Efficient Blurring and De-Blurring Techniques for Secure the Document Images

Dr. S. Vijayarani, A. Sakila, V. Nivetha

Abstract: Document images are more fashionable in today’s world and it is using in digitalized libraries and digitalized organization. These images are shared over the internet through emails, online messengers and social media/public channels. Unauthorized persons can be used it for fraudulent purposes like duplicating without getting permissions, hacks and attacks, copyright or patent infringement/abuse and so on. Hence it is necessary to provide certain security mechanisms for protecting these document images which becomes important for securing the confidential document images from unauthorized persons. The primary aim of this research work is to protect the document images before sharing and it is to be converted into its original form to authorized persons after sharing. In this research work, blur techniques are used for protecting the document images whereas deblur techniques are used to convert the protected document images into its original form. This work has proposed blur blur technique for protecting the document images and it is compared with average blur, gaussian blur and motion blur. We proposed dabber de-blur technique for reconstructing the blurred images and extracted the original image. The performance of dabber de-blur is compared with blind de-convolution and lucy richardson techniques. From the performance and output results it is observed that the proposed techniques have produced good results than an existing ones.

Keywords: Document Images, Information Retrieval, Image Security, Blurring, De-Blurring

I Introduction

Searching and retrieving important information from great amount of image data is known as image mining. These image data are collected from disparate sources such as scanned documents images, medical images, remote sensing images, natural images, etc. Image mining utilizes methods from image retrieval, artificial intelligence, image processing, computer vision and machine learning. In Image mining there are two different approaches; first one is to retrieve important information from the collection of images or database. Next method is to mine a combination of associated alphanumeric data and/or collection of images. Image mining applications are document image analysis, medical images (brain tumor, kidney stone, heart disease prediction, magnetic resonance imaging [MRI] and diamond eye), intelligent satellite mining system and multimedia miner. Traditional libraries and organizations handled large amount of hard copy and printed materials that are expensive and massive. However, at present, more libraries and organizations are slowly getting digitized, which means paper documents can be converted into image format by using digitized equipment’s. This conversion process has several pros and cons. The advantages are easy to convert, requires minimum memory space, information sharing becomes simple, easy to take multiple copies, compact to store, and so on. The disadvantages are difficult to extract information, unable to convert into their original form and security. Document images can be handled by the unauthorized persons and they may use it for fraudulent purposes like copying or duplicating without permission, hacks and attacks, copyright or patent infringement/abuse and so on. Hence it is mandatory to provide some security mechanisms for protecting the document images. Normally, encryption and decryption techniques are used for security. In this research work also encryption and decryption techniques are used. The primary objective of this research work is to secure the document images by using blurring and de-blurring techniques. In encryption, hiding the information from document image is done by using blurring techniques. During decryption, de-blurring techniques are used for extracting the information from blurred document images.

The remaining portion of the paper is organized as follows. Section 2 presents the related works. Section 3 represents the proposed methodology. Section 4 provides the experimental results. This paper is concluded in Section 5.

II Related Works

Jaipuneet Singh, et.al [2013] discussed the basic concept of motion blur and its techniques and how it is essential for producing high-quality animations. The authors have described about the importance of shutter speed in the field of motion Blur. This work calculated the shutter speed for adjusting the blur level. They assumed faster shutter speed has produced less motion blur level and slower shutter speed might be able to capture the motion blur and its frame.

Ariyan Zarei [2014] has analyzed optical CAPTCHAs to decrease the readability by OCR programs using Gaussian Blur filter. They produced two sequence of blur CAPTCHAs, first one is with radius of one and the other with radius of two. Their proposed system made CAPTCHAs nearly unreadable by OCR programs. Considering their results, blur CAPTCHAs with radius of two are more efficient than the radius one. The authors
acquired better result against OCR programs and also their readability by human users are extremely high.

Yogesh K. Meghrajani, et.al [2012] analyzed the performance of motion blur technique for automatically detected and discovered information from images. The authors proposed an interactive de-blur method for single blurred image. It is used to restore the blur kernel of the decimal parameters using image interpolation. Based on the experimental results, this method gives satisfactory restoration results for most desirable quality. Though this is very simple method, it is time consuming method for small volume.

Yan Chen, et.al [2011] analyzed local motion blur for image restoration. In this work they extracted blurred part from the difficult background, after that the blurred part is attached with a lowermost monochromatic background. The primary model of local motion blur is performed as a formation mechanism. Their proposed algorithm is effectual, simple and fast method of blur image restoration.

Sudha Yadav, et.al [2016] analyzed performance of various existing image de-blurring techniques such as Weiner filter, Lucy-Richardson, Regularized filter, Blind deconvolution, hyper spectral (PCA), neural network, Motion density, Handling outliers, ADSD-AR, and Blurred/Noisy image pair. Based on their performance analysis, ADSD-AR is efficient technique and it gave good results than other techniques.

III METHODOLOGY

This research work used blurring and de-blurring techniques to secure the document images.  

3.1 Blurring Techniques

The basic definition of Blurring is, unclear/ invisible or not understanding the information. Generally images are looks sharper or more detailed if it was able to identify all the objects and their shapes correctly in it [5]. However blur is un-sharp image region produced by camera or inaccurate focusing, subject movement or shallow depth of field. Blur makes perfect image into imperfect image of realization process [1] which is restricted to within the boundaries of a single pixel of the original image. Blur involves calculating weighted averages of areas of pixels in a source image for each pixel of the final blurred image. Computing these weighted averages can be very expensive [7]. Hence it is difficult to identify any object/content from the blur images. In research field, blurring plays vital role, because it is used for security purpose, hence unauthorized persons difficult to identify the image. This is very powerful operation used in image processing and procedural texture generation. Figure 1 depicted in blurring architecture.

3.1.1 Average Blur

The noise is present in the entire raw image is known as average blur. This blurring can be distribution of vertical direction and horizontal in the document image. It can be circular averaging by radius R which is computed by the following formula:

\[ R = \sqrt{g^2 + f^2} \]

where \( g \) is horizontal blurring size direction and \( f \) is vertical blurring size direction and \( R \) is the radius size of the circular average blurring [10]. It is most cost-efficient method to choose when producing a high quality images. Especially if there is a collection of images or small differences across a number of similar images. The visual quality of average blur is pixel-perfect which can be produced at a resolution fit for just about anything you can imagine [11].

3.1.2 Motion Blur

Motion blur is produced maximum level of degradation of the image. The filter is used to make the image appears to be moved by shifting with the aid of adding a blur in an exact direction. The motion blur can be managed by direction or angle and/or by intensity or distance in pixels based on the software use [4]. When a photograph is reserved of any moving object or the imaging system itself, it is moving then the degradation caused is motion blur. This is affected by the movement of the object relative to the sensor in the camera. [8]. 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. The standard of motion blur is to add up the radiance contribution over time, which can be expressed as
\[ L_p = \int \int A(x', w, t)s(x', w, t)g(x')dA(x')dt \]

Where \( g() \) is the filter function, \( s() \) represents the shutter exposure, and \( L() \) is the radiance contribution.

### 3.1.3 Gaussian Blur

Gaussian blur is used in the pre-processing stage in computer vision technique to improve the image structures at different scales [9]. It blends a particular amount of pixels incrementally, following a bell-shaped curve. The kernel coefficients decrease with expanding the distance from the kernel’s center. Center of the pixels have a greater weighting than these on the periphery. Larger values of \( \sigma \) present a wider peak (greater blurring). Kernel size should increase with increasing \( \sigma \) to manage the Gaussian nature of the filter. Gaussian kernel coefficients calculate on the value of \( \sigma \). In the edge of the mask, coefficients should be nearby 0. The kernel is rotationally radial with no directional bias. Gaussian kernel is independent that permits fast computation. Gaussian filters might not preserve image brightness. The blurring is a dense in the middle and plumages at the edge. It is commonly applied to an image when more switch over the Blur effect is needed [2]. A Gaussian blur is the end result of blurring of an image through Gaussian function.

\[ G(x) = 1/(2\pi\sigma^2) e^{-x^2/(2\sigma^2)} \]

Gaussian kernel coefficients are experimented from the 2D Gaussian function and it is defined as:

\[ G(x, y) = 1/(2\pi\sigma^2) e^{-(x^2+y^2)/(2\sigma^2)} \]

Where \( \sigma \) is that the variance of the distribution. It is a generally used effectively in graphics software to reduce image noise.

### 3.1.4 Blear Blur

This work has proposed a new technique for blurring the document image named as blear blur. Blear blur is to make the difference between two things, first one is blurring function another one is adding noise to the original images. Therefore the proposed blear blur technique is to produce imperfect image quality from the original input images. It makes unclear or less distinct with the original images. The following equation is used to evaluate the blur level of an image.

\[ B(x, y) = h \ast f(x, y) + n(x, y) \]

Where \( B(x, y) \) is the original image, \( h \) is the degradation operator, \( f \) is the blur function and \( n \) speckle noise, introduced during image degradation, that corrupts the image. The proposed technique is used to evaluate the how much the document is more blur than the existing techniques.

### 3.2 De-Blurring Techniques

The De-blurring techniques are basically used to sharp an image using different methods and parameters. Authorized owners only de-blur or reconstruct the blurred document images. In this work, we have analyzed two existing de-blurring techniques; they are, Blind De-convolution and Lucy Richardson and one proposed technique is Dabber blur. Figure 2 represents de-blurring architecture.

#### 3.2.1 Blind De-convolution

Blind De-convolution algorithm is used to retrieve information from blurred images. It 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 simultaneously. Additional optical system characteristics can be used as input parameters. It helps to improve the quality of the image restoration. The blurred pattern from the digital images is called as Point Spread Function (PSF). The standard non-linear and linear deconvolution technique used a known PSF. For blind deconvolution, the PSF is estimated from the collection of images to perform the deconvolution. PSF constraints can be passed through a user-specified function. Definition of the blind de-blurring method can be expressed by:

\[ g(x, y) = PSF \ast f(x, y) + \eta(x, y) \]

Where \( g(x, y) \) is the observed image, \( PSF \) is Point Spread Function, \( f(x, y) \) is the constructed image and \( \eta(x, y) \) is the additive noise term.

#### 3.2.2 Lucy Richardson

The Richardson–Lucy algorithm, also named as Lucy–Richardson de-convolution. It is very popular de-blurring algorithm in the area of image processing. This algorithm not required any information from the original clear image and it is an iterative algorithm. The equation of the Lucy- Richardson algorithm is:

\[ f^2(n + 1) = f^n H^2 \ast (g \ast Hf^n) \]
Where \((g)\) is a blurred image, \((H)\) is the blur filter and \((H^2)\) is the adjoin of \((H)\), \((n)\) is the number of the iteration. Where \(f(n + 1)\) is derived estimation from the blurred image \(\hat{f}\). This algorithm will be utilized but the only difference is that instead of using \((H^*)\) in the original equation. This equation is optimized by Lucy-Richardson technique and it is described in the subsequent equation:

\[ f^2(n + 1) = f^2nH^2 * (9/(Hf^2n)) \]

Where, in the first iteration, the value of \(f(n) = g\).

This algorithm is the implementation of maximum likelihood method and it is the ability to provide a good quality reconstructed images. De-blurring is used for recovering the information and it can be seen by the authorized persons. It is used to get the information very clearly from the blurred images. It is considered as decryption method which is used to restore the original image from the blur image. The following equation is used to reconstruct the blurred image, de-blur is approximately described by this equation:

\[ D(x, y) = h(x, y) * f + m(x, y) \]

Where \(D(x, y)\) is the blured image, \(h\) de-blur operator, \(f\) is de-blur function and \(m\) is noise removal operator for image reconstruction from the blurred image.

### IV Experimental Results

The primary objective of this research work is to secure the document images by using blurring and de-blurring techniques. Three existing and one proposed blurring techniques has been used for blur the document images. From the performance analysis blar blur technique is better than the other three techniques. Two existing de-blurring and one proposed de-blurring techniques have been used for de-blur the document images.

#### 4.1 Performance Analysis of the Blurring and De-Blurring Techniques

The PSNR (Peak Signal to Noise Ratio) measures have been used to estimate the performance of the proposed and the existing blurring techniques. Table 1 represents the Performance Analysis of Blurring Techniques. Figure 3 gives pictorial representation of the performance analysis of Blurring Techniques. The results it was found that the proposed blar blur and dabber de-blur techniques performs better than the existing techniques.

<table>
<thead>
<tr>
<th>De-Blur Techniques</th>
<th>Accuracy (PSNR value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blind de-convolution</td>
<td>22.63</td>
</tr>
<tr>
<td>Lucy Richardson</td>
<td>24.55</td>
</tr>
<tr>
<td>Dabber De-blur</td>
<td>26.45</td>
</tr>
</tbody>
</table>

#### 4.2 Performance Analysis of the De-Blurring Techniques

Table 2 represents the Performance Analysis of De-Blurring Techniques. Figure 4 gives pictorial representation of the performance analysis of De-Blurring Techniques.

<table>
<thead>
<tr>
<th>De-Blur Techniques</th>
<th>Execution Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blind de-convolution</td>
<td>1178</td>
</tr>
<tr>
<td>Lucy Richardson</td>
<td>1202</td>
</tr>
<tr>
<td>Dabber De-blur</td>
<td>936</td>
</tr>
</tbody>
</table>

#### Table 1 Performance Analysis of Blurring Techniques

<table>
<thead>
<tr>
<th>Blur Techniques</th>
<th>Accuracy (PSNR value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Blur</td>
<td>27.10</td>
</tr>
<tr>
<td>Motion Blur</td>
<td>33.02</td>
</tr>
<tr>
<td>Gaussian Blur</td>
<td>25.89</td>
</tr>
<tr>
<td>Blear Blur</td>
<td>37.85</td>
</tr>
</tbody>
</table>

#### Table 2 Performance Analysis of De-Blurring Techniques

<table>
<thead>
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</tbody>
</table>

#### Table 4 Execution Time of De-Blurring Techniques
Figure 4 Performance Analysis of De-blurring Techniques

Table 3 Execution Time of Blurring Techniques

<table>
<thead>
<tr>
<th>Blur Techniques</th>
<th>Execution Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Blur</td>
<td>1370</td>
</tr>
<tr>
<td>Motion Blur</td>
<td>1102</td>
</tr>
<tr>
<td>Gaussian Blur</td>
<td>1594</td>
</tr>
<tr>
<td>Blear Blur</td>
<td>947</td>
</tr>
</tbody>
</table>

Table 5 Experimental results of Blurring Techniques

Input Image

Abstract: Compression is one of the image mining techniques, which helps to save memory, easy file transfer and decrease costs for storage hardware and network bandwidth. Different types of compression techniques are available for compressing image to save transmission. Compression can be either lossy or lossless. In this paper, we provide the basic concepts of image compression and different types of compression techniques.

Keywords: Image mining, Compression, Lossy compression, and Lossless compression.

1 Introduction

Image mining is the process of searching and discovering valuable information and knowledge from large volumes of image data. These image data contain the real-time image data set and is collected from various sources such as Scanned Documents images, Medical images, Remote sensing images, Natural images, etc. Image mining has two different

Figure 6 Execution Time of De-Blurring Techniques
<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Blur</td>
<td>A type of blur that averages the pixel values across a window.</td>
</tr>
<tr>
<td>Motion Blur</td>
<td>A blur that simulates the effect of movement on an image.</td>
</tr>
<tr>
<td>Gaussian blur</td>
<td>A blur that uses a Gaussian function to spread the pixel values.</td>
</tr>
<tr>
<td>Blear Blur</td>
<td>A less common type of blur that uses a specific kernel to blur the image.</td>
</tr>
</tbody>
</table>
**Table 4 Experimental results of De-blurring Techniques**

<table>
<thead>
<tr>
<th>Decrypted Blurred Image</th>
<th>Blind De-convolution</th>
<th>Lucy Richardson</th>
<th>Dabber De-blur</th>
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<td><strong>Abstract</strong>: Compression is a one of the image mining technique, which helps to save memory, easy file transfer and decrease costs for storage hardware and network bandwidth. Different types of compression techniques are available for compress the image to easy transmission. Compression can be either lossy or lossless. In this paper provides the basic concept of image compression and different types of compression techniques. Keywords: Image mining, Compression, Lossy compression and Lossless compression.</td>
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**V Conclusion**

This research work is used to secure the document images by using blurring and de-blurring techniques. Three existing and one proposed blurring techniques have been used for blur the document images. From the performance analysis, it was found that the proposed de-blurring technique is better than the other three techniques. Two existing de-blurring and one proposed de-blurring techniques have been used for de-blur the document images. From the performance analysis, it was found that the proposed dabber de-blur technique is better than the other two techniques. In future, this...
research work will be extended for handling large amount of images for securing the document images.

REFERENCES