

# An Approach in Shadow Detection and Reconstruction of Images

D. Sunil Kumar<sup>1</sup>, M.Gargi<sup>2</sup>

<sup>1</sup>pursuing M.Tech in CSE at Vignan's LARA Institute Of Technology and Science, Vadlamudi, Guntur Dist., A.P., India.

<sup>2</sup>Asst.Prof, Department of CSE, Vignan's LARA Institute Of Technology & Science, Vadlamudi Guntur Dist., A.P., India.

## ABSTRACT:

*Shadow areas are viewed as unwanted information which effects the quality of an image. When the light source is illuminated on any object the shadow is observed on the other side of the object. This paper deals how to detect and reconstruct the shadow regions. The shadow regions are not only detected but also classified by using classifiers like SVM. In the detection process we observe that shadow and non shadow regions are separated. In the reconstruction process all the shadow areas remains some zigzag information. After the completion of reconstructing the shadow area there may be some noise data which is remained behind the reconstructed area. This area can be smoothened by using some morphological filters like contrast sharpening and smoothening filters. The main theme in this paper is to reconstruct the shadow area without any information loss.*

**Keywords:** shadow detection, SVM, Segmentation, reconstruction, smoothening, sharpening.

## 1.INTRODUCTION:

When the light energy is illuminated on the object there the shadow of that object appears. Detection and reconstruction of shadow areas plays a vital role in the image processing environment. The shadow and non shadow regions are identified only when the light energy is fallen on the object. If the light energy is fallen less that area is represented as shadow region whereas if the light energy is emitted more, this area is represented as non shadow region. To separate shadow and non shadow regions here we are implementing segmentation process. Support Vector Machine classifier can also be used to separate both the shadow and non shadow regions. This complete process depends on the borders extraction.

In this process of reconstruction first we can take data sets of own images having shadows, online Forum, research scholars. we take own images of shadows and then first we perform shadow detection using mat lab functions and then next we perform reconstruction of the shadow image then we perform mat lab methods like smoothening, sharpening, masking, filters, reconstruction function etc. then we get reconstructed image which would be helpful in various domains like bio medical imaging, satellite imaging etc. we can use svm and fuzzy logic for getting better results.

## 2. BACKGROUND WORK:

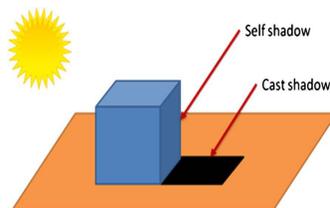
### i)Detection of shadow regions:

Basically shadows are declared as two different classes that is cast shadow and the other one is self shadow.

**Cast shadow** is caused by the projection of the light source in the direction of the object.

**Self shadow** is still a shadow but represents the part of the object that is not illuminated directly by the light source.

The pictorial representation of cast and self shadows are as follows



**Figure1:** Illustration of cast and self shadows.

There are two approaches to detect shadows, namely model-based and shadow-property-based approaches most of the detection algorithms are based on shadow properties, such as the fact that shadow areas have lower brightness, higher saturation, and greater hue values. In this approach shadows regions are detected by using segmentation process. The

working behind this segmentation process is to separate the shadow and non shadow regions. For instance, methods are attempted to detect shadows using a space color transformation and an automatic threshold estimator (e.g., Otsu's algorithm). Inspired by this comparative analysis, a better approach was developed, which is based on a novel successive thresholding scheme. Another technique applies the principal component analysis to isolate the luminance component in an RGB image, where the detection of shadows appears more accurate. Finally, physical properties (e.g., temperature) of a blackbody radiator have been exploited in a recent method to detect shadows correction. After detecting the shadow regions the major goal is to reconstruct/ compensate the shadow fallen area. The reconstruction of shadow areas is based on the hypothesis that both shadow and nonshadow classes follow a Gaussian distribution. Indeed, denoting the shadow class as  $X \sim N(\mu_s, \sigma_s^2)$  and the corresponding nonshadow class as  $Y \sim N(\mu_{\bar{s}}, \sigma_{\bar{s}}^2)$  the reconstruction of the shadow class will be reduced to a simple random variable transformation

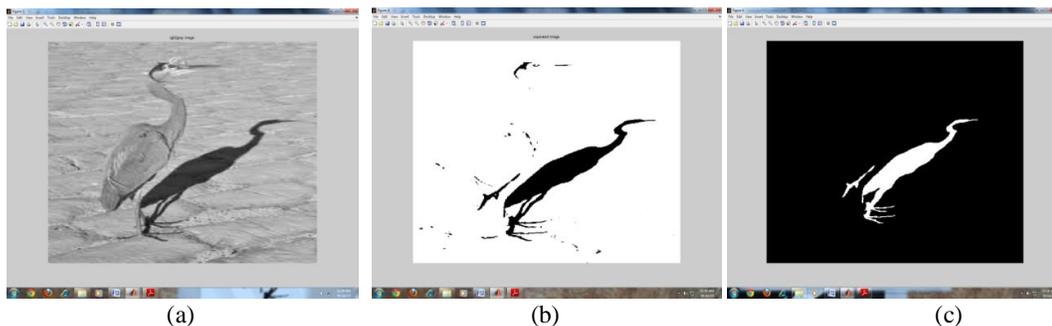
$$X \sim N(\mu_s, \sigma_s^2) \rightarrow X' \sim N(\mu_{\bar{s}}, \sigma_{\bar{s}}^2) \quad (1)$$

**ii) Mask construction:**

In order to apply the masks, all the images must be binary images. If they are not, they must be converted to binary images. In order to apply a mask, the image under process must be an edge detected image. Many edge detection techniques are available to use. The most proper one for the application should be chosen. As there is no a certain technique to choose the best edge detection operator, a number of trials with different operators may be required. Then the better one can be chosen. Mask for separating shadow versus non shadow is created in two steps, namely, 1. Binary classification and 2. Post processing.

**1) Binary Classification:** This classification procedure is used to implement in a supervised way by means of a support vector machine (SVM), which showed the effectiveness in data classification. The classification task is performed to extract the features of the original image with the help of wavelet transform. Initial level wavelet transform is applied on each spectral band which consists of frequency features. Daubechies wavelets is adopted in order to exploit the sparseness of the transformation while implementing texture areas (detection is perfect by exploiting the two local absolute values of the continuous wavelet coefficients). Consider image I collected of B spectral bands, this feature consists of  $B \times (1+4)$  of size.

**2) Postprocessing:** The image should be in the binary size. Consider the binary image  $M1$  it may be characterized by a "salt and pepper" noise which is visible to examine the noise in an image. Here two operations are performed for reconstruction. An opening by reconstruction, and for a closing by reconstruction, is applied on  $M1$  to satisfy this latent problem. morphological filters are introduced to deal with the problems occurred and to improve the quality by their effectiveness and to increase the capability in the shape preservation is performed by the possibility to adapt them according to the image filtering techniques (extracting the borders and shape of the surface). To remove unknown shadow pixels in a nonshadow area and also remote nonshadow pixels in a shadow area. For illustration, an example of enhanced mask.



**Figure2:**(a) the image converted from rgb to gray and the image (b) the mask applied for the initial level and the image (c) final mask image with borders M2

**3. EXTRACTING BORDERS:**

The main critic occurs in the separation of shadow and non shadow regions. This problem is like unknown borders, color inconsistency. Penumbra is a region which induces mixed pixels which are difficult to classify and also checks where the light source is not permanently covered. By this reason, for handling the border pixels we are defining a border between the shadow and nonshadow classes. These lasts are not processed within the shadow reconstruction procedure as is, but separately. The border region is constructed by means of morphological operators. The basic morphological operators

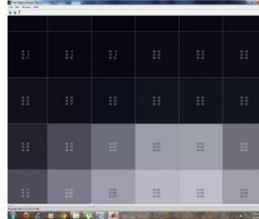
are dilation and erosion. Consider the mask  $c\_imgB2$  is dilated ( $\delta$ ) and eroded ( $\varepsilon$ ). Then, the difference between these two images is computed to form the border image  $B$

$$B[x, y] = \delta(c\_imgB2[x, y]) - \varepsilon(c\_imgB2[x, y]) \quad (2)$$

In order to focus on the penumbra, the sun direction is taken into account to adapt a proper structure for the morphological operators to examine the actual shadow direction.

$$c\_imgB_{NEW}[x, y] = \begin{cases} B[x, y], & \text{if } B[x, y]=1 \\ c\_imgB2[x, y], & \text{if } B[x, y]=0 \end{cases} \quad (3)$$

**i)Pixel information:**



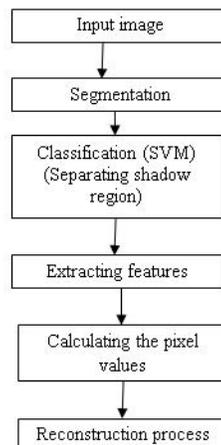
**Figure3:** [142.918343944882 114.005104380831 18.721602038247 12.9588358228434]

**ii)Complete process:**

Shadow regions and non shadow regions are separated by using segmentation process. Initially we examine the size of an image. If it is less than double range then it needs to resize the input image and convert in to `rgb` to `gray`. perform the clustering process here in order to get the similar data items. Shadow detection is the one which performs the detection process. This is done because, the detection is performed either by segmentation process or by subtracting the foreground and background intensity values of an image. After the shadow region is separated from non shadow region color, hue intensity and saturation are identified. In the past days shadow regions are not only detected but also performed remove operations. This shadow removal operators are used to remove the shadow regions. The main disadvantage in shadow removal procedure is losing the wanted data to overcome this problem we are using reconstruction procedure.

**4. RECONSTRUCTION WORK:**

To get accurate results we are using shadow reconstruction procedure when compared to the removal procedure. The reconstruction is based on a linear regression method to compensate shadow regions by adjusting the intensities of the shaded pixels according to the statistical characteristics of the corresponding nonshadow regions. The classifier which shows the shadow and non shadow regions separately in an image  $I$ . on the image  $I$  we are performing mask and marker operations. Mask disables the lightened images that means image with low intensity. Histogram values are low for this low intensity image. After mask construction, extracting the features of the image by reducing the low intensity values. To get exact cuttings of the shadowed area we are concentrating on luminance of light source and on the border pixels reconstruction. This reconstruction is completely based on the pixel information and the dimensions of an image. Calculating the dimensions plays a complex task in the entire processing of an image. This means recognizing the borders of shadow regions gives some clue for reconstruction.



**Figure4:** algorithmic execution of reconstruction process.

**Step by step explanation of execution of reconstruction process:**

**Step1:** We take images of our own application related examples: bio medical imaging etc.

**Step2:** We apply segmentation on the image and then image is segmented into regions for identification.

**Step3:** We then apply classification for classifying shadow regions and non shadow region using svm classifier which is the best classifier in giving best results. using probabilistic calculations.

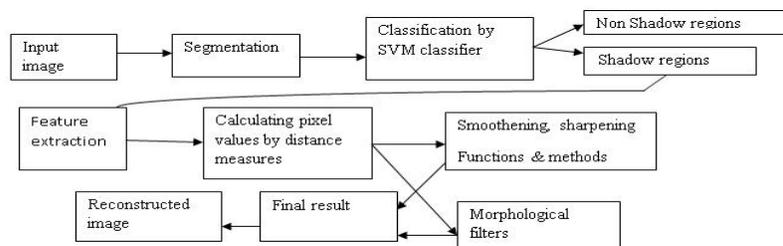
**Step4:** Then we extract the feature from classified images of shadow region images by using feature extraction concept in pattern recognition.

**Step5:** Then we calculate the pixel values in the images using some distance similarity measures like Euclidean distance, manhattan distance etc.

**Step6:** then we apply filters, sharpening, smoothening etc methods and apply methods for reconstruction of image .

**Step7:** finally we get a reconstructed image. reconstruction process is completed.

After implementing the reconstruction process of shadow areas some thin borders between non shadow and reconstructed shadow areas remains same. This area is calculated based on the pixels. In order to smooth are sharpen such contrast we are proposed to use smoothening or sharpening filters. In this morphological operations are used to perform robust data.



**Figure5:** reconstruction process

**Overview of Reconstruction process:**

First we take image and segment it into regions and then apply svm classifier and then it classifies shadow and non shadow regions and then apply feature extraction on shadow regions and then calculate pixel values by distance measure and then apply smoothening &sharpening and apply morphological filters and function & methods we get reconstructed image of shadow .this is final result of reconstruction process.

**5.CONCLUSION & FUTURE WORK:**

This paper is based on detecting and reconstructing the shadow regions which may be useful for the geosciences department. Detecting of shadows in an image and reconstructing the shadow area gives the original information to some extent. But shadow removal process changes the original information of an input image. This earth observation data may examine all the available features. We hope by Implementing the Border pixel reconstruction may give accurate results.

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#### **AUTHOR PROFILE:**



**D.Sunil Kumar**, pursuing M.Tech in Computer Science Engineering at Vignan's LARA Institute Of Technology and Science, Vadlamudi, Guntur Dist., A.P., India. His research interests are Image Processing, Pattern Recognition and Data Mining.



**M.Gargi**, Asst.Prof, Department of CSE, Vignan's LARA Institute Of Technology & Science, Vadlamudi Guntur Dist., A.P., India. Her research interests are Data Mining Data Warehousing and Image Processing,