A Survey on Shadow Detection Techniques

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Abstract— shadow in an image is unavoidable yet sometimes it is unwanted as it can affect the results of computer vision algorithm. Sometimes shadow is important because it provide some information about the scene and lighting conditions. Shadow detection is the initial step to shadow analysis and image processing in many applications. This paper will provide review some important techniques of shadow detection.

Key words: Model Based Techniques, Shadow Detection Techniques

I. INTRODUCTION

During image analysis, shadows in images cause some undesirable problems. Because of this reason attention was paid to detect and remove the shadow region over the past years. Sometimes, shadow reconstruction is important and shadow detection is the initial step because it gives some information regarding the scene. Shadow detection used in many applications like traffic surveillance, face recognition, image segmentation etc.

A. What Is Meant By Shadow?

A shadow is formed when the object blocks the light completely or partially from any source of illumination.
As the light travels in straight line and cannot bend leads to creation of shadow due to the occlusion of path of light [1]. Usually Shadow formed behind the opaque object when light falls on it.

B. Types of Shadows

In general, there are two types of shadows

- Self-shadow
- Cast shadow

A Self shadow is formed in the region of an object where the light from source cannot reach.

A cast shadow is the region projected by the object in the direction of light.

Based on the intensity, shadows are divided into two types

- Hard shadow
- Soft shadow

In soft shadows, the texture of the background surface is retained. The hard shadows are dark and they have less texture. The hard shadows detection is difficult because there is a chance of detecting dark objects instead of shadows.

II. DIFFERENT SHADOW DETECTION TECHNIQUES

Shadow detection techniques are classified as:

- Model Based Techniques
- Property Based Techniques

A. Model Based Techniques:

Model based techniques are limited to some applications and are applied only for simple and specific images. These techniques are depends on the information about lighting conditions and object as well as scene geometry is the main demerit [2]. These techniques works better with structures with repeated geometries. Hence, for segmentation purpose probabilistic models can be implemented easily.

B. Property Based Techniques

This method of shadow detection had few limitations compared to model based methods. This method uses geometrical properties as well as spectral properties like color, brightness etc. of shadow. These methods are widely used since its implementation is easy and simple. From reference [3], they are classified as:

- Thresholding based method
- Color transformation based method
- Region growing based method
- Classification based method

From reference [4] summarizes the classification of shadow detection methods in [8] from this cast moving shadow detection methods are classified as:

- Color/spectrum based methods
- Texture based methods
- Geometry based methods

From [6] moving shadow detection methods are classified as:

- Intensity information
- Photometric invariant information
- Color and statistical information

From [7] shadow removal methods are classified as:

- Chromaticity based methods
- Physical methods
- Geometrical and texture based methods

Different shadow detection techniques are tabulated along with advantages and disadvantages in below table.

SR.NO	METHOD	CONCEPT	ADVANTAGES	DISADVANTAGES
1	Threshold based	Using bimodal histogram ,shadow and non-shadow pixels are known	Simple and fast	Results are incoherent or blurred and may have noise.so, post processing required
2	Texture based	Considers the texture similarity and difference between background and	Results are accurate for stable lighting conditions	Implementation is difficult in outdoor scenes with less performance

		shadow		
3	Region growing based	Mean and standard deviation are required	Shadow and non-shadow regions are identified accurately. crispy edges	Requires more time to compute.
4	Classification based	Techniques are used based on shadow pixel properties	Shadow boundaries can be detected correctly	Misclassification chances are more.
5	Geometric property based	Uses geometric features	Detection is effective in controlled platform	Requires more time to compute and not possible for spatial and real time cases.
6	Color based	Spectral details are used. Pixels difference of background and shadow is used.	Good method for color images	It doesn't work if intensity of shadow and background is same
7	Chromaticity based	Hue and saturation together is called as chromaticity	Highly accurate	Chance of misclassify
8	Color and statistical information	Uses the illumination model to decide the pixels	Shadow detection is efficient	Cost of computation is high
9	Partial differential equations	Detection of shadow is done using gradient value. Filters like convolution are used for image smoothing.	Flexible and Implementation is simple	Performance is low

Table I: Different Shadow Detection Techniques

III. Conclusion

In this paper, a survey of different shadow detection methods is presented. The basics of shadow and its formation are discussed briefly. Different shadow detection methods are summarized with their pros and cons is tabulated.

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