An Efficient Way to Detect and Remove Shadows Based on Multiple Light Sources

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Abstract: ***A shadow is shaped when a light is blocked by an opaque object. They are sometimes unwanted as they may cause failure of image analysis and can also cause poor eminence of information. This paper first describes some important techniques that are used for shadow detection such as segmentation, Histogram Matching and some techniques that are used for shadow removal such as Morphological operations. The proposed methodology is to design a system based on three basic aims-the first goal is shadow detection of single and multiple images, second goal is to remove the shadow from the single and multiple images and third is to calculate the different parameter for measuring the quality of shadow removal method. Once the shadows are detected it becomes simple to detect a non shadow area which is estimated using morphological operators but sometimes when the shadow of any image is merged with the foreground object then the detection process becomes more complex.***

Keywords: Histogram Matching, Morphological Operations, Shadow Detection, Shadow Removal.

I. INTRODUCTION

A shadow is shaped when a light falls on object. If there is a shadow in an image it may cause poor quality of image quality. Shadows can be divided into two parts - self shadows and cast shadows. Shadows are not always black. When lights of different colors burnish on the same dot on a white surface, the light reflecting from that dot to eyes is called an additive mixture because it is the sum of all the light. In order to detect the shadow in an image the first step is to find challenges which may occur when removing shadows from a single image and multiple images and secondly a framework is provided for shadow removal, in which we attempt to overcome some of the fundamental problems. Experimental results demonstrating the capabilities of our algorithm are presented. The steps which are involved require the database of multiple shadows from various website, real world images and light images, and then the shadows are detected and removed from particular image.

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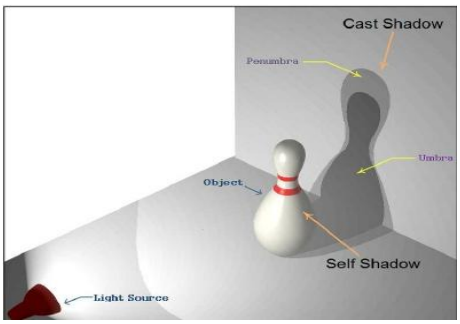


Fig. 1. Types of Shadow

II. LITERATURE REVIEW

There are many techniques based on different algorithm to detect and remove shadows from image. The following are the some of the literature reviews which has been published previously:-The shadow detection algorithms with high-resolution satellite images are used. The shadow reconstruction process is implemented. [1]. In paper [2], the method captures the shadows from still images and uses a modified nonlocal matching. A survey of various shadow detection techniques has been presented and compared by discussing their advantages and limitations.[3].A shadow removal method for aerial images is identified and implemented[4].

III. PROPOSED METHODOLOGY

The main objective of the proposed methodology is based on three basic aims:-

1. Our first goal is detect multiple shadows from input image.
2. Our second goal is to remove shadow.
3. Calculate the different parameter for measuring the quality of shadow removal method.

The proposed methodology is implemented with Matlab.In first section is to load the shadow image that is the images should be very clear identify the shadow from background image and must be in proper image file format. In the second section we add different type of noise. In the third section we call the functions which denoise the image by using wavelet. The fourth section we call the functions for finding different parameters like PSNR, MSE and time also we study the performance of the wavelets and find which wavelet gives the maximum value of all parameter for every type of images. The methodology includes five steps to detect shadow from an image:

1. The first step is pre-selection of shadow pixels.
2. The second step is grouping of shadow pixels.
3. The third step is selection of pixels with considerable gradient magnitude in each region

4. The fourth step is to calculate distance between the given frame and the background location image.
5. The last step is to find the correlation of the gradient direction between the given frame and the background image.

The following algorithms are used to detect shadow or shadows from an image:

Texture-based Shadow Detection

This shadow detection method includes two steps:
1. Selection of shadow pixel
2. Classification of shadow pixels based on background and foreground image.

Chromaticity-based Shadow Detection

This shadow detection method can be broadly used in surveillance applications**.** The advantage of this algorithm is faster to implement but disadvantage is sensitive to pixel-level noise.

Physical Method

This method is significantly faster in real time applications but it needs more operations.
In this researcher methodology the following modules are used to detect multiple shadows in an image:

1. RBG Image into Gray Scale Image Module-In this module we add the values of color image parameters and then divide it by three to get grayscale image.

2. Edge Detection Module- In edge detection, the detection should accurately hold as many edges as possible and a particular edge in the image should only be marked once.

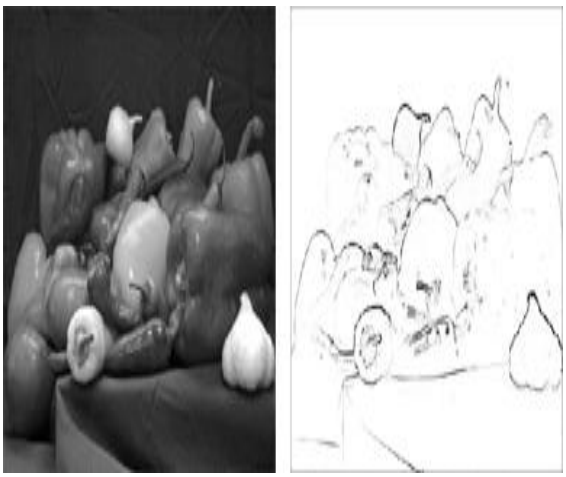


Fig. 2. Edge Detection

After applying all the steps and modules which are mentioned above, Morphological Operations are to remove detected shadow from an input image, the following algorithms are used for shadow removal:

Model Based Technique

This technique are applied to simple specifications only, when two types of light sources are directed to object either when light comes directly from sources or it coming indirectly.

Additive Based Technique

This technique is used in which the average pixel intensities are calculated.

Combined Shadow Removal

This technique is combined approach of Model based and Additive based technique. The image is converted to the YCbCr color-space.

IV. EXPERIMENTAL RESULTS

First of all an input image is a taken having multiple shadows in an image, Shadows must be dark enough so that it may be detected easily, if it is lighter than detection process will be harder and difficult to find a shadow from an image. The following image Fig 3 can be taken as an input image for detection and removal of shadows.

Fig. 3. An image with multiple shadows

Once the darker part of an image is extracted, color information can be used to categorize the shadow regions of the object and background of an image. Another constraint may occur due to the low intensity.

Fig. 4.Shadow extracted image

As the shadow of an image is extracted, next we highlight the shadow part of object and differentiate it between background and foreground. The following image fig.5 shadow dark image shows shadows in darker form.

Fig. 5. Shadow dark image

Once shadow is detected we add parameters to remove them. The first step is to calculate the pixels and boundary of each shadow. With the help of Laplacian of Gaussian and applying numerical formulas the images are first transformed to logarithmic and then exponential to remove the detected shadow in an image.

The Force Histogram Decomposition (FHD)

1. FHD decomposes the image along its intensity level-sets into layers.
2. Encodes two types of information: first encodes shape information, histogram of forces between a layer and itself and second encodes relative spatial relations.
3. Balances above two information with a parameter.

FHD parameters

1. Histograms of forces are used for calculations.
2. Constant force is used for shape information.
3. Gravitational force is used for spatial organization

The following figure shows an output image after applying algorithms and all the detection process to detect the edge as well as shadow in an image. After detecting the shadow, it has been removed and fill it will background color in an image.

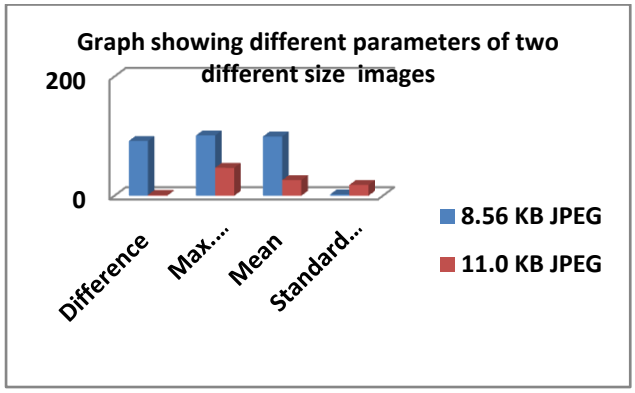
Fig. 6.Shadow removed image

The following table shows the calculated parameter value which input image and output image. The table shows the value of two images of different size which calculates the mean difference, max difference and standard deviation of input and output image.

Table- I: Calculated Parameter Values

IMAGE SIZE	DIFFERENCE	MAX. DIFFERENCE	MEAN	STANDARD DEVIATION
8.56 KB JPEG	91.8818	101.1088	99.33828	2.2856
11.0 KB JPEG	1.3692	46.81215	26.26522	18.072

The following is the graph shown according to calculated parameters:



V. CONCLUSION

In this paper, investigation of different approaches for shadow removal in multiple color images is done. In this research the author concentrate on developing FHD base filtering schemes for shadow removal. In addition, an example application of shadow detection is also mentioned. The wider the light source, the more blurred the shadow becomes. A graph is plotted which shows the different parameters of two different size images. Thus, the only constraint is that the shadow should be very clear in order to detect and remove from image.

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Prof. Rohini H. Joshi has 4.5 years of teaching experience. She is currently working as Assistant Professor in the Department of Information Technology at Shri Ramdeobaba College of Engineering and Management, Nagpur. She has published 5 research papers in reputed international journals and conferences. Her area of interest includes Image Processing and Web Designing.