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Abstract— In remote sensing images, shadows created by big tower, bridges, tree. It may destroy the information of an image. Missing information has a direct effect on common analysis and processing of image, this leads to inefficient classification. To separate shadow and non shadow regions, morphological feature is consider for segmentation. Relevance Vector Machine (RVM) classifier can also classify both the shadow and non shadow regions. Then, the borders extraction is performed for extracting shadow part of that image. In the removal process all the shadow areas remain some unusual manner. To remove shadows, mean and standard deviation for the shadow and non shadow region of an image are calculated. Then, the mean difference between shadow and non shadow part of the image is applied to shadow part of an image by normalization.

Index Terms— Borders extraction, Relevance Vector Machine (RVM), Shadow detection, Shadow removal.

1 INTRODUCTION

High-resolution image have many more pixels per square inch than the lower resolution image. This method creates a new logic in satellite image processing. Due to High-resolution image it is very easy to differentiate each and every object of image. For such kind image we required new detection, analysis and classification methods. Thus shadow brightness level is varied. They are having different colors other than non shadow part of that image. A shadow is created, when any object lies in the light emerging source.

The detection and removal of shadow areas play an important role in the image processing field. If the light source emitting energy is fallen less that area is considered as a shadow regions, whereas if the light source is emitting more energy, this area is represented as non shadow region [1]. A classifier called RVM can also be used to separate both the shadow and non shadow regions.

These areas are used to estimate the parameters from shadow formation model. A refined reconstruction process is then applied to produce a shadow-free image, while avoiding loss of texture information and the presence of noise. They are responsible for the changing shadow intensity level inside the shadowed region by processing that image from the interior towards the boundaries extracted. Afterwards, to ensure that the transition between the initial and the removal regions they apply image in edge detection along a segmentation [2]. The complete processing framework for shadow detection and removal method, the detection and classification techniques is incorporated by means of the state of enhancement approach. A performance check mechanism is substituted in order to reduce subsequent misleading problems [3]. The removal is based on a linear regression method to compensate both shadow regions by maintaining the intensity level of the shaded pixels according to the statistical characteristics of the corresponding nonshadow region. Borders are explicitly taken into consideration by making use of adaptive morphological filters and interpolation for the prevention of possible borders in the shadow-free image. The detecting and removal technique begins with a segmentation of the grayscale image. When segmentation is done shadow by examination of its adjacent segments [4]. They use this method to remove the shadows by normalization of the shadow’s borders in an edge representation of the image, and then reforming the edge using the histogram method. This is done for all of the grayscale image, thus leaving a shadow-free color image. The present method requires not only a camera image, but a multiple images [5]. They use thresholding method to find the illumination invariant Shadow-free image. Then use this invariant image together with the original image to locate shadow boundary. By setting these shadow boundaries to zero in an edge representation of the original image, and by subsequent reconstructed this edge representation by a method paralleling lightness recovery, they are able to arrive at our sought after full color, shadow free image.

2 PROBLEM FORMULATION

In remote sensing images, the shadows created by big tower, bridges, tree may destroy the information of an image. Shadows create when objects lies in the way of the direct light of the illumination source [6]. A shadow is divided into two major parts: cast and self shadow. The shadow cause by direct illumination of light on the object is called Cast shadow and the shadow cause on the object itself is called self shadow. Self shadow is the part of the object. We concentrate on cast shadow, which is present in most of
the images. Cast shadow having property of homogeneous dark areas, which lead to loss of information in an image. This paper works on removing the cast shadow.

3 PROPOSED METHOD

3.1 Preliminary processing

In the preprocessing step, Comparative Contrast Map is applied to the input image. In a Comparative Contrast Map, we merge the local image contrast with the local image gradient of the input image. It detects all of the non stroke edges from the background of loss document that often contains specific image variations due to noise, unusual lighting, bleed-through. In a way to extract only the stroke edges clearly, the image gradient requires to be normalized to compensate the image variation within the background of the document [7]. The purpose of the comparative contrast image construction is to detect the stroke edge pixels of background of the document image.

3.2 Image Stroke Edges Detection

In order to detect image stroke edge pixel candidate, here using Otsu’s thresholding method [8]. The binary map can be further improved through the combination with the edges by a Canny’s edge detector, because the Canny’s edge detector has a good localization point that it can make the edges close to actual edge locations in the detecting image. In improvement, the canny edge detector uses two comparative thresholds and is more accepted to different imaging artifacts. It must be noted that Canny’s edge detector by it often extracts a large number of non-stroke edges. The combination of Otsu’s thresholding and the canny edge map helps to extract the image stroke edge pixels accurately.

3.3 Segmentation of the image

The image can then be extracted from the document background pixels once the high contrast image stroke edge pixels are detected clearly. We then calculate the most accurate distance between two nearby edge pixels in vertical direction and use it as the estimated stroke height. The pixel image is scanned horizontally row by row and the edge pixel candidates are selected [9]. The histogram is constructed that the frequency of the distance between two nearby candidate pixels. The stroke edge height can then be approximately estimated by using the most consecutively occurring distances of the nearby pixels.

Segmentation algorithm:
- Set initial cluster centers (output gray tones).
- Classify pixels. Each pixel is labeled by the id number of the closest cluster.
- Calculate new cluster centers (output gray tones).
- If in cluster centers obtained are different to centers obtained in the previous iteration, then go to the previous step, otherwise go to the next step.
- Using cluster centers (output gray tones) classify pixels of the input image into output one. Change value of each pixel to the value of the closest cluster center.

Finally, The most proper one for the application should be chosen [10]. Then the better one can be chosen. Mask for separating shadows versus non shadow is created by binary classification. As there is no a certain technique to choose the best edge detection operator, a number of trials with different operators may be required.

3.4 Post processing

The binarization is the result of further improvement by post processing. The single foreground pixels that do not connect with other foreground pixels are removed to make the edge pixel set accurately [11]. The adjacent pixel pair that lies on similar sides of a image stroke edge pixel should belong to separate classes. Single pixel of the pixel pair is labeled to the next category if both of the two pixels belong to the same class. Finally, some symmetric pixel artifacts along the image stroke boundaries are removed.

4 METHODOLOGY

4.1 Document Image Binarization Technique

Binarization is to choose a threshold value, and classify all pixels with values above this threshold as white, and all other pixels as black. If greater then mean value, then its ‘1’ otherwise its ‘0’. Binarization is a process where each pixel in an image is converted into one bit and you assign the value as ‘1’ or ‘0’ depending upon the mean value of all the pixels. Frequently, Binarization is used as a pre-processor before OCR [12]. Image Binarization converts an image of up to 256 gray levels to a black and white image. In fact, most OCR packages on the market work only on bi-level (black & white) images. The simplest way to use the image

Therefore, adaptive image Binarization is needed where an optimal threshold is chosen for each image area. The problem is how to select the correct threshold. In many cases, finding one threshold compatible to the entire image is very difficult, and in many cases even impossible.

Otsu’s method:
Step by step explanation of execution of reconstruction process:
1. We have to separate the pixels into two clusters related to the threshold
2. find the mean of each cluster unit of the threshold
3. square the difference between the means of each pixel
4. multiply by the number of pixels in one cluster times the number in the other
5. calculate the histogram and probabilities of each intensity level threshold
6. set up initial cluster origin $q_i(0)$ and $\mu_i(0)$
7. set all possible threshold maximum intensity
8. update cluster units $q_i$ and $\mu_i$
9. calculate $\sigma_i^2(t)$
10. expected threshold considered as maximum

Canny edge map:
The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images.

In addition, the canny edge detector uses two adaptive thresholds and is more tolerant to different imaging artifacts such as shading [13]. The Canny Edge detection algorithm runs in 4 separate steps: Smoothing: Blurring of the image to remove noise. Finding gradients: The canny edge detector has a good localization property that it can mark the edges close to real edge locations in the detecting image. The edges should be marked where the gradients of the image has large magnitudes. Non-maximum suppression: local maxima should be marked as edges. Double thresholding: Potential edges are determined by thresholding [14].

4.2 Relevance Vector Machine (RVM) Classifier
It is a Bayesian alternative to support vector machine (SVM). Limitations of the SVM are classified into two classes. One is the large number of kernels (in spite of sparsity) and the other is kernels must satisfy Mercer criterion, cross-validation to set parameters $C$ (and $\varepsilon$) decisions at outputs instead of probabilities.

4.3 Extracting Borders
The main difficulty occurs in the separation of shadow and non shadow regions. This problem is the reason for without knowing the borders, color inconsistency. And one more thing is the penumbra, which is a region induces mixed pixels which are difficult to classify and also verifies whether the light source is permanently covered or not.

Shadow regions and non shadow regions are separated by using a segmentation process. As shown in figure 3, we examine the size of an image. If it is less than double range, then it requires resizing the input image and convert it to rgb to gray colored image. To perform the clustering process in order to get the similar data items for detecting the shadow region. Shadow detection is the one of the main cause for removing it for clear picture [16]. 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 entire shadow region is separated from non shadow region color, hue, intensity and saturation are identified. In the olden days shadow regions are not only detected, but also performed removal operations with the help of some removal techniques in image processing. This shadow removal operator is used to remove the shadow regions for the effective way for increasing the performance of the system.

4.4 Shadow Removing
In this shadow removal process, we have two steps, namely to calculate mean and standard deviation for shadow and nonshadow region respectively. Then calculate mean difference between shadow and nonshadow region and apply these differences to shadow part. In the first step, we calculate mean for shadow region and as well as for nonshadow regions [17]. For mean calculation, normalized histogram method is followed in order to enhance the image with the help of image enhancement technique. Then calculate mean and
standard deviation for shadow and nonshadow region of the image using no (1).

\[ m_1 = \text{mean}(A(1,:)); \quad s_1 = \text{std}(A(1,:)); \]
\[ m_2 = \text{mean}(A(2,:)); \quad s_1 = \text{std}(A(2,:)); \]
\[ m_3 = \text{mean}(A(3,:)); \quad s_1 = \text{std}(A(3,:)); \]

... \]
\[ m_{10} = \text{mean}(A(10,:)); \quad s_1 = \text{std}(A(10,:)); \quad (1) \]

After enhancing the image by calculating mean values for shadow and nonshadow region [10], now calculate mean difference between shadow and nonshadow part using equation (2). Then incorporate the mean difference of non shadow part of an image by using normalization technique with the help of standard deviation using equation no (3) and (4) respectively.

\[
(N_1 + N_2) * m_0 = \sum(i=1:N_1+N_2)\{x_i\}
= (N_1 * m_1 + N_2 * m_2) \quad (2)
\]
\[
(N_1 + N_2 - 2) * v_0 = \sum(i=1:N_1+N_2)\{(x_i-m_0)^2\}
= \sum(i=1:N_1)\{(x_i-m_0)^2\} + \sum(i=N_1+1:N_1+N_2)\{(x_i-m_0)^2\} \quad (3)
\]

1st term = \[ \sum(i=1:N_1)(x_i-m_1)^2 + 2*(m_1-m_0)\sum(i=1:N_1)\{(x_i-m_1)^2\} + (m_1-m_0)^2 \quad (4) \]

5 EXPERIMENTAL ANALYSIS

5.1 Analysis of Shadow Detection Method

The performance of our shadow detection method is as follows. Each step of this method is described herein, and the steps and corresponding results. In order to compare with our method, we determined the pixel-level shadow detection result with manually selected proper threshold according to the image grayscale histogram image.

It is seen from the segmentation result that segmentation considers shadow features can effectively segment shadows and dark objects such as vegetation and water bodies into different subjects. It means that, in the following process, the problem of shadow and dark objects being segmented as a whole object can be restricted. Show the recovery of a shadow with the threshold, which indicates that vegetation; rivers, dark moist soil, and true shadows can be detected. We can see that the shadow area detected by the threshold selected by our method is larger than those with a pixel-level threshold method. In this way, it can be ensured that no shadow will be excluded. It can be seen that our method can effectively remove vegetation false shadows. According to the morphological characteristics of objects, the rivers in the image have been effectively removed. We see that pixel-level shadow detection have lost some very useful spatial information.

5.2 Analysis of Shadow Removal Method

To verify our shadow removal method, the following examination was performed. The mean and standard deviation is calculated and it is applied in the shadow area of an image. Then, the shadow area and also the corresponding mean grayscale difference in RGB bands are obtained.

5.3 Performance Measures

In the existing system, they have used SVM for Classification. Here used RVM which helps to attain minimum error rate than the previous.

<table>
<thead>
<tr>
<th>Model</th>
<th>Error</th>
<th>No. of Kernels</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVM</td>
<td>10.97%</td>
<td>38</td>
</tr>
<tr>
<td>RVM</td>
<td>10.43%</td>
<td>3</td>
</tr>
</tbody>
</table>

6 CONCLUSION

This paper solved the important problem of shadow content image. We solve this problem by not only detecting shadow, but also remove shadows from image. In our paper, we use binary classification for shadow and nonshadow part of the image. To get clear boundary, we first apply canny edge detection algorithms. For removal process, we calculate the mean and standard deviation for shadow and nonshadow part of the image and apply the mean difference between shadow and nonshadow part to shadow part. To improve final result this difference applies by using a normalization process with the help of standard deviation.
REFERENCES


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