video-conferencing, the parameters of the PSF cannot be pre-determined to instantaneously deblur images. Moreover, on-line identification techniques used to estimate the degradation may result in significant error, which can create artifacts in the restored image. In other applications, the physical requirements for improved image quality are unrealizable. For instance, in space exploration, the physical weight of a high resolution camera exceeds practical constraints. Similarly, in x-ray imaging, improved image quality occurs with increased incident x-ray beam intensity, which is hazardous to a patient's health. Thus, blurring is unavoidable. In such situations, the hardware available to measure the PSF of an imaging system is often difficult to use. Although these methods work well to identify the PSF, they are esoteric, which limits their wide use. The problem of recovery of the true image f(x, y) requires the deconvolution of the PSF from the degraded image. Deconvolution is performed for image restoration in many applications such as astronomical speckle imaging, remote sensing, and medical imaging, among others. The Blind Deconvolution Algorithm can be used effectively when no information about the distortion (blurring and noise) is known. The algorithm restores the image and the point-spread function (PSF) simultaneously. Additional optical system (e.g. camera) characteristics can be used as input parameters that could help to improve the quality of the image restoration. PSF constraints can be passed in through a user-specified function.

4. RESULTS

In our project original image is taken and by adding noise, image is converted into blurred image, this image is shown in figure 4 "(a)".Next gradient is applied to the blurred image to find the blurring length. Five steps are involved in finding the blurring length. Plot rounding values of the gradient image. Apply Gaussian low pass to rounding values. Find the pulse width of peaks of the plot for either maximum peak or minimum peak. The pulse width (difference) gives the de-blurring length. The gradient image is as shown in figure "(b)". Next the blurred image can be deblurred by using the obtained blurring length and deconvblind algorithm. The Deblurred image is as shown in figure "(c)".

Figure 4” (a)”Original Image

Figure 4” (b)” Gradient Image

Figure 4 “(c)” Deblurred image

5. CONCLUSION

Using this project blurred image (defocused image) can be reconstructed. This project uses Deconvblind algorithm to Deblur an image and Gradient for finding the length (velocity with which the image is blurred). By this project report, an image of up to 40% blurring can be reconstructed. We used gradient to find the orientation of blurring and then we applied deblurring technique (i.e. deconvblind algorithm). We have built a program coding with MATLAB going through all the stages of the focus de-blurring. It is helpful to understand the procedures of focus de-blurring. And demonstrate the key issues of our project.

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