International Journal of Advanced Trends in Computer Applications
www.ijatca.com

Image Enhancement of blurred digital Images using Adobe Photoshop Software: A review study on forensic application

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Abstract: *Nowadays everyone has the ability to capture, store and transfer the digital image. In forensics, unlike other physical evidences, image shows the authenticity of real objects and scene. Sometimes in criminal activities photographs are taken by any witness but due to their blurred appearance they become neglected as evidence. These days many sophisticated image-processing software's are available that has led not only to increase the cases of manipulated or faked photographs but also emerged as problem solver to the similar images. Various softwares which works as image enhancement improves the quality of digital image that can help to retrieve the useful information from blurred image. The current paper deals with review of literature reported related to image enhancement or de-blurring of digital images of both types i.e. motion blur and out-of-focus blur using Adobe Photoshop Software.*

Keywords: Digital Image, Image Enhancement, Image Blur, adobe photoshop, Computer Forensics

I. INTRODUCTION

The digital image is the image that is stored in the binary form and sub-divided into a pixel matrix [1]. A digital image value of one or more bits, specified by the bit depth, consists of each pixel. Digital value may be energy, brightness, color, intensity, sound elevation, or a classified value extracted from image processing [2], but is not limited to it. In the digital world, technological progress has led to a massive rise in the number of digital images are common in all spheres of life.

Due to their immediacy and the simple way to understand the image content, photographs, unlike text, provide an efficient and natural communication medium for humans. Historically, the credibility of visual evidence has been trusted, so that an image printed in a newspaper is generally accepted as a confirmation of the truthfulness of the news, or video surveillance images are suggested to a court of law as probationary content [3].

The sheer volume of image, audio and video proof captured can be huge for large-scale incidents or crimes. Unlike other types of forensic evidence, records of images, audio and video may provide eye-witness accounts of crime in real time. High-quality audio, image, and video records are often not available for most crimes. Forensic imaging, forensic audio and forensic video expertise can aid there.

A digital image's history can be interpreted as a composition of many stages, compiled into three key stages: acquisition, coding, and editing. While Acquisition, the light coming from the real scene framed by the digital camera is concentrated by the lenses on the camera sensor, but the light is usually filtered by the CFA before reaching the sensor (Color Filter Array). In practice, only one basic main color (red, green or blue) is obtained for each pixel. In order to obtain the digital color image, the sensor output is successively interpolated to obtain all the three key colors for each pixel, via the so-called demosaicing process. In camera processing, the received signal undergoes further processing, which may involve white balance, color processing, image sharpening, contrast enhancement, and gamma correction [3].The processed signal is stored in the camera memory with coding; the image is lossy-compressed in most cameras to save energy, and the JPEG format is typically the chosen one for commercial devices [3].

Finally, for example, to improve or to change its content, the created image can be post-processed. During its life, any image editing can be applied to an image: geometric transformation (rotation, scaling, etc.), blurring, sharpening, contrast correction, image splicing, and cloning are the most used ones (or copy-move, the replication of a portion of the same image). Finally, the image is most frequently saved in JPEG format after editing, so that recompression takes place [3].

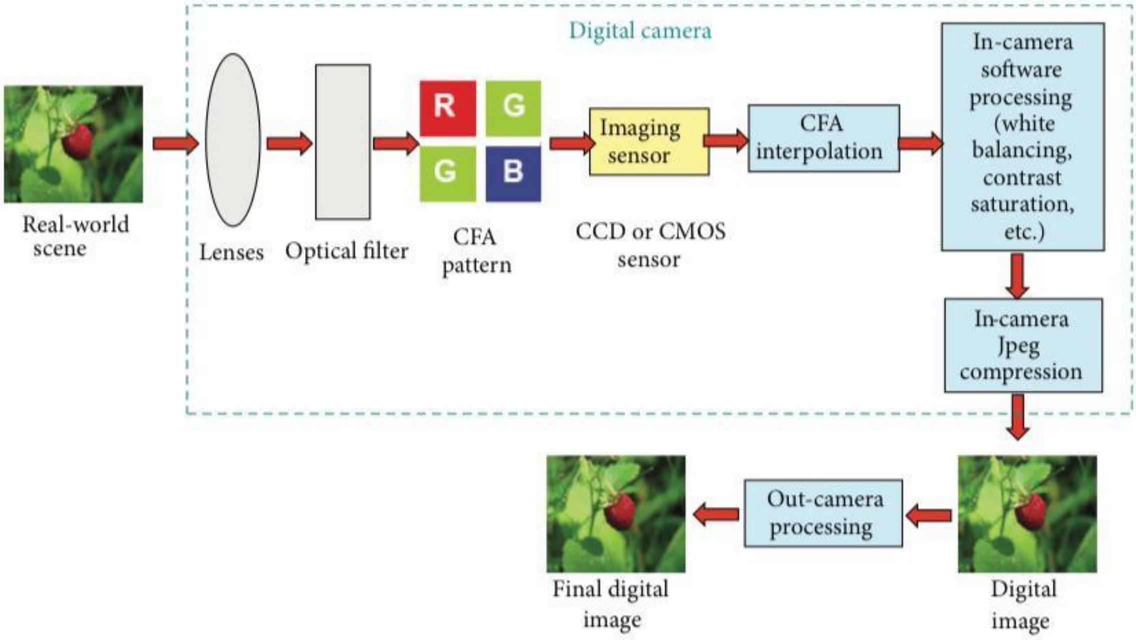

Figure 1: A structure reflecting the steps a digital image undergoes to compose the normal life cycle [3].

Cameras are used to capture photographs that show that the original scene captured is accurately portrayed [4]. However any captured image is more or less blurry [1]. Picture de-blurring is therefore important in rendering photos sharp and useful. Image de-blurring restores the original image, which is sharp. The main problem is that some information about the missing details is still present in the blurred image, but they are concealed and can only be retrieved if established blurring process details are provided [4]. Blur can be characterized mathematically as linear progress that leads to image degradation [1].

Two types of blur are usually identified as the main source of blurring of images, motion and out-of-focus [9]. The blur of motion occurs for many reasons, such as the motion of objects during the image capture process [7], the motion of cameras at the time of the scene capture [8]. In addition, due to many causes such as lens defocusing, and lens focusing mistake, the out-of-focus blur occurs. Forensic images are degraded by blur due to both the problems. The complicated part is when there is more than one kind of blur in an image, which happens in most pictures. The numerous blur forms occurring in different sections of a single image [6], or on top of one another, cannot be solved by current deblurring technology. For instance, if a moving car image is captured and the camera is shaken during the capturing of the image, because of its motion, the car may be blurred and the whole image can have some blur due to the shake of the camera [4].

Adobe Photoshop is a Computer Software that is used from photo editing and compositing to digital painting, animation and graphic design [5]. Photoshop is faster, smarter and easier to edit and enhance the image in many fields such as in Astronomy, Medicaland Forensics and in other image related fields.

II. REVIEW OF LITERATURE

Suk Hwan Lim *et al.* (2005)determines an algorithm that automatically decides whether, through image analysis, the captured photograph is out of focus. They ran their algorithm on their database of 3000 images (350 of which are out-of-focus). In this method, the image is first divided into blocks, and each image's local sharpness is calculated. Then, from the image data and the matrix of local sharpness measures, many figure-of-merits are determined. Their algorithm can detect 90% of the truly out-of-focus images in their application with simple predicates. 10 percent false alarm (False alarm means that the image is well-focused but the image is out-of-focus with their algorithm decided), when generating it. They will prevent over-training and keep the algorithm more general with the use of simple predicates. To improve the algorithm's efficiency, the misses and false alarms are being analysed. Misses typically occur when direct light sources are tricked by the sharpness estimator, sharp Shadows or Reflections.

They also expanded the current approach to demonstrate how well-focused a multi-level picture is (e.g. 1-very bad, 5-very good). Another noticeable course is on lowering the number of errors and false alarms. They were also trying to improve the accuracy by including the metadata of the capture stored during the capture of the image. They decided whether the picture is well-focused or not by evaluating the figure-of-merits. Experimental results show 90 percent detection rate with 10 percent false alarms.

B. Bascle *et al.* (2005) suggest a method for achieving the objective of improving the accuracy of motion-blurred photographs of low quality. A new approach for motion deblurring, focus deblurring and super-resolution from image sequences has been introduced in this paper. Firstly, using region-based matching, an item of interest is tracked through the series. Secondly, in terms of pixel sampling, defocus blur and motion blur, deterioration of images is modelled. The direction and magnitude of the motion blur are calculated from tracked displacements. Eventually, a deblurred image of high resolution is rebuilt. Video sequences of moving figures and distorted script highlight the strategy.

The methodology was highlighted via experimental observations. This section illustrates an approach that uses a series of images to achieve super-resolution and deburring of a moving object, considering both optical blur and motion blur. Consideration is given to an affine motion model. Double resolution of the restored image is accomplished with respect to the original images. Only the area of interest in the image has been added to the deblurring algorithm, and the results are shown as blow-ups of these regions.

J. Jia (2007) split the image deblurring into processes of filter estimation and image deconvolution, and propose a new algorithm to estimate the motion blur filter from the alpha values perspective. The relationship between the clarity of the object boundary and the blur of the picture motion is studied. The filter estimate is formulated to solve a Maximum A Posteriori (MAP) problem with the given probability and transparency prior to it. In order to tackle both the camera motion blur and the object motion blur, their unified approach can be implemented.

On the building boundary, the transparency is computed. Using the Lucy Richardson process, they restore the input image. They have shown that the transparency on the object boundary will uniquely evaluate the blur filter in a 1-D motion. Therefore, given precise alpha values, solving the 1-D motion is a well-positioned problem. They have also shown that it is possible to estimate a near upper bound for the filter size in 2-D space and suggested an optimization method to compute the blur filter. It can be the optimization by adding generalized transparency; it was neatly applied to solve the camera motion blur problem. The precise calculation of alpha was crucial to the success of their technique. When applying state-of-the-art image deconvolution techniques, it is still common for the deconvolved image to contain visual artifacts, even if the filter is known.

S. Cho *et al.* (2007) suggest a technique to eliminate non-uniform motion blur from different blurry images. For the entire picture, conventional methods concentrate on estimating a single motion blur kernel. They seek, on the other hand, to restore images blurred by unexplained, spatially varying kernels of motion blur induced by different relative movements between the camera and the scene. They formulated the issue as a regularized energy function and used an alternative optimization strategy to solve it. The feasibility of the suggested approach was shown through real world studies.

They used both virtual and real-world images to test the proposed algorithm. To perform the estimation stage, the input images were first transformed into grey scale images. After the parameters were obtained, to achieve the final result, the restoration step was performed for each colour band. While they used only two images as input, more than two images can obviously be taken by the algorithm as well. In this case, for each pair of images, the estimation step was carried out and the restoration step is carried out by optimizing the energy functions of all pairs of images simultaneously.

V N Strakhov *et al.* (2008): In restoring astronomical images, the numerical output of the successive overrelaxation technique (SOR) is discussed. Resonant properties are revealed by local analysis of the convergence rates, with convergence improvement at a spatial frequency defined by the SOR relaxation parameter. The study will serve as a reference for the realistic selection of the relaxation parameter(s), which governs the SOR algorithm's regularization properties. One specific prediction is that rapid image deblurring involves deep underrelaxation (τ 1) in traditional implementations. This theoretical outcome helps us to better understand the productive characteristics of underrelaxation, which were found in previous work. However, the theoretical analysis of the convergence properties of +SOR remains a challenge that the simple analysis implemented in this paper cannot address.

The most impressive finding of SOR performance in their test inversions is that it is competitive with that of conjugate gradients and related techniques (GMRES) when evaluated in terms of the number of iterations required, which were often considered to be ultimately superior in problems of quadratic minimization. Contrary to the behavior of the conjugate gradients, when the non-negativity restriction was applied, the convergence rate of SOR further increases. Apparently, this acceleration is connected to the smaller number of 'active' unknowns in the model image, while the remainder of the unknowns was held at zero value and remains 'inactive'. The ultimate simplicity of its implementation was a special characteristic of SOR. The algorithm is at the same time fairly versatile. Changing the relaxation parameter x between different iterations allows the resulting frequency-response function to be tuned more finely, and changing x between different sections of the picture allows the solution to be constrained by a spatial variant.

Z. Al-Ameen *et al.* (2013) illustrate the problem of image deblurring in computer forensics, as the blur covers crucial information that is actually present in the captured image. In addition, motion and out-of-focus blur are the types of blur that are constantly dealt with in forensics. Various examples of deblurring are provided to illustrate the importance of deblurring in the forensic field. In addition, to provide additional deblurring information, brief descriptions will be deliberated on the deblurring methods and the blur forms. The main goal of this paper is to provide a deeper understanding of the forensic science of deblurring images. Different types of blur can affect the recorded images, as stated earlier. In order to improve the field of image deblurring, numerous laboratories, software companies and researchers are constantly aiming to develop new algorithms that are rapid, reliable and accurate. Finally, these algorithms are used not only in forensics, but in various fields of imaging.

G. Sulong *et al.* (2013): This article discusses the field of digital forensics with image deblurring, as due to the blurring artifact, the latent information that are currently present in the captured images are obscured. In addition, motion and out-of-focus blur are the constant modes of blur that are being dealt with in forensics. To concentrate on the significance of deblurring forensic images, numerous examples were given. In addition, for additional information, succinct comments on deblurring techniques, applications and blur styles were intended. In order to improve the field of image deblurring, numerous laboratories, software companies and researchers are constantly aiming to develop new algorithms that are rapid, reliable and accurate. As a result, to highlight the issue, numerous deblurring applications were presented in this article. Finally, these algorithms are used not only in forensics, but also in a variety of fields of imaging.

I. M. El-henawy *et al.* (2014): In this paper, they presented a detailed analysis of image deblurring, blur form, noise model, and finally a comparative study of various techniques of image deblurring. In order to test these techniques in terms of efficiency, blur type, peak signal to noise ratio and structural similarity, they conducted several experiments (SSIM). Image blur is a common issue that occurs as a result of camera shake, long exposure time, or object movement while capturing digital images. The captured image is corrupted as a consequence and the recorded scene becomes unreadable. The field of blur removal has recently gained a growing interest in a lot of studies. The accuracy of the latent image is calculated to determine the efficacy of various image deblurring techniques. There are two types of quality evaluation indicators which can be used: subjective measures and quantitative measures. Without measuring a numeric quantity by an explicit formula, subjective tests measure the happiness or interpretation of the consumer. This form of metric is the most reliable since it tries to accommodate various user requirements directly. The second category of metric is the objective metrics that are used to measure a numeric quantity using an explicit formula. In the assessment of picture deblurring techniques, there are two types of objective metrics commonly used: Peak Signal-To-Noise Ratio (PSNR) and Structural Similarity (SSIM). To calculate the image quality in dB, PSNR is used to (decibels). PSNR tests how often the two images are identical between two images (deblurred image and original image). On 20 different blurred images, each of the mentioned techniques was checked. To each blurred image, they added a Gaussian noise. To approximate the realistic conditions during image processing, the standard deviation of the Gaussian noise is 0.005. For each of the techniques tested, the obtained PSNR and SSIM are registered.

F. Vankawala *et al.* (2015): In order to minimise the effects of blurring, this paper performed output comparisons of various techniques. Based on blur forms, Peak Signal-to-Noise Ratio (PSNR), mean square error (MSE) and execution time, the study and comparison were acknowledged. Image Deblurring is a technique used to minimise the amount of blur in a blurred image and create a sharp and consistent image of the degraded image. Based on the literature review and simulation results analysis on different image deblurring algorithms proposed by various researchers, it can be concluded that Richardson Lucy provides comparatively better results for various Gaussian algorithms such as PSF, Van Cittert and Disk as PSF and also states that there are the same number of operations by Richardson Lucy and Van Cittert where poison maps have the largest number of operations and Laplacian has the lowest number of iterations. In addition, it can also be inferred that Laplacian yields weak outcomes. It can be concluded that these algorithms perform poorly in the presence of noise in an image, based on a study carried out on a noisy image.

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