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# Shadow Detection and Removal from Images-A Review

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***Abstract-*** **Over the last decades several approaches were introduced to deal with shadow detection and removal. Shadows are visual phenomena which happen when an area in the scene is occluded from the primary light source (e.g. sun). Shadows are everywhere around us and we are rarely confused by their presence. This article provides an overview of various methods used for shadow detection and removal using some main components like texture analysis, color information, Gaussian mixture model (GMM) and deterministic non model based approach.**

***Index Terms-*** **Shadow Detection; Shadow Removal; Texture; Color;**

## I. Introduction

The presence of shadows has been responsible for reducing the reliability of many computer vision algorithms, including segmentation, object detection, scene analysis, stereo, tracking, etc. Therefore, shadow detection and removal is an important pre-processing for improving performance of such vision tasks. Decomposition of a single image into a shadow image and a shadow-free image is a difficult problem, due to complex interactions of geometry, albedo and illumination. Many techniques have been proposed over the years, but shadow detection still remains an extremely challenging problem, particularly from a single image. Most research is focused on modeling the differences in color, intensity, and texture of neighboring pixels or regions.

### 1.1 An overview of image formation

In order to understand the shadows, one needs to understand what an image is and how it has been formed. An overview of image formation has been explained in the figure below.

Mechanism of image formation depends upon these two factors:

1. Light from a radiation source is reflected by surfaces in the world. Reflected light from the world hits the sensor.

2. Images are formed when a SENSOR registers RADIATION that has interacted with PHYSICAL OBJECTS.

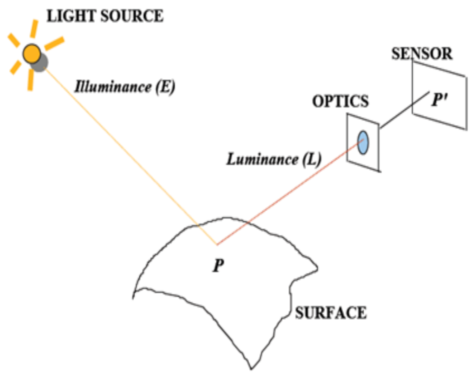


Figure 1: Mechanism of image formation.

### 1.2 Ingredients of image formation

The resulting image is affected by two sets of parameters:

**Radiometric parameters**

These parameters determine the intensity/color of a given image pixel

- Illumination (type, number, intensity, color-spectrum)
- Surface reflectance properties (material, orientation)
- Sensor properties (sensitivity to different electromagnetic frequencies)

**Geometric parameters**

These parameters determine where on the image a scene point appears

- Camera position and orientation in space
- Camera optics (e.g. focal length)
- Projection geometry

**Luminance** (L) amount of light striking the sensor depends on **Illuminance** (E) amount of light striking the surface as well as **Reflectance** (R) which depends on material properties $\mathbf{L(x,y,\lambda) = E(x,y,\lambda)}$ **[Intensity at a particular location and wavelength]** * $\mathbf{R(x,y,\lambda)}$ To determine properties of objects in the world (e.g. their colors), we need to recover R, but we don't know E so this is difficult.

### 1.3 Measuring surface properties

Measuring surface properties is a big factor in deciding color on an image. As explained in the figure below. Two points need in consideration in order to understand surface color.

**1.** If color/intensity of light source changes, color/intensity of reflected light also changes (i.e. L varies with E).
**2.** If color/reflectance of surface changes, color/intensity of reflected light also changes (i.e. L varies with R).

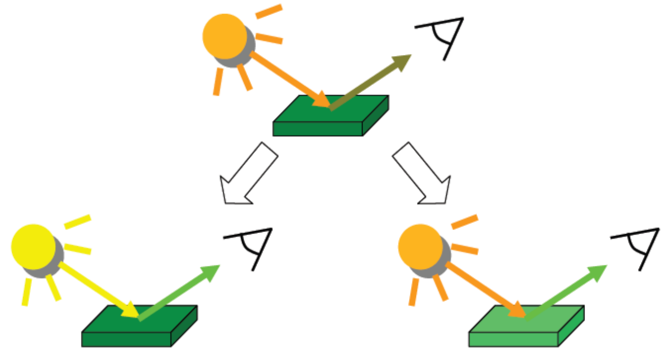

Figure 2: Measuring surface properties.

### 1.4 Color perception

We perceive different colors of same object or scene at different time in a day. This is happening due to the following reasons.

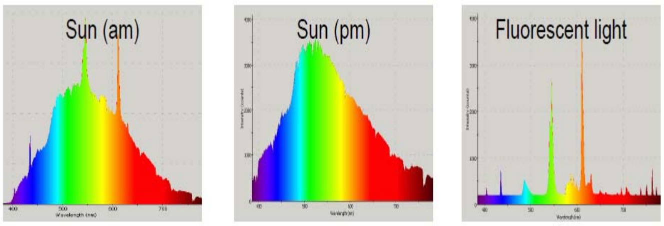


Figure 3.Color perception

Light is produced in different amounts at different wavelengths by each light source. Light is differentially reflected at each wavelength, which gives objects their natural colors (albedo = fraction of light reflected at a particular wavelength).The radiation that drives the human construct of color, is fundamentally color less. The sensation of color is determined by the human visual system, based on the product of light and reflectance.

## II. Literature Survey

A brief literature review is needed in order to understand work done by various scholars in this field. As existence of shadows may cause serious problems while segmenting and tracking objects: shadows can cause object merging. For this reason, shadow detection is applied to locate the shadow regions and distinguish shadows from foreground objects. In some cases, shadow detection is also exploited to infer geometric properties of the objects causing the shadow (“shape from shadow” approaches). In spite of the different purposes, invariably the algorithms are the same and can extend to any of these applications.

Hongya Zhang et al. [1] put forward an object oriented shadow detection and removal method. In this method, shadow features are taken into consideration during image segmentation, and then, according to the statistical features of the images, suspected shadows are extracted. Furthermore, some dark objects which could be mistaken for shadows are ruled out according to object properties and spatial relationship between objects. For shadow removal, inner–outer outline profile line (IOOPL) matching is used. First, the IOOPLs are obtained with respect to the boundary lines of shadows. Shadow removal is then performed according to the homogeneous sections attained through IOOPL similarity matching.

Huazhong et al. [2] present a novel method for object tracking in surveillance scenes. It improve the ‘ViBe’ background subtraction algorithm by adding the scale invariant local ternary pattern operator ‘SILTP’ so as to detect moving shadow and increase the accuracy of segmentation. An object tracking method based on Compressive Tracking and Kalman filter by using the result of background subtraction is presented, improve the accuracy and robustness of the tracking system in surveillance scenes.

YAN Jinfeng et al. [3] proposes an approach based on regional growth to detect moving cast shadow. Firstly, the pixel distribution histogram in RGB color space or the luminance ratios in HSV color space is used to detect the possible shadow area, which can produce a possible shadow area to reduce the calculation of subsequent processing. Secondly, we implement the regional growth approach based on the Breadth-First Search algorithm to get a relatively accurate shadow area. This approach considers both the color information and the edge features of images, which yields accurate detection of moving cast shadows as shown by experiments.

Haibin Wang et al. [4] describe a mixed approach to deal with the shadow of the foreground objects from video surveillance. Firstly, a new description of local texture operator---LMTO (Local Match Texture Operator) is adopted; it can be an excellent capability in describing the local texture information. Secondly, we propose a new determination mechanism which combines the luminance, texture information and color-ratio of the pixels.

Jing Li et al. [5] has proposed an improved Gaussian mixture model which can effectively remove the ghost which appears when the speed of moving object is too slow or too fast; On this basis, they propose a robust method to eliminate shadows based on normalized RGB space. The test and analysis of large number of experimental videos with different lighting conditions, backgrounds and shadow casting surfaces indicate that this method can effectively handle a variety of different shadows with good adaptability and robustness.

Kan ouivirach et al. [6] propose and experimentally evaluate a new method for detecting shadows using a simple maximum likelihood formulation based on color information. We first estimate, off line, a joint probability distribution over the difference in the HSV color space between pixels in the current frame and the corresponding pixels in a background model, conditional on whether the pixel is an object pixel or a shadow pixel. Given the learned distribution, at run time, we use the maximum likelihood principle to classify each foreground pixel as either shadow or object. In an experimental evaluation, we find that the method outperforms standard methods on three different real-world video surveillance data sets. We conclude that the proposed shadow detection method would be an extremely effective component in an intelligent video surveillance system.

Yu-Jen Chou et al. [7] uses a color camera to combine with a depth camera to detect the events. Depth information can resolve the light and shadow change condition problem and complicated color background. It divides up the foreground object easier and more completed, and the foreground object is used to detect events.

Trevor Beugeling et al. [8] presents novel methods for detection of salient shadow and object regions in underwater acoustic images. Both methods are based on the watershed transform. The methods exploit shape and appearance characteristics of salient shadows and objects. Experimental evaluation shows satisfactory results for the shadow detection algorithm.

## III. Conclusion

It is observed that Shadows are everywhere around us and we are rarely confused by their presence. Tracking or detection of moving objects is at the core of many applications dealing with image sequences. One of the main challenges in these applications is identifying shadows which objects cast and which move along with them in the scene. Shadows cause serious problems while segmenting and extracting moving objects, due to the misclassification of shadow points as foreground. In this paper, we have provided a comprehensive survey of shadow detection and removal in indoor and 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.

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## References

[1] H. Zhang, K. Sun and W.Li, “Object-Oriented Shadow Detection and Removal From Urban High-Resolution Remote Sensing Images,” IEEE Trans.Geosci.Remote Sens.,vol. 52,no. 11,pp.6972-6982,Nov 2014.

[2] H. Xu and F. Yu, “Improved Compressive Tracking in Surveillance Scenes,”Proc. of the Seventh International Conference on Images and Graphics,pp. 869–873,2014.

[3] Z. Yicheng, Y. Jinfeng, L. Qiang, L. Feng and Z. Jin,“Moving Cast Shadow Detection Based on Regional Growth,” Proc. of the 32nd Chinese Control Conference.,pp.3791-3794, july 2013.

[4] H. Wang, Q. He,“Shadow Removal Based on the Luminance,Texture and Color-Ratio of the pix,” Proc. of the IEEE International Conference on information and automation,Yinchuan,China,pp.762-766, August 2013.

[5] J. Li and G. Wang, “A Shadow Detection Method Based on Improved Gaussian Mixture Model,” IEEE.,2013.

[6] . K. Ouivirach and M.N. Dailey, “Extracting the Object from the shadows: Maximum Likelihood object/shadow Doscrimination,” IEEE.,2013

[7] Y.J. Chou, B.C Wang and S.F. Su,“Enhance Intelligence Video Surveillance with Depth and color Information,” Proc. of the IEEE International Conference on system science and engineering,Budapest,Hungary,pp.19-24,july 2013.

[8] J. Li and G. Wang, “Detection of objects and their shadows from Acoustic Images of the Sea Floor,” MTS.,2013.