Detection of Shadow in Very High Resolution Remote Sensing Images Using Different Feature Extraction Methods

Sarita A. Ingale¹, Karbhari V.Kale²
PG Scholar¹, Professor²
Department of Computer Science & IT
Dr. Babasaheb Ambedkar Marathwada University, Aurangabad, Maharashtra, India

Abstract:
The shadows are mainly observed because of tall buildings, towers etc. in urban areas. To reduce the shadow effects in very high resolution images Remote Sensing (VHR) for their further applications, shadow detection is necessary. In this project, we have addressed the issue of detection of shadow in VHR Remote Sensing images. The shadow detection and classification is done by using (SVM) support vector machine. Noise and wrong shadow regions are handled by using morphological filtering method. While going for shadow detection, first of all extract the features of an image and for extracting that feature two Techniques are used. This two Techniques for Feature Extraction are: 1) Wavelet Decomposition 2) RGB Technique. The Best Results are coming from RGB Technique.

Keywords: Feature Extraction, Shadow Detection, Support Vector Machine (SVM), Very High Resolution (VHR) Remote Sensing Images.

I. INTRODUCTION
Very high resolution (VHR) images create a new era in satellite image processing and remote sensing field. We can easily identify full detail of each object from VHR image such as vehicles, roads, different shape of buildings, trees, seas etc. as well as shadow of buildings. When any object lies in the way of light emerging source then shadow is created. The difference between shadows vs. non shadow is shadows are having different color tones than non-shadow part of the image. Generally shadows are defined as undesired information of an image [1]. Shadow represent an important problem for both sellers as well as users of remote sensing images as they may cause high risk to present false color tones or to lose objects [2]. Shadow can be a cause to destroy shape of an object, or to merge objects. Shadow which is present in image gives bad result for the classification, mapping, interpretation etc. [3]. To avoid above drawbacks and to increase the image quality shadow detection and shadow reconstruction is necessary in VHR images. Shadow detection generally can use model based approach [4]. This is not easy approach because it needs information before scenario and sensor information before processing the data. For such kind of problems it uses shadow property based approach. Shadow property based approach uses hue, saturation, intensity properties of shadow [5]. In this paper hierarchical supervised classification scheme is used for the shadow detection Morphological filtering is used to eliminate the noise. In classification task of SVM and for training phase of data, feature extraction of image is necessary. Transformation from one rich content of images into various content features is known as Extraction. The process of generating features to be used in the selection as well as classification tasks is known as Feature Extraction. Feature selection reduces the number of features supplied to the classification task and those features which are likely to assist in discrimination are selected and used in the classification task. In this paper extracting the features of input image using R, G and B components. We are taking the mean of R, G and B respectively. And apply this features input to SVM. This paper is organized as follows, in section I introduction is formulated. In Section II, background is formulated. Section III presents literature review. Section IV proposed method. Section V shows experiment al results. Section VI presents the conclusions.

II. BACKGROUND
Background of cast and self-shadow:
In many metro-cities due to shadows of buildings, towers etc. information in the VHR images may be lost. Missing information in image gives effect on common analysis and mainly in the processing chain. Shadows are created when any object lies in the way of source like sun. Generally shadows are of two types 1) cast shadow 2) self-shadow as shown in Fig.1. The shadow which is caused by projection of light source in the direction of object is called cast shadow and shadow is the part of object that is not illuminated directly by the light source is called self-shadow. It can come from diffuse light present in the scene. Cast shadow shows property for homogenous dark areas. This shows the loss of information in an image. This paper works to recover the loss of information in an image. In this paper shadow detection is implemented by using supervised hierarchical classification scheme because of following reasons :1) It separates shadow and non-shadow areas in the given image 2) Also it identifies non shadow part of image as well as its shadow counter part of that image. Accordingly, ground truth information is needed for both categories of classes. In training phase for region of interest (ROI) creation human help is needed. By doing features extraction feature comparison is done by using...
SVM. Then filtering is used to remove unwanted noise in that image

III. RELATED WORK
T. Kim presented a technique which might be extension of Tsai method. In this paper, they used color image transformation and global thresholding. Experimental result shows that the accuracy is more. For shadow removal they used avalanche histogram equalization [1]. A solution to the problem of automatic shadow detection and reconstruction of features proposed by P.M. Dane [3]. Binary classification for shadow and no shadow region of image analyzed by K. Kouchi and F. Yamazaki. To get clear borders, they first applied canny edge detection algorithm and then applied image imposing process on binary image with canny edge detected image and original image. So the output of image imposing had the classification of shadow and no shadow regions with clear boundary. For reconstruction process, they calculated mean and standard deviation for shadow and no shadow pixels of image and applied mean difference between shadow and non-shadow pixels to shadow pixels. To improve final result this difference had been applied by using normalization process with the help of standard deviation [4]. The several invariant color spaces to analyze shadows were introduced by E. Salvador, A. Cavallaro, and T. Ebrahimi in which first is shadow candidate pixel were being extracted and then by using the invariant color features shadow candidate pixels were being classified as self-shadow or as cast shadow points. The advantage of invariant color features found as a low complexity of the classification stage as well as the method gave better performance in detecting and classifying shadows [7]. Tsai used the several invariant color spaces that decouple luminance and chromaticity, including HSI, HSV, HCV, YIQ, and YC C model. By this approach images found with dramatically improved visualization of features within recovered shadow regions [9]. Chung was found more accurately the successive thresholding scheme (STS) to detect shadows. STS-based algorithm has been implemented for identifying shadows of color aerial images under the observation of shadow maps and dependent on the modified ratio map, the coarse-shadow map was being made by using the global thresholding process. From the coarse-shadow map, successive thresholding scheme first classified all the pixels into the true and candidate shadow points and after that the proposed fine shadow determination process was being implemented to identify the true shadows from the candidate shadows [10].

D. Cai, M. Li, Z. Bao, Z. Chen, W. Wei, and H. Zhang presented an effective approach for shadow segmentation as well as compensation in colour satellite images. The approach uses NSIDI (normalized saturation-intensity difference index) in HSI (Hue-Saturation-intensity) colour space to detect the presence shadows [11][12][13]. F. Yamazaki, P. Sarabandi, M. Matsuoka, and A. Kiremidjian presented an efficient and simple approach for detection and removal of shadow based on Hue-saturation-value (HSV) color model which is in complex urban color remote sensing images for resolving problems caused by shadows. In the proposed method shadows are detected using (NDVI) normalized difference index and subsequent thresholding. Once the shadows are identified, they are classified as well as a non-shadow area around each shadow defined as buffer area is estimated using morphological operators. The mean as well as variance of these buffer areas are used to reconstruct the shadow regions [16].

IV. PROPOSED METHOD
Fig. 2 shows the proposed methodology. The original image will perform first binary classification to distinguish between shadow and non-shadow areas. To handle the Salt and Pepper noise generally median filter is used. The removal of noise is performed by taking the place of window center by the median of center neighborhood. Classification allows localization of shadow and non-shadow to the same object. Following some detail steps of shadow detection are provided.

A. Training phase:-
Training phase is divided into two steps namely Pre-processing followed by Feature extraction.

1) Pre-processing:
In Training phase, first part is preprocessing. In Region of interest (ROI) creation select shadow and non-shadow blocks manually.

2) Feature Extraction:-
1) Feature Extraction in RGB:
Selecting gradient-based features makes the scheme strong to illumination variations whereas use of orientation information to define features supplies strongness against contrast variations. Basic idea behind these features is to split an image into tiles called cells. Then extract a weighted histogram of gradient orientations for each cell. Defining multiple resolutions, Gradient computation as well as computing histogram of gradient orientations are the steps in feature extraction. RGB colors are called primary colors, as they are additive. By varying their combinations, other colors can be acquired.

2) Feature Extraction using Wavelet Decomposition:
Wavelets are functions generated from one single function W by translations as well as dilations. The basic idea of the wavelet transform is to represent any arbitrary function as superposition of wavelets. Any such superposition divides or decomposes the given function into different scale levels. In which each level is further divided or decomposed with a resolution adapted to that level. The discrete wavelet transform (DWT) is identical to a hierarchical sub band system. In which the sub-bands are logarithmically spaced in frequency and that represents octave-band decomposition. Features are extracted in terms of R, G and B values respectively. Then calculating the
mean of R, G and B values, these features are stored for the next process.

B. Testing phase:-
First divide the original image into 8*8 blocks. Then extract the features of that blocks in terms of mean of R, G and B values. Then apply these features of original image, training data and number of classes at input of SVM. For Shadow 1 will be selected and for non-shadow 0 will be selected.

![System Block Diagram](image)

C. Binary classification: -
Binary classification is applied in a supervised way by using support vector machine approach (SVM). Which proves its effectiveness in data classification. For binary classification at the SVM, 3 inputs are given which is feature extracted of original image, training data, and classes. The output of SVM shows either 0 or 1. For Shadow 1 and non-shadow 0 will be selected.

D. Noise removal: -
The binary image may be characterized by a salt and pepper effect due to presence of noise in the image. The difficulty in removing salt/pepper noise from binary image is because of the image data and the noise share the same small set of values isolated non shadow pixel in shadow area. To attenuate this problem right choice of filter is necessary. We are using Median filter to remove salt/pepper noise from images. The noise removal is performed by taking the place of window center by the median of center neighborhood and its drawback is the distortion of corners and thin lines in the image.

V. EXPERIMENTAL RESULTS
Method of detecting of shadow from images were implemented on Matlab 7.10.0

![Experimental Results](image)
Fig. 4.1. (a) Original image (b) gray image (c) wavelet decomposed image (d) Binary image

Fig. 3.2. (a) Original image (b) binary image (c) Filtered image

(d) Fig. 4.2. (a) Original image (b) gray image (c) wavelet decomposed image (d) Binary image
Comparative Analysis:
In Fig 3.1, 3.2, 3.3 and Fig 4.1, 4.2, 4.3 shows the two different methods of feature extraction of the original image. In the Fig 3.1, 3.2, 3.3 images the feature extraction is done by using R, G and B methods and we are getting result at Fig 3.1(b), 3.2(b) and 3.3(b). And Fig 4.1, 4.2, 4.3 shows same original image. The feature extraction on that original image is done by using the Wavelet decomposition which is shown in Fig 4.1(c), 4.2(c), 4.3(c). As we compare two methods result of binary classification we could observed that the feature extraction using R, G and B method is good. Also from below Accuracy estimation table, we observed that the binary classification result is good in the R, G and B method than wavelet decomposition.

Accuracy Estimation Using PSNR and MSE:

PSNR:
PSNR is nothing but peak signal to noise ratio between two images. It is used for Quality Measurement for original and noisy (compressed) image. If higher the PSNR, better the quality of an image.

Formula:
PSNR = 10 log10 ([R.^2]/MSE)

MSE (Mean Square Error):
It is used to measure image compression quality, which represents squared error between original and noisy (compressed) image. If lower the MSE, lower the error in the image.

Formula:
MSE = (|I1(m,n)-I2(m,n)|^2)/M*N
Where, M represents row and n represents Column.
Table 1:

<table>
<thead>
<tr>
<th>Method</th>
<th>PSNR Estimation by Wavelet Decomposition</th>
<th>PSNR Estimation by RGB</th>
<th>MSE Estimation by Wavelet Decomposition</th>
<th>MSE Estimation by RGB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Boumerdes Image</td>
<td>32.39</td>
<td>33.08</td>
<td>32.20</td>
<td>33.14</td>
</tr>
<tr>
<td>2) Atlanta Image</td>
<td>32.73</td>
<td>33.52</td>
<td>32.39</td>
<td>32.06</td>
</tr>
<tr>
<td>3) Jeddah Image</td>
<td>32.80</td>
<td>33.40</td>
<td>32.57</td>
<td>33.07</td>
</tr>
</tbody>
</table>

VI. CONCLUSION

This paper deals with the important and challenging problem of detection of shadow in VHR Remote Sensing images. The classification tasks implemented are performed by using support vector machine (SVM). As we compare two methods result of binary classification, we observed that the feature extraction using R, G and B method is good. Also from Accuracy Estimation table, we observed that the binary classification result is good in the R, G and B method as compare to wavelet decomposition.

VII. ACKNOWLEDGEMENT

The authors would like to acknowledge geand exten dour heartfelt grat it ude to UGC who have funded for development to fUOGCSAP (II)DRSPhase-IF.No.-3-42/2009to Department of Computer Science & IT, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (MS), INDIA.

VIII. REFERENCES


