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DETECTION AND REMOVAL OF SHADOW USING OBJECT ORIENTED TECHNIQUE

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ABSTRACT
In high resolution images, there is loss of information because of traditional pixel level shadow detection method. Here present object oriented technique which can automatically detect and remove shadows from satellite images. In this method, for image segmentation image parameters are used. Threshold values are used for the separation of shadow region. From this shadow will be detected. Some dark objects are known as false shadows. These false shadows are rules out according to object properties and spatial relationship between objects. For shadow removal morphological operation inner outer outline profile line (IOOPL) is used. Using homogeneous section over each object shadow will be removed. Homogeneous sections are attained through IOOPL similarity matching. This is effective method foe detection and removal shadow from urban high resolution remote sensing images.

KEYWORDS: Change detection, image segmentation, inner-outer outline profile line (IOOPL), object-oriented, shadow detection, shadow removal.

INTRODUCTION
For the perception of earth and their flying advancement, recently high resolution remote sensing data opened new time in remote sensing field, various remote sensing satellites like IKONOS, Quick-Bird, GEO-Eye, RESOURCE 3 and so on. As a result it is necessary to process these remote detecting pictures. But there is the presence of shadows which are few downsides of these high determination pictures. In urban territories like huge surface like bridges, buildings, towers, etc shadows are complex. Also shadows themselves become some type of information in the process of 3-D reconstruction, building position recognition, and also in height estimation. These shadows give undesired data and thus can create issues for client. So to overcome these problems shadow detection and removal is important thing.[1]
There are many effective algorithms are present for detection and removal of shadow. Existing shadow detection methods are classified into two types 1) model based and 2) feature based. Model based method uses prior information like camera position, scene, moving targets [2][4]. Feature based method uses information like grayscale, saturation, brightness, and texture. Also improvement of these two proposed methods becomes improves calculation [5]. Color space information and automatic threshold method(Otsu's technique) are some strategies to identify shadows [7]. To distinguish shadows and also to determine a shadow free picture by mirroring some presumptions the illuminant invariance model can be utilized [13]. For shadow discovery for example HSV, YIQ, HCV images with diverse color spaces can be utilized [7]. In the process of shadow detection some dark objects can be considered as shadows that is false shadow. These false shadows should be ruled out. Pixel-level technique gives insufficient results. So there is new technique is proposed known as object oriented technique. It gives effective and sufficient result. Here, Convexity Model (CM) based segmentation is done. Then shadow will detected by thresholding and false shadow will be eliminates. After that boundary extraction will be done. Then using IOOPL shadow will be removed.

PROPOSED METHODOLOGY
Detection and removal of shadow from images is divided into two phases:-
A. Shadow Detection
B. Shadow Removal

A. SHADOW DETECTION

Shadows are made when light source is blocked by an object. Then behind that object 3-Dimensional volume is formed.

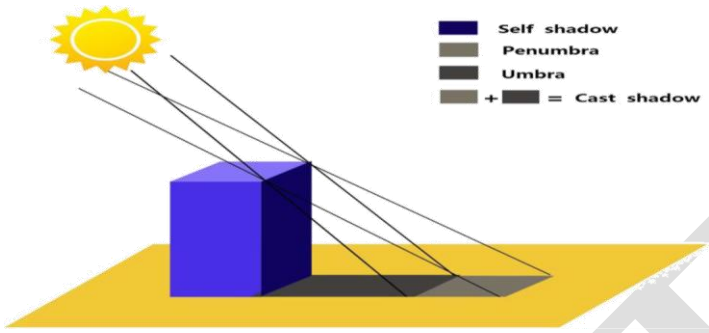

Figure 1:- Principle of Shadow Formation

Mainly shadows are divided into two parts:- 1) Self shadow, 2) Cast shadow.
The shadow on a subject on the side that is not directly facing the light source is known as self-shadow. The cast shadow is defined as the shadow of a subject falling on the source of another subject because the former subject has blocked the light source. The cost shadow is again divided into two parts:- 1)umbra, 2)penumbra. When light has been directly blocked by object then shadow created that shadow known as umbra, while penumbra shadow is created when something partly blocks the direct light. As shown in fig 1. In this paper the algorithm is mainly focused on cast shadow area of the remote sensing images. The block diagram of shadow detection is shown in the following fig. 2

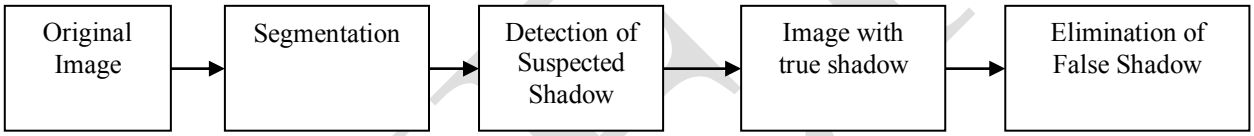

Figure 2:- Block Diagram of Shadow Detection

1) Image Segmentation Considering Shadow Features: Higher resolution images contain high spatial information. As they carry the large amount of data, it is hard to process on them. Pixel based methods are not sufficient for these images as they may take excessive time for processing these images. Image segmentation is needed for the use of spatial information to detect shadows. Traditional image segmentation gives insufficient result, which makes it difficult to separate shadows from dark objects. Convexity Model (CM) constraints for segmentation can improve the situation to certain degree. CM based segmentation along with color shape and shape factor is used which distinguish between shadows and dark objects. The parameters of each object will be recorded like grayscale average, variance, area and perimeter. This segmentation gives better result and it will be less time consuming result.

2) Detection of suspected shadow area: Thresholding methods are used for the separation of shadow non-shadow regions. According to histogram values of images threshold is obtained. Threshold is obtained by the neighborhood values of mean of two peaks. Suspected shadow can be detected by comparing grayscale value estimation of each object and threshold by using following equation (1) and (2)

$$Gq = \frac{1}{2}(Gm + Gs) \quad (1)$$

$$h(T) = \text{Min}\ \{h(Gq-\varepsilon), h(Gq+\varepsilon)\} \quad (2)$$

Where, Gm- Average grayscale value of an image
Gs - Left peak of the shadow in the histogram

T - Threshold, where $T \in [Gq-\varepsilon, Gq+\varepsilon]$
ε - Neighborhood of T
h(I)- Frequency of I , where I = 0, 1, …, 255.

In the wake of directing expansive number of examinations, it has found that to supplant the right peak, the normal of grayscale qualities are utilized. To rearrange this operation Gs i.e. left peak of the shadow in the histogram can be supplanted by half of the grayscale normal, when the left peak is not required. To maintain a strategic distance from the impact of anomalous data, a few pixels on left and right sides of histogram are excluded. For a similar question, when in the shadow and non-shadow range, their grayscale distinction at the red and green wavebands is more discernible than at the blue waveband. In this manner, it recover a suspected shadow utilizing the threshold method at the red and green wavebands.

3) Elimination of False Shadow: Some dark objects for example vegetation can be considered as shadows, so these false shadows should be ruled out. Hence to remove these false shadows spatial information is utilized. According to Rayleigh scattering, as compare to blue waveband grayscale difference at red and green waveband is more noticeable. Hence its grayscale average at blue is more noticeable as compared to red and green. Green vegetation can become a false shadow. According to various properties of green vegetation Gg is greater than Gb. Hence for object i, if Gb> Gg, then i can be considered as vegetation and it can be ruled out.

B. SHADOW REMOVAL

In order to remove shadow from image shadow removal method is used. The block diagram of shadow removal is shown in following Fig. 3.

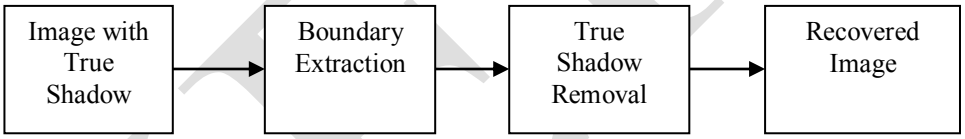

Figure 3:- Block Diagram of Shadow Removal

1) Boundary Extraction: Shadow removal method is based on IOOPL matching . According to inner and outer pixels of image boundary the inner and outer IOOPL lines are obtained. The diagram of shadow boundary, inner and outer outlines lines is shown in following fig. 4.

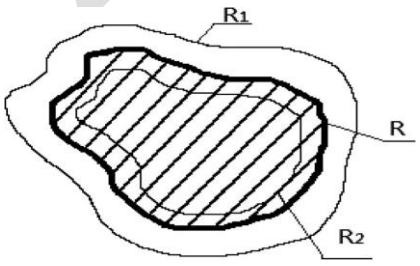

Figure 4:- Diagram of shadow boundary, inner, and outer outline lines.

As shown in fig 4. R is the vector line of shadow boundary obtained by shadow detection. Using morphological operation inner and outer profile lines are obtained. R1 is the outer outline obtained by expanding R outward. R2 is the inner outline obtained by contracting R inward. If R1 and R2 are close then it is probability that they belong to same object. Therefore, outer profile lines belong to non-shadow area and inner profile lines belong to shadow area

2) True Shadow Removal: For true shadow removal inner-outer outline profile line (IOOPL) matching is used. When correlation between both outlines i.e. inner and outer outlines are nearly close, then there is large possibility that this location belongs to same type of object. To obtain inner outer profile line (IOOPL) the grayscale value of corresponding nodes along inner and outer outline at each waveband will be collected. To recover shadow areas in an image IOOPL matching is used. To rule out non-homogeneous section IOOPL will be divide into average sections with same standard. Then similarity of each line pair will be calculated. For the calculation of similarity following equation 3 is used. In following equation similarity set A and set B is expressed.

$$(A, B) = \frac{\sum_{i=1}^{n}(c_i^A - \overline{c^A})(c_i^B - \overline{c^B})}{\sqrt{\sum_{i=1}^{n}(c_i^A - \overline{c^A})^2 \cdot \sum_{i=1}^{n}(c_i^B - \overline{c^B})^2}} \qquad (3)$$

Where, A= Curve representing one set
B= Curve representing another set
c_i^x = Grayscale of node i on curve X
$\overline{c^x}$ = Grayscale average of all nodes on curve X
If correlation coefficient is large in IOOPL matching the IOOPL line pair belongs to same type of object and then it will be considered to be matching. If correlation coefficient is small in IOOPL matching then some different types of objects exists in this section. So these parts will be removed.[1]
True shadows are removed using homogeneous sections obtained by line pair matching. For shadow removal there are two approaches. First approach is relative radiation correction which calculates the radiation parameter according to homogeneous points to each object. It is good at restoring the contrast between background and objects. Second approach is polynomial fitting which collects and analyze all homogeneous section and it retrieves all shadows directly with obtained fitting parameters. It is good at restoring all of image radiant information.

RESULT AND DISCUSSION

The results of this methodology are shown through images. For this process input image has taken shown in fig. 5. This image cab be any color image or grayscale image. If color image is taken as an input image then it can be converted into grayscale image as shown in fig. 6.

Figure 5:- Input Image

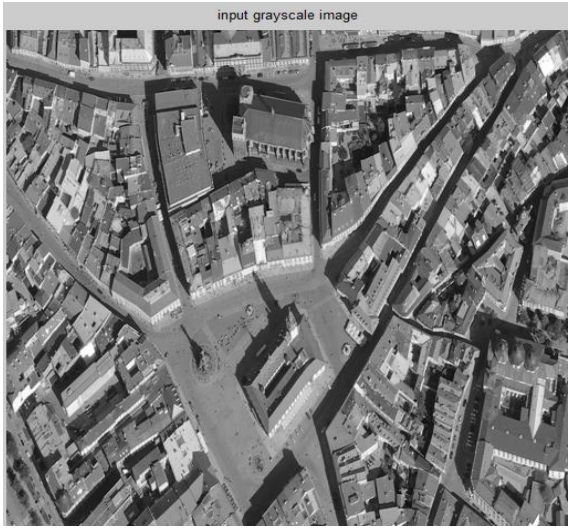

Figure 6:- Input Grayscale Image

From the segmentation result shown in fig. 7, it can be seen that segmentation that considers shadow and dark objects. Then shadow area is detected through threshold method shown in fig. 8. After that suspected shadow is detected and false shadow is eliminated from image as shown in fig.9. After elimination false shadow, inner and outer line generation for shadow removal. The inner outer outline profile line (IOOPL) graph generation is shown in fig 10. With the help of RRN (Relative Radiometric Normalization) shadow is removed. The output image i.e. recovered image is shown in fig. 11.

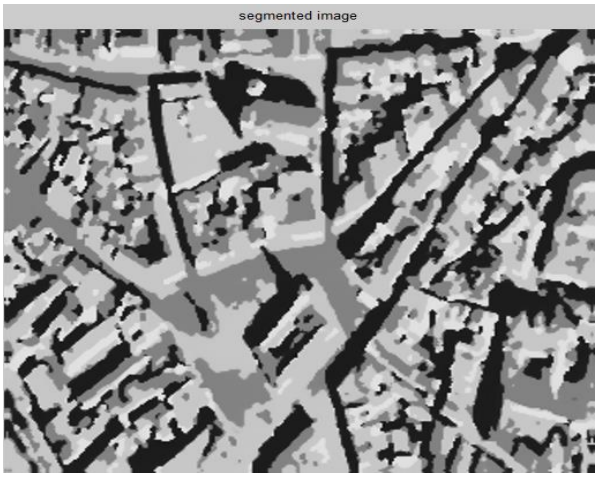

Figure 7:- Segmented Image

Figure 8:- Shadow detection Image

Figure 9:- Suspected Shadow Detected and False Shadow Eliminated Image

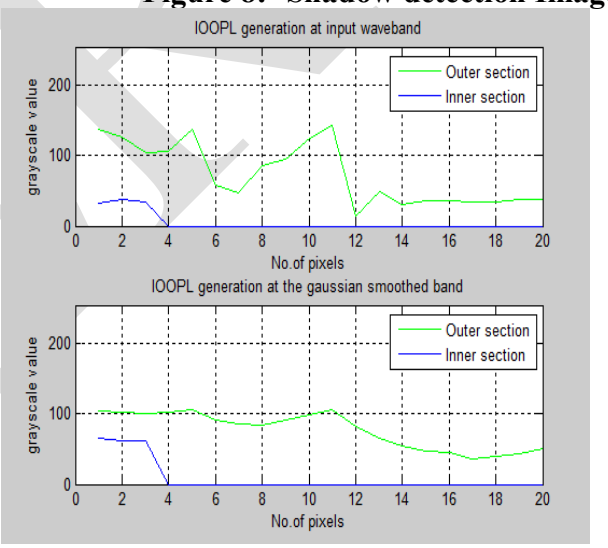

Figure 10:- IOOPL Graph Generation

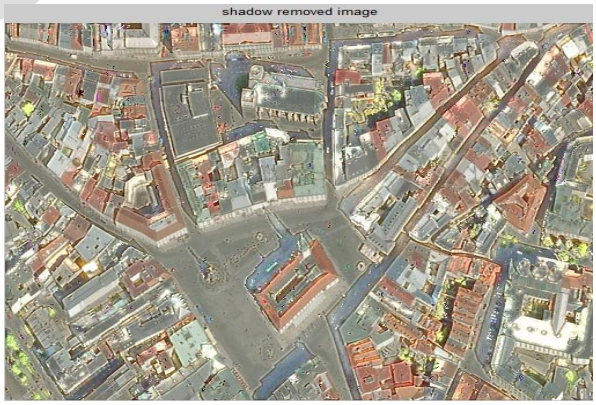

Figure 11:- Shadow Removed Image

CONCLUSION

Shadow detection technique is proposed for stable and accurate identification of shadows. For shadow detection segmentation of an image is done. After that shadow will be detected by thresholding. With the full use of spatial information of image shadow detection is done using object-oriented shadow detection method. After that boundary extraction is done for shadow removal process. Next, for shadow removal IOOPL matching is used. From this shadow free image will be obtained.

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