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ROBUST FUZZY LOGIC TECHNIQUE FOR LOW CONTRAST IMAGE SHADOW REMOVAL

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ABSTRACT

The shadows are playing very hazardous for recognizing objects in low contrast Images. Shadow leads to the problem of false positive errors and false negative errors. Shadows are created because the light source has been blocked by object. In the existing method, suspected shadows are extracted and removed by taking the shadow features into consideration during image segmentation and by calculating the statistical features of the image. But the main limitation of existing method is that the dark objects which could be mistaken for shadows are ruled out according to object properties and spatial relationship between objects. Many effective algorithms have been proposed for shadow detection but no algorithm is produced accurate results. In this project robust fuzzy logic technique is using to eliminate shadow of object. This method accurately identifies shadow areas with information such as gray scale and brightness of the images. The threshold value is obtained by s-curve from the estimated grayscale value of the shadow areas by estimating control parameters. This method work perfectly for low contrast, noisy and overlapped images.

Keywords: shadow, FBM, MBM, fuzzy logic, control parameters.

1. INTRODUCTION

The detection and removing of shadow from images is one of the critical issues. For shadow detection and removing there have been many approaches projected. Since shadow detection is one of the most basic ancient in images. for identifying the shadows from the images many algorithms are proposed for identifying the shadows and for removing the shadow. For shadow detection and removing convexity model and IOOPL model were used. However, Most of previous approaches have some drawbacks. [1] In this paper authors introduced the blackbody radiator model for shadow detection, and to give the description of the illumination process. This method contains the calculation of the parameter values for the input images. Here the shadow will be identified based on the high scores of the illumination, sun elevation and Lat/Lon coordinates. The scores are generated based on the processed data set of near infrared images. The drawback is this method is not limited to remotely sensed data. [2] Here for identification and classification of shadow s in color images, a novel method is proposed. for identification of shadow in images we are using the information of color and Luminance. Classifying the shadow points as a self shadow points if they are presented between the edges of objects the proposed method successfully detect and classify the shadows and these are very less astrictive. [3] In this paper, it defines the clarification. They used the technique for making a separation of shadows from images. The RGB color and the final results found by the WAVELENGTH that is noticeable. The main drawback is the quality of the images is very less.[4] they used shadow removal technique that defines the illuminant plane in an artificial infinite technique, due to the lower cost and the dependability, it become successful on the proposed system of the paper. They finalized that minimum shadow region that is overlapped; they used the shadow flash algorithm for the true illumination sources. And they used to resolve the disadvantage of 3D shape they define the quality. [5] In this paper for detecting shadows of color aerial images they introduced the STS algorithm based on the coarse-to-fine strategy. Based on the map ratio the global thresholding process, coarse-shadow map will construct. This method first divide the image into pixels, the proposed method is used to find the true shadows from the candidate shadows, while compared to existing algorithms the proposed algorithm shadow detection accuracy. [6] In this paper they included STATCOM with the control in the discrete; it will improve the immovability of system using power. Here they used the concept of fuzzy logic to control the discrete system to change the variables. They showed the use of fuzzy logic in the system. They used 3-level stages to demonstrate the fuzzy logic control .each level describes the values that used, whether it is count (or) maximum count and the variation and also they represents the timing they each electrical circuits. [7] This paper introduced the SSSC with separate control to improve the temporary stability of power system, here the SSSC moved between capacitive and operating value and this reactive voltage is defined by the fuzzy logic discrete controller. This FLDC will be based on power function ,here in changing the control variable the FLDC will involve using the separate control of SSSC realize the 24-pluse three level configuration. [8] By using the stability for voltage in dynamic way has introduced to find the location of UPFC in bus systems such as IEEE-5 and 14. In this project proved finding the location is accurately not only 5 and 14 and also indicates that all buses increased their performance involved profile nothing but it determines the location that are connected to all the buses.[9] in this paper they used the wavelets for influential the pattern recognition of the soul faces and fingerprints, and this approach is used for image density, and they achieved 96.7% in extended work we use the other methods like principal components for pre-processing and we can use the other method that can

improve the performance of the system. [10] Here the fuzzy logic filtering is used to de-noising the digital images we can use this proposed model and it will give the good results, the values will be compared with the PSNR values and the visual observation. The proposed method will take less time so this filtering method is simple and it takes less hardware to implement. [11] Mammography is an instrument (or) equipment used to detect the cancer in the women. This depends on radiologist's opinion and the approach is depends on OTUS strategy of threshold. For segmentation, identification of signal in the breast cancer. For that they introduced the automated detection method. This method find the breast cancer by involving the normalizing breast region and threshold values by using the OUST technique. The drawback of the existing method uses histogram so they implement (or) proposed new method with the variance and average mean using fuzzy logic. It will remove ambiguity in the misclassification when the weight of the previous method was used.

2. IOOPL MODEL

Here in the existing method the authors used the IOOPL model for shadow removing. In this existing system it mainly consists of two steps 1.shadow detection 2.shadow removing. In this shadow detection the segmentation process will be using and for the segmentation the convexity model is used.

Algorithm

The convexity model (Reference)

Step 1:

$$\sum f_1(x) - f_i(x_0) = \sum f_1^{'}(x_0) * (x_i - x_0) + 0.5 * \sum f_i^{''}(x_0) * (x - x_0)^2$$

$$F(x) - f(x_0) = f^{'}(x_0) * (x - x_0) + 0.5 * f^{''}(x_0) * (x - x_0)^2$$

After that performing the detection of shadow areas

Step 2:

$$M_q = \frac{1}{2}(M_r + M_p)$$

$$R(a) = \min\{R(M_q - \varepsilon), R(M_q + \varepsilon)\}$$

In this equations
Mr is minimum grayscale value
Mp stands for in the histogram the left peak value of shadow
a is for threshold value
ε represents the neighborhood of a.
and the false shadows are deleted

Step 3:

$$Diff = \frac{1}{m}\sum_{i=1}^{1}\left|\overline{D_s} - \overline{D_{si}}\right|, \ \overline{D_s} < \overline{D_{si}}$$

Here $\overline{D_s}$ is the average value of the object s in the grayscale

Step 4:

Here we are performing the shadow removing and the authors used the IOOPL matching model
The similarity of curve T,S is expressed by

$$Similarity(T,S) = \frac{\sum_{i=1}^{n}\left(a_i^n - \overline{an}\right)\left(b_i^m - \overline{bm}\right)}{\sqrt{\sum_{i=1}^{n}\left(a_i^n - \overline{an}\right)^2}\sqrt{\sum_{i=1}^{n}\left(b_i^m - \overline{bm}\right)^2}}$$

Here,

n = number of nodes on curve T and curve S
a_i^n = gray scale value of the node A
$\overline{an}$ = gray scale average of all nodes.

Step 5:

Here the author used the relative radiometric correction for shadow removal implementation.

$$PQ_{ref} = u * PQ_{rect} + V$$

Here,

PQ_{ref} = PQ reference image object
PQ_{rect} = PQ object of corrected image

Step 6:

Using mean variance method

$$x_k = \frac{H_{ak}}{H_{bk}}; \ y_k - \overline{ak} - x_k.\overline{bk}$$

Where,

$\overline{bk}$ Average of grayscale of inner homogeneous at waveband k,
$\overline{ak}$ is the average of grayscale of outer homogenous at waveband k,
H_{ak} and H_{bk} are the standard deviation of the inner and outer homogeneous section of the waveband.

Step 7:

Finally based on the inner homogeneous section collect the all shadow points and corrected as

$$PQ_{nonshadow} = x_k * PQ_{shadow} + y_k$$

Here,
PQ_{shadow} is for gray scale pixel shadow values after correction,

PQ_{shadow} Stands for gray scale pixel shadow values before correction and x_k and y_k are the coefficients of the mean and variance maximum and minimum values.

Step 8:

Calculation of polynomial fitting to define the shadow area which is directly obtained by this fitting parameters base on the gray scale values as

$$F(x) = mx^3 + nx^2 + dx + e$$

3. PROPOSED METHOD

The proposed fuzzy logic technique introduced the s-curve model this model will divide the image into three parts as object, shadow, and overlap area. Fuzzy logic which produce optimal threshold to avoid the fuzziness in the image and makes good regions regarding background and object .Fuzzy set theory assigns a connection degree to all elements among the world of discourse according to their potential to fit in some class. The connection degree can be expressed by a mathematical function $\mu A(x_i)$ that assigns, to each element in the set, a membership degree between 0 and 1.Let be the universe (finite and not empty) of discourse and *i, x* an element of fuzzy set A in X is defined as

$$A = \{(x_i, \mu A(x_i)) x_i \in X\}$$

The S –curve is used for modeling the membership degrees. This type of function is suitable to represent the set of bright pixels and is defined as

$$\mu_{AS}(x) = S(x,a,b,c)$$

$$S = \begin{cases} 0 & , x \le a \\ \left\{\frac{(x-a)}{c-a}\right\}^2 & , a \le x \le b \\ 1 - 2\left\{\frac{(x-a)}{(c-a)}\right\}^2 & , b \le x \le c \\ 1 & , x \ge c \end{cases}$$

Where b=(1/2)(a+c).

The S-curve show in the Fig1 can be controlled through parameters a and c. Parameter b is called the cross over point where μ_{As}(b) = 0.5 .The higher the gray level of a pixel (closer to white), the higher membership value and vice versa.

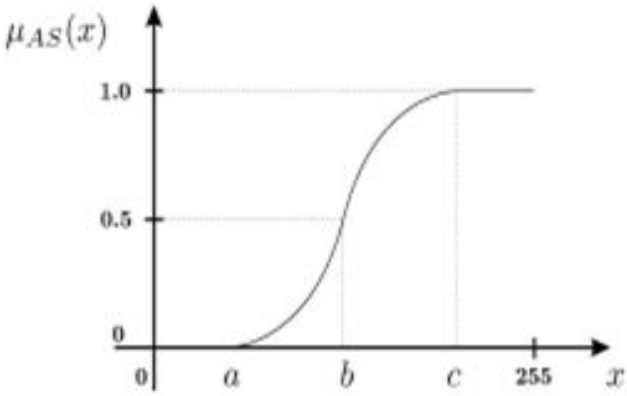

Figure-1. Typical shape of the S-curve function.

The optimal threshold value exists at the two peaks or at the bottom rim of a single peak. The histogram that separates the object from the surroundings, its probability of occurrence is small in gray level histogram. Because of the optical threshold should be near the cross where the object and the background intersect

In this proposed method the mean, trapped difference values and the jack card values will be calculated for comparison of the images.

$$mean = mean(mean(abs(original\ image - output\ image)))$$

$$s = std(std(original\ image - output\ image))$$

$$JC = \frac{c}{(150*150)} output\ images\ compression$$

4. EXPERIMENTAL ANALYSIS

To elucidate the performance of the proposed methodology, we consider 12 shadow images as an image set. It contains satellite images and synthetic and normal photographs which contain similar and dissimilar gray level histogram characteristics, changing from uni- model to multi model histograms. Figure shows the comparison of means (μ) of two different methods containing existing and proposed methods. The proposed method gives the optimum threshold value compared to the other method the smooth curve shows the quality of image without shadow. From the experiments for each test image we obtain standard deviation (σ) and are compared with gold standard images by two methods and given the values in the table. For the smooth images the standard deviation produces the smaller range of values because it retains the higher values like edges, noise, shadows and it removes the lower values. The third parameter is jacquard formula used to test quality of images the value is high for quality images without shadow the graphs show that three parameter are producing optimal threshold.

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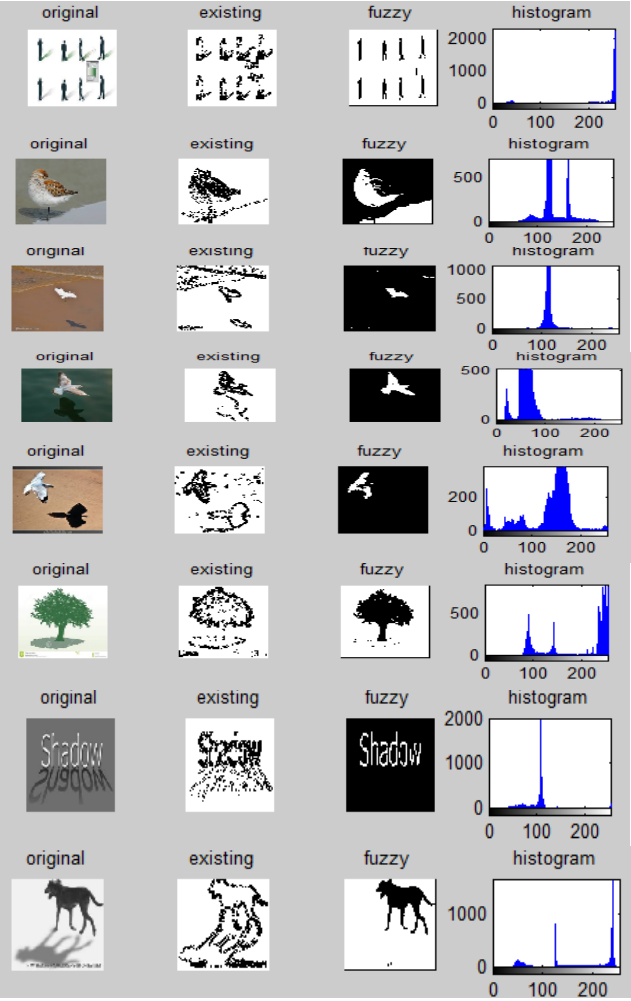


Figure-2. (a) Original image (b) existing image with noise(c) proposal image (or) output image (d) histogram graph image.

Table-1. Mean.

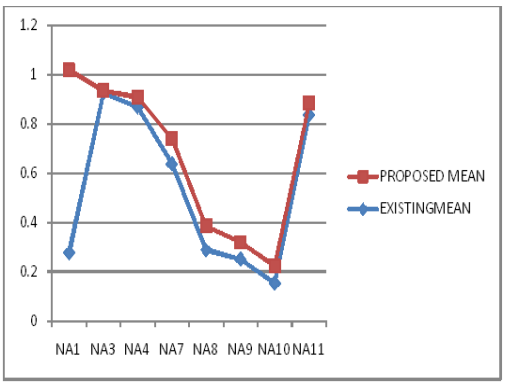
IMAGES	EXISTINGMEAN	PROPOSEDMEAN
NA1	0.2752	0.7435
NA3	0.9263	0.0101
NA4	0.8698	0.0398
NA7	0.6392	0.1037
NA8	0.2882	0.1002
NA9	0.2498	0.0719
NA10	0.1524	0.0701
NA11	0.8388	0.0479

Table-2. Standard deviation.

IMAGES	EXISTINGSD	PROPOSEDSD
NA1	0.0777	0.0641
NA3	0.3156	0.0829
NA4	0.0935	0.0471
NA7	0.1291	0.0841
NA8	O.1876	0.1009
NA9	0.2089	0.0864
NA10	0.2102	0.1203
NA11	0.2077	0.1388

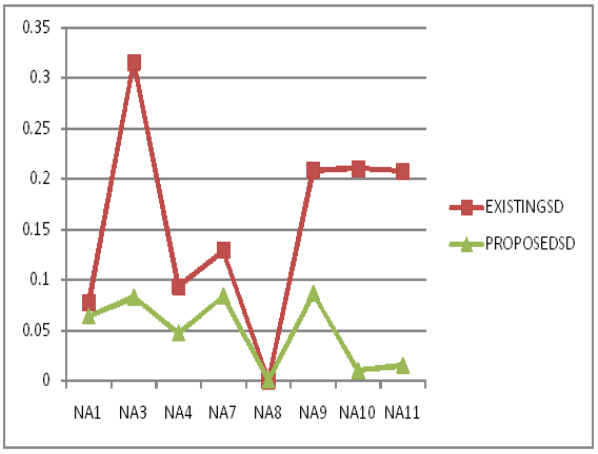
Table-3. Jacard.

IMAGES	EXISTINGJC	PROPOSEDJC1
NA1	0.7248	0.2565
NA3	0.0737	0.9989
NA4	0.1302	0.9602
NA7	0.3608	0.8963
NA8	0.7118	0.8998
NA9	0.7502	0.9281
NA10	0.8476	0.9299
NA11	0.1612	0.9527



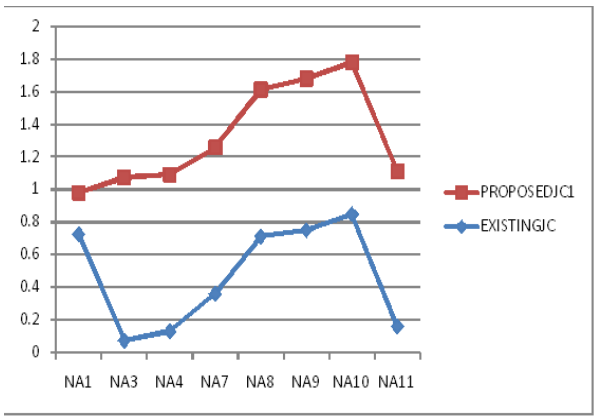
Fig(f): graph representation of the mean values for existing and the proposal methods

Figure-3. Mean.



Fig(h):graph representation of stranded deviation values.

Figure-4. Std.



Fig(j):graph representation of the jack values.

Figure-5. Jacard.

5. CONCLUSIONS

In this paper s-curve model has been presented from the Fuzzy logic technique .by using this model we can easily eliminate the shadow and extract the object very successfully. This model will achieve the problems like noise images and time complexity. The result of our proposed s-curve model, we have to notice that by using s-curve model for shadow removing and object extraction is a good choice with respect to existing models, in convexity model and IOOPL models. As future work we proposed the automate parameters selection for remove the shade from the images.

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