A Survey on Various Shadow Detection Methods

Niketan V. Balar[1] Hetal Bhaidasna[2] Zubin Bhaidasna[3]
[1]M.Tech Student [2,3]Assistant professor
[1,2]Department of Computer Science & Engineering
[3]Department of Information and Technology Engineering
[1,2]Parul Institute of Engineering & Technology, Vadodara, India,
[3]Parul Polytechnic Institute, Vadodara, India

Abstract— Shadow is creating because the light source has blocked them. Shadows in an image can inform information about the object's shape, orientation and information about the light source. Shadows degrade the quality of images and affect the information thus the correct image interpretation it is important to detect a shadow. Thus, Shadow detection in real scene images is a challenging but interesting area. Shadow detection is useful many applications like object recognition, scene interpretation and segmentation etc. Many algorithms and methods have been developed for different environmental circumstances to detect a shadow from the images. This paper reviews on some methods to detect shadows. This paper is aimed to provide a survey on various methods of shadow detection with their comparative study and disadvantages and advantages.

Key words: Image Enhancement, Image Processing, Shadow, Color Information, Shadow Detection

I. INTRODUCTION

Image processing has one of the research area that the interest of broad variety researchers. Image processing is studies of image to image transformation and mainly deals with processing of pictures, images, video etc. Shadows in digital images are either helpful or troublesome in image processing. The shadow and non shadow area are created when the light energy is fallen on the object. Shadows produce error in analysis of biophysical parameters such as water, vegetation and they can partial or total loss of information in the image [4].

Shadows in images create lots of problems on image analysis. Shadows make the interpretation of urban targets such as buildings, roads and vegetation become more difficult due to the loss of part or all of the radiation information in areas obstructed by shadows in the images [3]. Hence, shadow detection is an efficient way to detect a shadow in images and get extract some useful information from it. There are many different methods for shadow detection present this paper. Therefore the shadow detection in an image is an important pre-processing step for improving performance of computer vision algorithm and image enhancement.

In this paper section II present is overview of shadow, section III present is literature survey and section IV present are various shadow detection techniques.

II. OVERVIEW OF SHADOW

A shadow is generated because the direct light from any source of lighting is blocked either totally or partially by an object. If the light energy is emitted more, that area is represented as non shadow region whereas if the light energy is fallen less, this area is represented as shadow region. Hence, when light is blocked an image is created known as shadow.

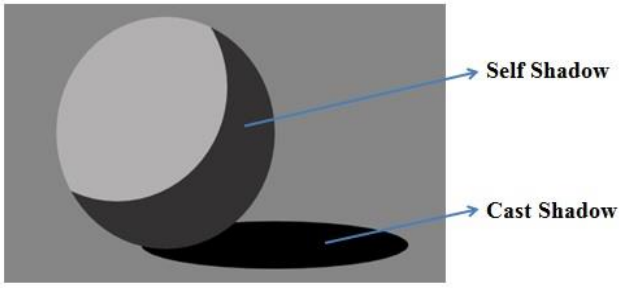

Fig. 1: Types of Shadow [8]

There are classified into two types of shadow, self shadow and cast shadow [7]. Self-shadow is objects itself and another is cast-shadow. Both self and cast shadow has different brightness value. The brightness of all the shadows in an image depends on the reflectivity of the object upon which they are cast as well as the illumination from secondary light sources. Self shadows usually have a higher brightness than cast shadows since they receive more secondary lighting from surrounding illuminated objects.

There are two types of cast shadow, umbra and penumbra [6]. The part of a cast shadow where direct light is completely blocked by its object is called umbra, while the part where direct light is partially blocked is called penumbra. These regions are created due to multiple lighting and the difference between the two lies in the contrast they have to the background.

Properties of Shadow: There are some properties obtain from images which can be used to differentiate between background, object and shadow. These properties are described as following.

- A shadow has lower boundaries compared to a background.Shadow and background both are illuminated by different lights. background illuminated by direct light while Shadows illuminated by indirect lights
- RGB values of a shadow are lower than the background in the corresponding pixel [3].
- A shadow with lower brightness in comparison to the background pixels and this difference changes smoothly between neighbour pixels.
- In Hue-Saturation-Value colour space, the hue and saturation components of shadow pixels are a bit smaller than the background [10].

III. LITERATURE SURVEY

In recent years, several techniques have been proposed to detect shadows from images. Various algorithms and methods are used to detect the shadow.

A thresholding based approach to detect the shadows from an image was proposed by Vishal Gangadharrao Mamde, P.U.Chati [1]. In this paper author use systematic method is helpful to differentiate dark objects and small object shadow area. First the use color image transformation with global thresholding for image segmentation. Then morphological operation is applied to boundary of shadow and next step is filtering for two differentiate a shadow and non-shadow boundaries region. For the object detection they apply tsai method but they got very less accuracy. Experimental results show the exactly identify shadow but use more effective parameters so that get high accuracy in shadow detection.

In [2], Namrita Singh, A.A.Maxton describe method is color model based shadow detection image analysis mechanism. First the transform color aerial image in to C1C2C3 color model then apply fuzzy thresholding using minimize fuzzy divergence value it means the dividing between shadow and non-shadow pixels. Morphological operation opening and closing have been used in order to eliminate apart from others pixels. In next step is edge detection to segment images based on intensity for separates two disjoint regions. Color model was use for cloud shadow detection segment because of its property to comparatively dull pixels such as cloud and his background in the image.

Hui Luo, Zhenfeng Shao [3] introduces shadow detection to urban high resolution images. To detect shadow pixels using the color information, first the color transformation on remote sensing images and then calculating the four shadow color features image. Otsu thresholding method is applied in four shadow features images to acquire four candidate shadow images. Morphological operation is applying the shape information of shadow areas in the image. This method is efficient and major feature selected to distinguish shadow and non-shadow in the image and its takes more time for computation process.

In the detection process shadow and non shadow regions are separate by SVM classifier [4]. This classification procedure is supervised based shadow detection mechanism. First author the satellite image acquisition then thresholding for differentiates shadow and non-shadow regions. A classification is done by SVM in order to distinguish between shadow and non-shadow classes are classified separately with the same images. Morphological operation is removing isolated shadow pixels in a non-shadow area and also isolated non-shadow pixels in a shadow area. In next step is edge detection to segment boundary for separate regions and last multiclass classification for difference between non-shadow classes on the one side and the shadow classes on the other side. In this method shadow and non-shadow classes are easily classified separately in the image and this method is simple and easy to implement.

In [5], Anaam K. Hadi proposed method using the edge information based shadow detection. Edge detection is one of the most commonly used operations in image analysis. Firstly the image acquisition and apply color image conversion and get normalized component image. Then apply the Laplace operator on normalized image and automatic threshold to make edge detection between the shadow and non shadow objects. The Laplacian operator is a second order method of enhancement. It is particularly good at finding the fine detail in an image. Any feature with a sharp discontinuity like noise will be enhanced by a Laplacian operator. In this method computational complexity is high.

IV. VARIOUS SHADOW DETECTION TECHNIQUES

Shadow detection techniques can be categorized as following:

A. Model Based Technique:

Model based technique has applied in video monitoring and some specific scene conditions. This method is dependent on prior information about illumination conditions, 3D geometry of the scene, moving targets, and camera altitude being imaged for calculate positions of the shadows [1]. This method has some limitations however these input data of model based algorithms are not easy to acquire. Due to large computation and lots of auxiliary data obtained difficultly. This method has rarely been used because the prior knowledge is not always available [9].

B. Property Based Technique:

Property-based technique does not require any a priori information [6] they can be applied directly to raw data based on some specific spectral and spatial assumptions. These method not only geometrical features are used but they are also combined with the spectral properties of shadow such as invariable color features, analysis of brightness, saturation, texture etc. As some color features of shadow areas and non shadow areas are totally different. These approaches have been widely used because simple and easy to implement. They can be classified into several methods thresholding based, color model based, Edge based etc.

C. Machine Learning Technique:

Machine learning technique is described as unsupervised and supervised methods. Unsupervised method is very popular for a rough and quick interpretation of scene object classes. Unsupervised method usually involves clustering. Supervised method is work on some training samples with ground truth to build classifiers [4]. Both unsupervised and supervised method are rarely used because of computational load is expensive.

METHOD	PRINCIPLE	PROS	CONS
Thresholding based [1],[6]	Threshold level is set to distinguish between shadow and non-shadow pixels for object and background.	Simple and fast.	Results might be some blurred.
Color models based [2],[3]	Color value of shadow and background same but different intensity.	Reliable technique for colored images.	Fails when intensity of shadow and background is same.

Edge based [5]	It used when Brightness changes sharply and detect missing pixels.	An edge gives the Boundary between shadow and the backgroun d.	It is not suitable for small objects and their shadows.
Supervised based [4]	Classificati on techniques like SVM are used based on the properties by shadow pixels.	Detect probable shadow boundaries accurately. Simple and easy to implement.	There are chances of misclassificati on and Shadows of small objects are missed sometimes.
Unsupervis ed based [9]	Machine learning method like clustering is used based on the total number of classes in the scene.	For a rough and quick interpretati on of scene object classes.	Computationa l load is expensive.

Table 1: Comparative Analysis of Various Shado Detection Methods

V. CONCLUSION

Image processing studies image to image transformation. The input and output both are images in image processing. In this paper, first the basics of the shadow, then different types of shadows are mentioned which appear in the images. Secondly, a survey of various shadow detection techniques has been presented. In exiting methods have some limitation and some situation the shadow detection is successfully detected. C1C2C3 color model was use for cloud shadow detection because of its property to comparatively dull pixels. Shadow detection algorithms using the feature of the C1C2C3 color model, the C3 component without processing makes the results unsatisfactory. This paper present is comparative analysis of different shadow detection methods for different types of images.

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