A BACKGROUND ESTIMATION METHOD FOR SHADOWS REMOVAL OF DOCUMENT IMAGES

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ABSTRACT

Document shadows make digitisation difficult and seeing uncomfortable. This study provides two steps to eliminate shadows from single document images: shadow detection and removal. An iterative nearby information-based technique estimates pixel-wise local background colour images for shadow detection and shadow map generation. The local background colour image provides a global reference background colour for shadow reduction. Local and global background colour estimates the shadow scale for relight shaded zones.The proposed method may efficiently produce high-quality unshadowed document photographs.

Index Terms— Shadow removal, Document images, Neighboring information, Local background color

1. INTRODUCTION

The emergence of smartphones has made snapping images in a variety of settings easier and more comfortable. People can share their photographs at any time using the mobile internet, as long as they have a smart phone in their possession. An ongoing pattern reveals that there are increasingly more people using a camera instead of a scanner.

Normally, shadows are generated when an illumination source is partially occluded by objects. Most of shadow detection and removal algorithms focus on the outdoor scenes under the sunshine Objects like the ground, grass, and walls that have background colours are most often what are covered by shadows in their respective zones. The background is vivid even in the fixed and static images that are captured by surveillance cameras.In this paper, our goal is to build a method that can simultaneously eliminate shadows from document photos and preserve text information. This will be accomplished by designing a method.

When there are shadows in a document image, the background of the shadow parts tends to be dark, while the background of the illuminated sections tends to be bright . This motivates us to make an estimate of the amount of darkness in an image (i.e., shadow map).

In this paper, we offer a new method for removing shadows that does not involve any interaction from the user. There are two primary contributions included here. First, we devise a method that makes use of the information available about each pixel's neighbours in order to make a prediction about the background colour of that pixel. This method builds a shadow map and provides an estimate of the global reference background colour. Second, in order to generate an image without any shadows, we offer a method that uses a shadow scale that is generated based on both the global and the local background colour. Experiments that were carried out on a document dataset have demonstrated that our strategy is effective.

2. THE PROPOSED METHOD

The suggested procedure primarily consists of two stages, which are shadow detection and shadow elimination. Estimations of the local background colour image, the shadow map, and the global reference background colour are all part of the shadow detection stage. During the stage devoted to the removal of shadows, the estimation of the shadow scale γ (x, y), which is used to re-light shadow areas, is the primary focus. Figure 1 presents the flowchart for your perusal.

2.1. Local and Global Background Color Estimation

Document images include dark words and bright backgrounds. Each pixel's neighbours help estimate the local background colour (bright). An effective selection policy to estimate local background colour is as follows.

$$I_{max}(x,y) = max(I(i,j)), (i,j) \in \mathbf{W}$$
$$I_{min}(x,y) = min(I(i,j)), (i,j) \in \mathbf{W} \quad (1)$$

$$\alpha = (I_{max}(x,y)) - I_{min}(x,y))/I_{max}(x,y) \quad (2)$$

$$L(x,y) = I_{max}(x,y) * (1-\alpha) + I_{min}(x,y) * \alpha \quad (3)$$

In Eq.1, W represents the neighboring window (like 5 × 5). The maximum value $(I_{max}(x,y))$ and the minimum value $(I_{min}(x,y))$ in the neighboring window are selected to compute a fusion factor which is used to correct the extreme white noise. The local background color $L(x,y)$ is estimated by Eq.3 (shown in Fig. 1 (b)).

An example of local background color image is shown in Fig. 1 (c). A shadow map (shown in Fig. 1 (d)) can be easily generated by applying Otsu [3] to Fig. 1 (c). Given the local background color image and shadow map, global reference background color can be obtained by an approximation means:

$$G = \frac{1}{n} \sum L(i,j), (i,j) \in \textbf{Unshadowed Region}$$

(4)

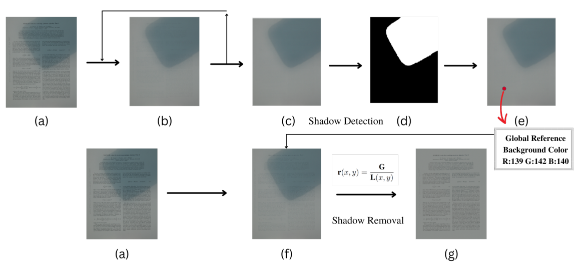


Fig. 1 The Flowchart of document shadows removal. The dash line represents an iterative process to estimate the local background color. (a) Input image, (b) Local background color image (neighbor:5×5), (c) Background color image after several iterations, (d) Shadow map, (e) Find global reference background color, (f) Local background color image (neighbor:3×3), (g) Coarse unshadowed result with MSE 20.115,

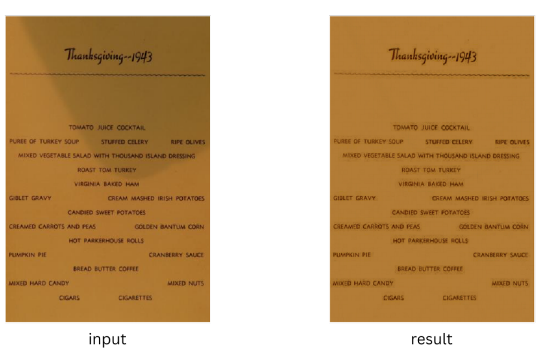


Fig. 2 Demonstration of the method on another image

2.2. Shadow Removal

In most cases, the areas that are cast in shadow are significantly darker than the areas that are not cast in shadow. By applying a shadow scale r, the shadowed areas can have their lighting restored $r(x,y)$

$$r(x,y) = \frac{G}{L(x,y)}$$

(5)

we use $L(x,y)$ from eq.(3). is derived from a 3×3 neighbor window, which ensures to acquire a relative accurate background color. Each pixel calculates three RGB channels. Multiplying shadow pixel intensity and r yields an unshadowed image (Fig. 1 (g)) for a document image with uniform illumination $r(x,y)$. When the illumination is not uniform, it is possible that artefacts will be created, and it is important that these must be corrected.

2.3. Tone Fine-tuning

Optionally to further enhance our image we can do tone fine tunnelling. We are using this method to remove artifacts.we define tone scale as a ratio between lit regions and shadow regions.

$$\tau = \frac{bg_{lit}}{bg_{shadow}}$$

(6)

where bg_{lit} represents the average background color of unshadowed regions and bg_{shadow} represents the average background color of shadow regions. τ is calculated from a perspective of entire image, which is different from pixel's shadow scale $r(x,y)$ The fundamental component of a tone scale is a gradient that runs from lighter to darker areas. When referring to a pixel, when its If the shadow scale $r(x,y)$ is out of the ordinary, the symbol can be a helpful reference.

In the case of pixels that make up text, if they are sufficiently dark and Since $r(x,y)$ is significantly larger than, the shadow scale should be increased. be shortened while maintaining the text's original details. After the final adjustments to the tone process, it is anticipated that a better shadow removal result will be achieved,

3. QUANTITATIVE COMPARISON

In this section, we compared our method with the reference ground truth image using MSE and ErrorRatio. Mean Squared Error (MSE) and ErrorRatio as follows:

$$MSE(R,GT) = \frac{1}{n} \sum (R(x,y) - GT((x,y))^2$$

(7)

$$ErrorRatio = \frac{RMSE(R, GT)}{RMSE(I, GT)}$$

(8)

where RMSE is the root MSE and R, GT, and I represents the result of unshadowed image, ground truth, and input image, respectively.

MSE of input w.r.t Ground Truth = 464.04642

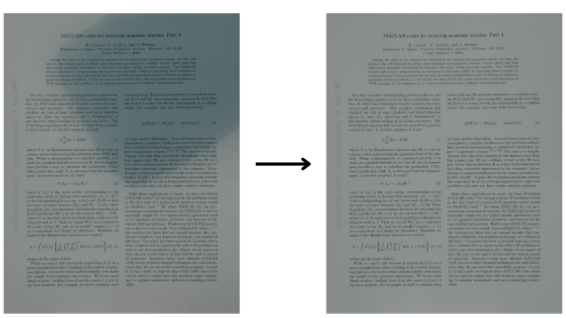
MSE of result w.r.t Ground Truth = 20.115389

$$ErrorRatio = \frac{20.1153}{464.04642} = 0.043$$

(9)

4. VISUAL RESULTS

Figure 2,3 shows visual results of this method. In one side we can see the shadowed image and in the other side we can see the unshadowed result. Improvement is clearly visible between the images with minimal shift in background colour and perfectly removed shadows.



Input Result

Fig. 3 The final input and output pair

5. CONCLUSION

In this piece of report, we proposed an automated approach to removing shadows from photographs of documents. It does this by using the information about a pixel's neighbours to estimate the local background colour of the image in an iterative manner. This makes detecting shadow maps an easy task. When shadow scale is applied to an input image, an unshadowed output can be generated, and then tone fine-tuning can be performed afterwards. The proposed strategy appears to perform better than other state-of-the-art approaches, according to both qualitative and quantitative assessments and comparisons. In the future, our effort will concentrate on the elimination of shadows from document photos that contain figures, which will further increase our efficiency.

6. REFERENCES

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