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Detection and Enhancement of Shadowing Effect occurs in Images

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Abstract— ***Shadowing in images is unwanted and occurs in an area where direct light from a light source cannot reach due to obstruction by an object. It can affect the successful recognition of edge, object, image matching, change detection and other processing. This paper presents the survey and analysis of current shadow detection and enhancement methods of images. An algorithm of detection and enhancement of shadowing effect is proposed in this paper.***

Keywords— Cast Shadow; Self Shadow;Shadowing;umbra

I. INTRODUCTION

Shadowing in images and its detection is an important field of most object detection and tracking algorithms. Shadings in images occur when objects occlude light from a light source and they appear as surface features. Shadow detection and enhancement of images covers many specific applications such as traffic surveillance [1, 2], face recognition [3, 4, and 5] and image segmentation [6]. Object shadow detection has been an active field of research for several decades. Most researches focus on providing a general method for arbitrary scene images and thereby obtaining "visually pleasing" shadow free images. Many techniques [7, 8, and 9] have been proposed for removing shadows from images. This paper aims to give a relatively comprehensive study on the current methods of detecting and removing shadows. In general, shadows can be divided into two major classes: Self shadow and Cast shadow.

A self shadow occurs in the portion of an object which is not illuminated by direct light. A cast shadow is the area projected by the object in the direction of direct light. Cast shadows can be further classified into umbra and penumbra region, which is a result of multi-lighting and self shadows also have many sub-regions such as shading and inter-reflection. Usually, the self shadows are vague shadows and do not have clear boundaries. On the other hand, cast shadows are hard shadows and always have a violent contrast to background. Because of these different properties, algorithms to handle these two kinds of shadows are different. For instance, algorithms to tackle shadows cast by buildings and vehicles in traffic systems could not deal with the attached shadows on a human face. Accordingly, this survey attempts to classify various shadow removal algorithms by the different kind of shadows they focus on and in fact, by the different assumptions they made to the shadows.

The penumbra (from the Latin paeans "almost, nearly" and umbra "shadow") is the region in which only a portion of the light source is obscured by the occluding body. An observer in the penumbra appears like a partial eclipse. The umbra (Latin for "shadow") is the darkest part of the shadow. In the umbra, the light source is completely occluded. So in the umbra it is said shadows experience total eclipse. Hence it is a complete or perfect shadow of an opaque body, where the direct light from source of illumination is completely cut off.

The antumbra is the region from which the occluding body appears entirely contained within the disc of the light source. If an observer in the antumbra moves closer to the light source, the apparent size of the occluding body increases until it causes a full umbra. So it appears like an annual eclipse.

II. Various Algorithm of Shadow Detection

Yung, N.H.C.; Pang, G.K.H. ; Lai, A.H.S. [10] proposed the shadow confidence score and the bounding hull, the cast shadow is identified as those regions outside the bounding hull and with high shadow confidence score. Andrea Cavallaro , Elena Salvador , Touradj Ebrahimi [11 presented an algorithm for the de-diction of local illumination changes due to shadows in real world sequences. The algorithm was designed to be able to work when camera, illumination and scene's characteristics were unknown. Experimental results show that the proposed algorithm outperforms state-of-the-art methods and can be applied on both indoor and outdoor image sequences. Wang [12] suggested a three step process to remove shadows from a foreground object obtained after subtraction of an image from a background image. The first step was illumination assessment, in which the foreground region is analyzed to determine if it contains any shadow based on pixel intensity and energy. If a shadow was suspected to exist on aggregate statistics of bright and dark pixels, the shadow detection step was performed. In the final step, the object is recovered by using information from the object area and shadow attributes to construct the object. Yasuyuki Matsushita, Member, K. Nishino proposed an illumination normalization scheme which can potentially run in real time, utilizing the illumination eigen space, which captures the illumination variation due to weather, time of day, etc., and a shadow interpolation method based on shadow hulls. Beril Sırmacek and Cem Unsalan recommended a novel approach for building detection using multiple cues. Yue Wang , Shugen Wang preferred an edge detector . The general principle of the partial differential equations used in image restoration, a new shadow detection algorithm based on the PDES was presented, which uses the gradient values to be the parameter of edge detector. Ruiqi Guo, Qieyun Dai Derek Hoiem predicted relative illumination conditions between segmented regions from their appearances and perform pair wise classification based on such information. Classification results were used to build a graph of segments, and graph-cut is used to solve the labeling of shadow and non-shadow regions. Andres Sanin, Conrad Sanderson, Brian Lovell proposed physical method improves upon the accuracy of the chromacity method by adapting to local shadow models, but failed when the spectral properties of the objects were similar to that of the background. Nijad Al-Najdawi a, Helmut E. Bez Jyoti Singhai c, Eran.A. Edirisinghe presented a comprehensive survey of shadow detection methods, organized in a novel taxonomy based on object/environment dependency and implementation domain. Q. Ye, H. Xie, Q, Xu proposed a method to remove tall building shadows in true colour and colour infrared urban aerial images based on the theory of colour constancy. G.L loyds Raja,Maheshkumar H.Kolekar presented a novel method of illumination normalization based image restoration. A modified retinex algorithm was proposed to remove the shadow and restore the image. First, image was splited into illumination (L) and reflectance (R) components. The Reflectance component was subjected to threshold filtering while the illumination component was subjected to modified retinex algorithm and the resulting reflectance component was combined effectively with the output of threshold filter for obtaining the shadow-free image.

III. Algorithm of Shadow Enhancement

The first step is to remove noise of image with shadow by filter. To remove shadow properly, average frame is computed to determine effect of shadow in each of the three dimensions of color. So the colours in shadow regions have larger value than the average, while colours in non-shadow regions have smaller value than the average values. Images are represented by varying degrees of red, green, and blue (RGB). Red, green, and blue backgrounds are chosen because these are the colors whose intensities, relative and absolute, are represented by positive integers up to 255.

Create a threshold piecewise function to remove shadow regions. The results of the threshold function is a binary bitmap where the pixel has a value of zero if the corresponding pixel is in the

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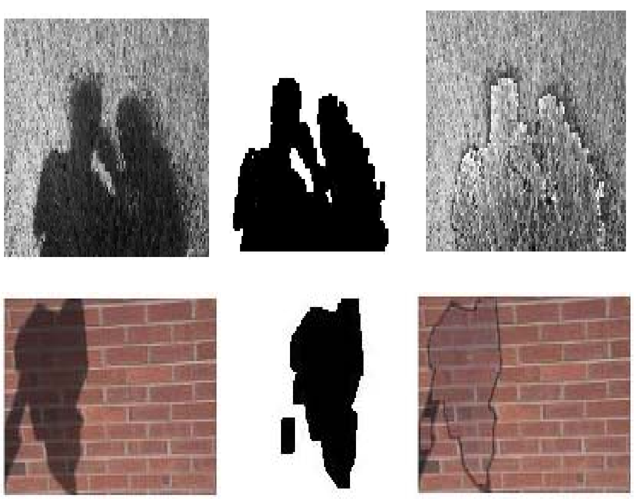
shadow region and it has a value of one if the corresponding pixel is in the non shadow region. Finally, convolute the noise-free binary image with the original image to separate the shadow from the non-shadow regions. By testing the effects of shadow on specific pixels located in the solid backgrounds, the effect of shadow can be derived for different pixel value combinations by applying binary and morphological function. Solid colours are utilized as a background in order to remove as many variables as possible from the experiment. Pixels with wide variations in colour may reside next to each other giving skewed results. The separate analyses of these three solid backgrounds showed a correlation utilized to predict the effect of shadow in a multitude of situations. Finally energy function is applied to remove shadow.

IV. Simulation Results

The algorithm of shadow detection and enhancement of shadow portion is applied to various color images and the results are shown in figures 1 (a) to 1(c).



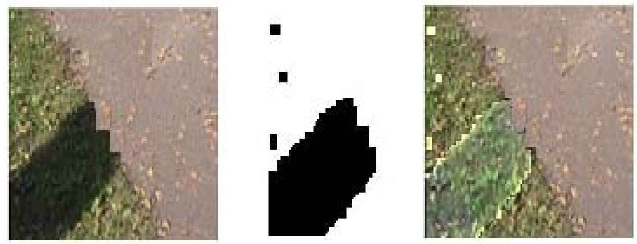


Fig. 1. (a) Original image (b) Shadow image (c) Enhanced image.

Table 1: PSNR, MSE, Normalized Absolute Error, Normalized Cross-Correlation.

Pictures	PSNR	MSE	NAE	NCC
Person	38.130	10.00	0.2615	1.0806
Bricks	45.648	1.77	0.1026	1.0505
Grass	41.536	4.56	0.1422	1.0468

V. Conclusion

This paper represents the study and analysis of shadowing in images. We proposed a shadow detection and enhancement algorithm. The algorithm detects and enhances the shadow portion of image effectively and accurately.

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