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Detection and Removal of Shadow using Chromaticity

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***Abstract*-- In this paper, we address the problem of shadow detection and removal from still images of natural scenes. Due to obstruction by an object light from a source cannot reach the area and creates shadow on that area. Shadow creates significant problems in many computer vision and image analysis task so, Shadow removal is an important task when we deal with outdoor images. Most shadow detection methods are based on image analysis. In this paper, a new algorithm is proposed to detect and remove the shadow form the still outdoor images. The proposed algorithm uses the chromaticity to detect and remove the shadow.**

***Keywords*-- Shadow Detection, Shadow Removal, Chromaticity,Intensity,texture.**

I. INTRODUCTION

Foreground object identification and detection is the first stage in many image processing applications such as traffic monitoring and video surveillance. During this stage, the shadow causes serious problems in the segmentation and extraction of the objects. Differentiating moving objects from shadows is a vital task because shadows arise various problems such as shape distortion, phantom objects etc. 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. In the past literature of computer vision and image processing, some algorithms use luminance, chrominance and density [5].Therefore, it is of essential importance and keen interest to discuss and investigate the shadow extraction and elimination technique [6].

Following are the general concepts of shadows:

A shadow is an area where direct light from a light source cannot reach due to obstruction by an object. Shadow detection and removal is an important task in image processing when dealing with the outdoor images. Shadow occurs when objects stop up light from light source. Shadow often degrades the visual quality of images. There are two types of shadow, self-shadow and cast shadow. Self-shadow is objects itself and another is cast-shadow. Self-shadow usually have a higher brightness than cast shadows.[7],[9],[18]

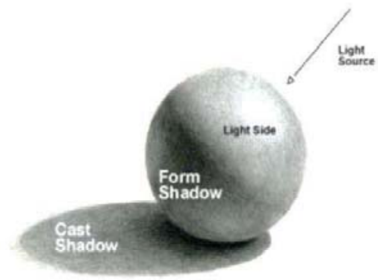

Fig.1 Shadow is divided as cast-shadow and self-shadow

Self Shadow and Cast Shadow are shown in fig.1.The self shadow (also called attached shadow) is the part of an object that is not illuminated by direct light. Cast shadow of an object can be defined as the dark area projected by the object on a surface[9],[10].

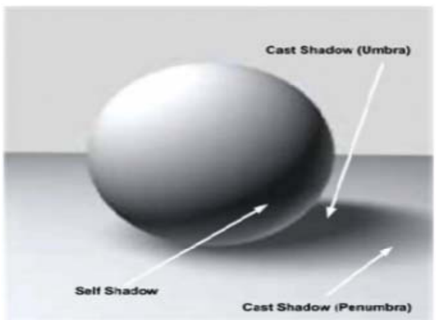

Fig.2 Types of Shadows

Cast shadow can be further divided into umbra and penumbra region (Shown in fig.2). Umbra(hard shadow) region is the part of cast shadow where direct light is completely blocked; the penumbra(soft shadow) region is the part of a cast shadow where direct light is partially blocked. In outdoor scenes, there are mainly two light sources: direct sunlight (regarded as a point light source) and diffuse skylight (regarded as an area light source)[4],[9].

Shadows play an important role in our understanding of 3Dgeometry [7].

- Shadows help to understand relative object position and size in a scene.
- Shadows can also help us understanding the geometry of a complex receiver.
- shadows provide useful visual cues that help in understanding the geometry of a complex occluder.

Shadows can be detected using the features extracted from three domains: spectral, spatial and temporal. Nevertheless, temporal features are not very reliable because they depend heavily on the object speed and the frame rate of the camera. Hence, this paper mainly focuses on spectral and spatial features. Particularly, the following characteristics are exploited to detect shadow.
They are:

- A shadow darkens the background area on which It falls.
- A shadow only falls on the ground plane.
- A shadow changes luminance of an area significantly but does not impact color so much.

II. RELATED WORK

Many Shadow detection and removal techniques have been used earlier .

- The existing method[14] “paired region technique” for shadow detection and removal relies on the initial segmentation, which group soft shadow with non shadow region so unable to detect soft cast shadow.
- The Single region classification method also have some limitations. The thresholding technique[15] used to detect and remove the shadow unable to distinguish the dark region and shadow region.
- The existing method[16] used the color and edge information to detect the shadow but fails to detect shadow if the intensity of background and shadow/ foreground and shadow will be same.
- The existing method[17] used segmentation to remove the shadow which is unable to remove the shadow from the image.

III. PROPOSED METHOD

Following are the steps used in the presented algorithm

Step 1) Image used for shadow removal has been loaded as RGB image and three components of RGB are put in three columns of array

Step 2) Red and blue intensities of all pixels are divided by geometric mean of Red, green and blue pixels and are stored in two separate arrays.

array1 = {R/G.M.}, array 2 = {B/G.M.}

Where

R represents the Red intensity of pixel.

B represents the blue intensity of pixel.

G.M.(Geometric Mean) = (R*G*B)^(1/3)

Step 3) Then natural log has been taken for both arrays in order to plot the one dimensional arrays obtained above in two dimensional orthogonal space. Let two arrays obtained at this step are array3 and array4.

array3 = log{array1}, array 4 = log{array2}

Step 4) A direction perpendicular two these two arrays has been obtained in order to remove shading or shadow effect. The direction has been found by equation

Cos(angle)*array3 + sin(angle)*array4

Step 5) Vary the angle and find the direction where there is maximum removal of shadow in the image and change the pixel value of original image, after changing the pixel value of original image apply some morphological operations and thresholding techniques, to detect and remove the shadow.

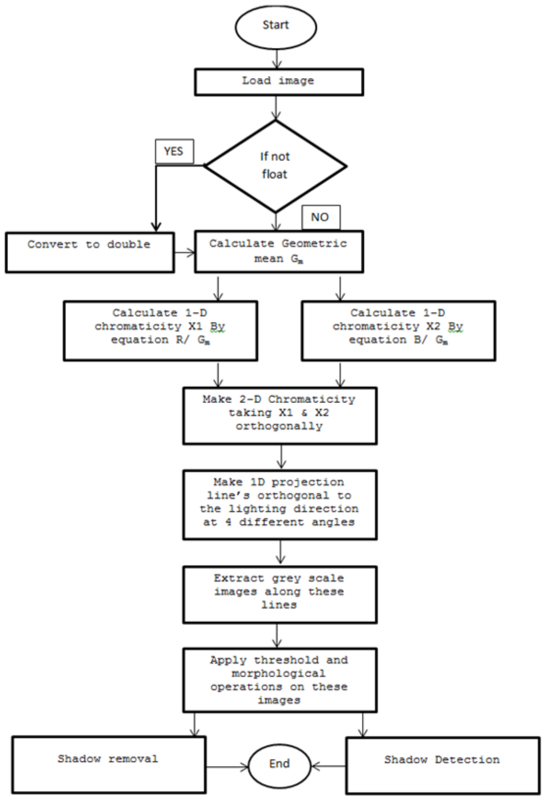

Fig.3 Flow Chart of Proposed Method

IV. EXPERIMENTAL RESULTS

Results comes at different points of the presented algorithm has been described below

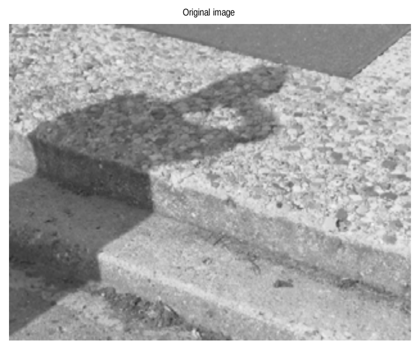

Fig.4 Test Image taken for Experimental Results

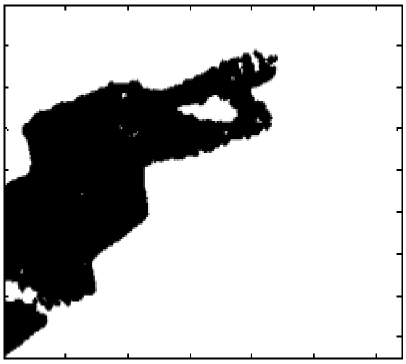

Fig.5 Shadow area detected

Fig.6 Image with Shadow removal

It has been found that Average gradient before shadow removal is 0.03318 and after shadow removal is 0.07644. The increased value of Average gradient shows that shadow contrast has been eliminated in better average of gradient value.

V. CONCLUSION AND FUTURE SCOPE

We implemented a method for finding the invariant direction, and thus a grayscale and hence an L1-chromaticity intrinsic image that is shadow-free, without any need for a calibration step or special knowledge about an image. The results indicate this proposed processing works well on removing shadows. In future, Algorithm can be modified to improve efficiency in closed camera scenes and also will try to give the better results than obtained results.

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