ALORITHM FOR SHADOW DETECTION IN REAL COLOUR IMAGES

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***Abstract*—Shadow detection in real scene images is always a challenging but yet interesting area. Most shadow detection and segmentation methods are based on image analysis. This paper aimed to give a comprehensive and critical study of current shadow detection methods. Various approaches have been discussed related to shadow detection in images. The principles of these methods rely on intensity difference or texture analysis of the shadow area and the bright area of the same surface. A real-time shadow detection scheme for color images is presented in this paper. The RBG ellipsoidal region technique is used to detect shadow in colour image.**

Keywords-Shadow Detection; Shadow segmentation; Umbra; Penumbra; Cast Shadow; Self Shadow

I. INTRODUCTION

Shadow detection is an important aspect of most object detection and tracking algorithms. Shadows and shadings in images occur when objects occlude light from a light source and they appear as surface features. Shadow detection and removal over the past decades 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 both still and moving images. In general, shadows can be divided into two major classes: Self shadow and Cast shadow.

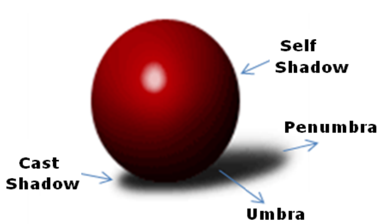

Figure 1. Types of Shadow in Image

A self-shadow occurs in the portion of an object that is not illuminated by direct light. A cast shadow is the area projected by the object in the direction of direct light.

Figure 1 shows some examples of different kinds of shadows in images. 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 interreflection. Usually, the self-shadow 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 caste by buildings and vehicles in traffic systems could not deal with the attached shadows on a human face. This paper 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 is the region in which only a portion of the light source is obscured by the occluding body. The umbra is the darkest part of the shadow. In the umbra, the light source is completely occluded.

II. VARIOUS MEHODOLOGIES OF SHADOW DETECTION

Shadow detection is applied to locate the shadow regions and distinguish shadows from foreground objects. In order to systematically develop and evaluate various shadow detectors, it is useful to identify the following three important quality measures: (a) Good detection (low error probability to detect correct shadow points should occur). (b) Good discrimination (the probability to identify wrong points as shadow should be low, i.e. low false alarms rate). (c) Good localization (the points marked as shadows should be as near as possible to the real position of the shadow point). There are two general approaches based on shadow properties to detect shadow.

A. Model Based Techniques

In this, the 3D geometry and illumination of the scene are assumed to be known. This includes the sensor/camera localization, the light source direction, and the geometry of observed objects, from which a priori knowledge of shadow areas is derived. For example, consider polygonal regions to approximate the shadows of buildings or urban elements in some simple urban scenes. However, in complex scenes with a great diversity of geometric structures, as it is usually the case of quick bird images, such models are too restrictive to provide a good approximation. In addition, in most applications the geometry of scene and/or the light sources are unknown [10, 11].

B. Image Based Techniques

This makes use of certain image shadow properties such as colour (or intensity), shadow structure (umbra and penumbra hypothesis), boundaries, etc., without any assumption about the scene structure. Nevertheless, if any of that information is available, it can be used to improve the detection process performance. Some common ways of exploiting image shadow characteristics are:

- The value of shadow pixels must be low in all the RGB bands. Shadows are, in general, darker than their surrounding, thus it is delimited by noticeable borders (shadow boundaries) [12, 13].
- Shadows do not change the surface texture. Surface markings tend to continue across a shadow boundary under general viewing conditions [13]
- In some colour components (or combination of them) no change is observed whether the region is shadowed or not, that is, this is invariant to shadows [12, 14].

C. Colour/Spectrum Based Techniques

The colour/spectrum model attempts to describe the colour change of shaded pixel and find the colour feature that is illumination invariant. Cucchiara [15] investigated the Hue-Saturation-Value (HSV) colour property of cast shadows, and it is found that shadows change the hue component slightly and decrease the saturation component significantly. The shadow pixels cluster in a small region that has distinct distribution compared with foreground pixels. The shadows are then discriminated from foreground objects by using empirical thresholds on HSV color spac. Salvador et al. [13] proposed a normalized RGB color space, C1C2C3, to segment the shadows in still images and video sequences. K. Siala [16] consider the pixel's intensity change equally in RGB colour components and a diagonal model is proposed to describe the color distortion of shadow in RGB space.

D. Texture Based Techniques

The principle behind the textural model is that the texture of foreground objects is different from that of the background, while the texture of shaded area remains the same as that of the background. The several techniques have been developed to detect moving cast shadows in a normal indoor environment. The technique proposed by D. Xu [17]) include the generation of initial change detection masks and canny edge maps.

E. Geometry Based Techniques

Geometric model makes use of the camera location, the ground surface, and the object geometry, etc., to detect the moving cast shadows. The Hsieh [18], Gaussian shadow model was proposed to detect the shadows of pedestrian. The model is parameterized with several features including the orientation, mean intensity, and center position of a shadow region with the orientation and centroid position being estimated from the properties of object moments.

III. DETECTING SHADOW IN REAL COLOUR IMAGES

Shadows are detected using the features extracted from three domains: spectral [15, 19, and 20], spatial [21] and temporal [22]. Nevertheless, temporal features are not very reliable because they depend heavily on the object speed and the frame rate of the camera. The shadow regions are detected as follows:

- Compute the average colour of the image. So the colours in shadow regions have larger value than the average, while colours in non-shadow regions have smaller value than the average.
- Construct a threshold piecewise function to extract 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 shadow region and it has a value of one if the corresponding pixel is in the non-shadow region.
- After calculating the threshold function on the image, the pepper noise appears at different regions in the image. Hence pepper noise is removed.
- Then, convolute the noise-free binary image with the original image to separate the shadow from the non-shadow regions
- Finally, energy function is used to remove shadow.

IV. RESULT AND DISCUSSION

In this paper, different techniques are discussed to detect shadow in a particular image. The shadow regions are detected using algorithm discuss above. The hypothesis test has been carried to detect shadows in real colour images. However, Removing and suppressing shadows in images remains a difficult problem for computer vision systems and it is hard to measure the performance in this task. The algorithm derived showed that it is possible to detect shadow from image without losing a large amount of pertinent data. The detection of shadow in real colour images is shown in figures 2 to 4.

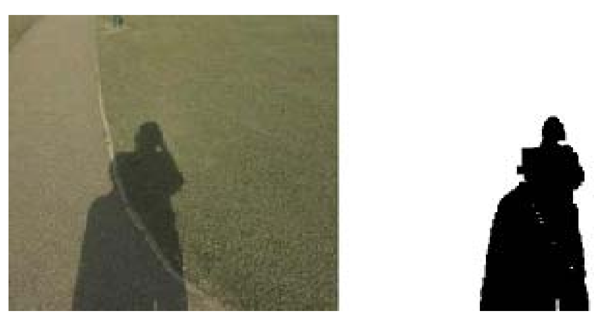

Figure 2. (a) Original Image (b) Shadow Detected Image

Figure 3. (a) Original Image (b) Shadow Detected Image

Figure 4. (a) Original Image (b) Shadow Detected Image

V. CONCLUSION

In this paper, first the basics of shadow is discussed that how shadow occurs, then different types of shadows are mentioned which can appear in the images. Various approaches of shadow detection and segmentation are given, along with hythesis test that is used to detect shadows in the images. At last results are shown in which original image is taken and shadow detected image is produced.

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