A Review: Shadow Detection And Shadow Removal from Images.

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Abstract- Shadows appear in remote sensing images due to elevated objects. Shadows cause hindrance to correct feature extraction of image features like buildings ,towers etc. in urban areas it may also cause false color tone and shape distortion of objects, which degrades the quality of images. Hence, it is important to segment shadow regions and restore their information for image interpretation. This paper presents an efficient and simple approach for shadow detection and removal based on HSV color model in complex urban color remote sensing images for solving problems caused by shadows. In the proposed method shadows are detected using normalized difference index and subsequent thresholding based on Otsu's method. Once the shadows are detected they are classified and a non shadow area around each shadow termed as buffer area is estimated using morphological operators. The mean and variance of these buffer areas are used to compensate the shadow regions.

Keywords- Shadow detection, Thresholding,Shadow Removal.NSVI(normalized saturation-value difference index (NSVDI),HSV(Hue-Saturation-Value)

I   INTRODUCTION

In urban remote sensing images, shadows are usually cast by elevated objects such as various cultural features (buildings, bridges, towers, etc.) when they are illuminated by the Sun at the time of exposures. Shadow in remote sensing image is conflict information in computer image processing. On the one hand, it can reduce the successful rate of edge extraction, object recognition, image matching, change detection and other processing for the corresponding ground objects in the shadow . On the other hand, it can produce a great deal of useful information about shape, relative position, surface character and other characters of the object generating shadow . It is a necessary step to eliminate shadow and restore the scenes in the shadow area before performing object recognition and image matching tasks for the shadow area.Thus, shadow detection and elimination has become very important in image processing. Shadow detection and removal has wide application in change detection from remote sensing images done to assess damage due to natural disasters like earthquakes, tsunamis, landslides etc. since shadows obstruct the correct extraction of buildings and shadows lead to false detections. VHR remote sensed images show very fine details of features such as building, roads, vehicles, and trees. However, the amount of shadow increases with the spatial resolution. Shadow detection and removal methods work together to remove shadows. Shadow detection methods can be categorized into method based on model and method based on shadow property Shadow spectra and shadow geometrical features are used in shadow property based methods . Tsai presented a method which uses the spectral ratio image in HSI space to segment shadow Polodorio proposed a method by thresholding saturation intensity difference image in HSI color space Shadow compensation is to restore the surface under shadows. Considering that a surface texture does not significantly change when shadowed, neighbouring non shadowed segments are usually used to compensate shadowed ones. In the literatures, algorithms include gamma correction method , linear correlation method , posteriori probabilities method .Almost all these approach are operated band by band in RGB color space, which makes the composite color unnatural.Another method is proposed in.To overcome the above mentioned problems, a simple and efficient shadow detection and removal algorithm for remote sensing images is proposed in this paper. The proposed method first detects shadow by considering the HSV color space using Otsu's method of thresholding. Once shadows are detected they are removed using the mean and variance values of the buffer area which is the non shadow area around each shadow

II OVERVIEW OF SHADOW DETECTION

A) SHADOW: A shadow is an area where direct light from a light source cannot reach due to obstruction by an object. There have been few studies concerning shadow removal, and the existing approaches cannot perfectly restore

the original background patterns after removing the shadows.

B) Assumptions of Shadow: Here are our basic assumptions are as follows
1) The illumination image is spatially smooth.
2) There is no change in the texture inside the shadow region.
3) In the shadow regions, the illumination image is close to being constant. Pixels inside shadow regions have different colours because of the reflectance image, not the illumination one
.
C) Self and Cast Shadow: Shadow detection and removal is an important task in image processing when dealing with the outdoor images. Shadow occurs when objects occlude light from light source. Shadows provide rich information about the object shapes as well as light orientations. Some time we cannot recognize the original image of a particular object. Shadow in image reduces the reliability of many computer vision algorithms. Shadow often degrades the visual quality of images. Shadow removal in an image is an important pre-processing step for computer vision algorithm and image enhancement.
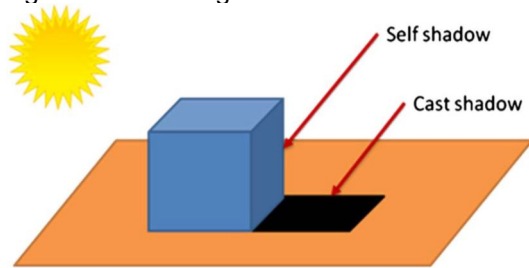

Fig. 1. Illustration of cast and self shadows.[7]

III) VARIOUS SHADOW DETECTION METHOD:

SR NO.	METHOD	KEY IDEA	ADVANTAGES	DISADVANTAGES
1	Region growing	Seed pixels have been selected and set as shadow group. Mean and standard deviation are calculated.	Orientation based technique.	Region growing, failed when the pixel intensity varied widely in the shadow region.
2	Dual-Pass Otsu Method	Pixels value is separated into high and low level intensity. Threshold is set to distinguish between self and cast shadow. Cast shadow pixels are than replaced by background pixels.	It is computational inexpensiveness.	Performance is poorest.
3	Edge Subtraction and Morphology	Canny edge detection is used to detect background edge and foreground edge. Resultant edge image is calculated by difference of both background and foreground edge. Centroid of vehicle-shadow region is found by formula.	Method is best when scenes containing light and dark vehicles	It is most computationally expensive.

4	Gradient-based background subtraction	Fixed threshold is set for T vertical and T horizontal, boundary of object is extracted using neighbored ratio. Foreground is extracted by using mixture of Gaussians.	Location is used to detect the shadow. Shadow detection is done correctly. Real time applications take advantage of this algorithm.	
			Gradient vector is used to detect shadow. Image information is used.	
5	Based on Intensity Information	Standard deviation is calculated for ratio value. Conditions are set for a shadowed pixel.		Actually the pixel intensity value is susceptible to Illumination changes.
6	Based on Photometric Invariants Information	Intensities in the neighbor pixels in the foreground region is equal to the ratio of neighbor pixels in the background image in the presence of shadow.	Performance is better by using robust features. It takes little time. The average time consumption is good for real-time application.	
7	Partial Differential Equations	Different filters are used to smooth the image.	Shadow detection is successful and effective.	

IV) CONTRAHARMONIC FILTERS:

The contra harmonic filter is the most popular nonlinear filter for removing impulse noise, because of its good denoising power and computational efficiency. It is a nonlinear digital filtering technique, often used to remove noise.The main idea of the contra harmonic filter is to run through the signal entry by entry, replacing each entry

with the mean of neighboring entries. The pattern of neighbors is called the "window", which slides, entry by entry, over the entire signal. For 1D signal, the most obvious window is just the first few preceding and following entries, whereas for 2D (or higher dimensional) signals such as images, more complex window patterns are possible (such as "box" or "cross" patterns). If the window has an odd number of entries, then it is simple to define: it is just the middle value after all the entries in the window are sorted numerically .Mathematically it can represent as follows.

$$f(x,y)=\frac{\sum_{(s.t)\in s_{xy}} g(s,t)^{Q+1}}{\sum_{(s.t)\in s_{xy}} g(s,t)^{Q}} \qquad \textbf{(1)}$$

Where Q is called the order of the filter.This filter well suited for reducing the effects of salt and pepper noise.For positive values of Q the filter eliminates pepper noise and for negative Q its reduce salt noise.

v) SHADOW REMOVAL TECHNOQUE USING COLOR IMAGE:
 We can segment the image that means we have shadow and non shadow region of the image now we can remove the non shadow region of the image.
(1) Color transformation
The RGB-based color images are converted into HSV color space. In HSV color space, shadow regions hold some special properties which can be used for shadow segmentation: high saturation,low value and high hue.
(2) Shadow segmentation
Compared with other type of objects such as roads, vegetation and buildings, shadow areas have higher value of saturation component and lower value of

value component in HSV color space. Based on these particular properties of shadows, the normalized saturation-value difference index is constructed to identify shadows. NSVDI is calculated by subtracting the value component from the saturation component for each image pixel. In NSVDI images, shadow regions are segmented by a threshold.

(3) Shadow compensation

Considering that a surface texture does not significantly change when shadowed, neighboring non-shadowed segments are usually used to compensate shadowed ones. Common methods are operated band by band in RGB color space, which makes the composite color unnatural. Thus, histogram matching method is used to adjust the hue, saturation and value component in segmented shadow regions respectively, by matching histogram with the local surroundings around each shadow region. Then, the result images are converted back to RGB color space.

VI) SHADOW REMOVAL TECHNOQUE USING VARIOUS ALGORITHM:

1) Model based shadow removal

We use a simple shadow model, where there are two types of light sources: direct and ambient light. Direct light comes directly from the source, while environment light is from reflections of surrounding surfaces. For shadow areas part or all of the direct light is occluded.The shadow model can be represented by following formula:

$$I_i = (T_i COS\theta_i L_d + L_e)R_i \quad (2)$$

I_i represents the value for the *i*-th pixel in RGB space

L_d and L_e represent the intensity of the direct light and environment light, also measured in RGB space

R_i is the surface reflectance of that pixel

θ_i is the angle between the direct lighting direction and the surface norm

T_i is the attenuation factor of the direct light; if

$T_i = 1$ means the object point is in a sunshine region; if $T_i = 0$ then the object point is in a shadow region

We denoted by $K_i = T_i COS\theta_i$ the shadow coefficient for the *i*-th pixel and by r=$\frac{L_d}{L_e}$ the ratio between direct light and environment light. Based on this model, our goal is to relight each pixel using this coefficient in order to obtain a shadow free image. The new pixel value is computed based on the model

$$I_i^{shadow\ free} = \frac{r+1}{K_i r+1} I_i \quad (3)$$

2) Additive shadow removal

Another rather simple shadow removal technique was an additive correction of the color intensities in the shadow area. We computed the average pixel intensities in the shadow and lit areas of the

image(lets call them E_{shadow} and E_{lit}) and added this difference to the pixels in the shadow areas

3)Combined shadow removal

The third shadow removal method vas the combination of the previous two ones. We converted the

images to the YCbCr color-space. After, we used the additive method for the correction on the Y channel,

and the model-based method for the correction of the Cb and Cr channels

.

VI) CONCLUSIONS

In this paper, we have provided a comprehensive survey of shadow detection and removal in indoor outdoor scene, traffic surveillance images etc. survey is done on various types of images real time application or traffic images. A survey on various shadow detection and removal method and algorithm with their advantages and disadvantages.

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REFERENCES

[1]. Li Xu, Feihu Qi, Renjie Jiang, Yunfeng Hao, Guorong Wu A survey on shadow detection and shadow removal in real images.

[2]. Wang Junli ,Wang Shugen, 2002. A method of image shadow detection based RGB colour space. Information Technology, 26(12), pp.7-9.

[3]. Yan Li,Tadashi Sasagawa and Peng Gong,2004. A System of the Shadow Detection and Shadow Removal for High
Resolution City Aerial Photo. ISPRS, COMMISSION

[4]. Barnes N.and Liu Z.Q,1999. Knowledge-based shape from shading. Int. J. of Pattern Recognition and Artificial Intelligence, 13(1), pp.1-23.

[5]. Ortega A.and Shah M, 1998. From shape from shading to object recognition. Int. J. of Pattern Recognition and
Artificial Intelligence, 12(2), pp.191-208.

[6]. Yang Yijun, Zhao Rongchun and Jiang Wenbing, 2002. Detection of shadow areas from aerial imagery. Signal
Processing,18(3),pp.228-232.

[7]. Wang, Ning ; Lang, Congyan ; Xu, De ,2011, Image-Based Shadow Removal via Illumination Chromaticity Estimation in Multimedia Information Networking and Security (MINES),pp. 33-36

[8]. Grégoire Mercier, Senior Member, IEEE A Complete Processing Chain for Shadow Detection
and Reconstruction in VHR Images.