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An efficient artificial bee colony with boundary value segmentation for shadow detection

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Abstract: ***In the area of computer vision shadow detection is important as it provides the image with high resolution with pixel clarity. There are several approaches have already be introduced but scope in this area is wide and open. In this paper an efficient artificial bee colony (ABC) with boundary value segmentation for shadow detection has been proposed. The proposed approach is the hybridization of association rules, Otsu approach, gradient segmentation and ABC algorithm. First the data preprocessing has been applied for adjoin and adjacent matrix. Then association rules have been applied for adjoin and associated pixels and joint correlations have been formed. The Otsu's approach and gradient segmentation have been applied. It is beneficial in threshold value estimation in case of intra class variations also. Finally ABC algorithm has been applied for the final object detection and tracking. The results indicate that the approach is efficient in shadow detection and tracking.***

Index Terms: ***Shadow detection, artificial bee colony, association rules, Boundary value segmentation.***

I. INTRODUCTION

Shadow detection and the remedy in the removal is the latest trend in the computer vision area as it provides the image accuracy and object recognition properly. The published works in this area shows the wide impact and suggest several differentiability in this area [1−5]. Park shadow, object confusing and misleading in tracking are the major drawbacks in the detection methods [6]. So there is the need of effective techniques which should take care of boundary values so that exterior and interior regions should be classified. In 2015, Khna et al. [7] discussed the automatic detection and removal of shadow in images. They have developed a framework based on the multiple convolutional deep neural networks. They have proposed the Bayesian formulation to extract and removal of the images. In 2016, Bulla andShreedarshan [8] discussed the moving objects for the shadow casting. They have presented histogram-of-oriented gradients (HOG) features based approach for effectively dealing the fake shadows. For moving object detection they have used Gaussian mixture model (GMM). For chromaticity and intensity HSV color space has been used. Their results support the approach. In 2016, Shedlovska YI, Hnatushenko [9] discussed the shadow detection in case of satelliteimages. They have considered WorldView-2 satellite image of anurban area. They have used colortransformation and thresholdingfor the shadow mask extraction. In 2016, Gao et al. [10] presented a spatio-temporal basedmoving shadow detection approach. They have used watershed algorithm for the segmentation of the sub-regions. Then the extraction of the frames and adjacent pixels has been processed. It performs better in terms of one region adequately. In 2016, swami et al. [11] discussed the method of shadow detection based on flash image. But they suggested that this method may fails in dark background areas. They have proposed a new approach based on the seamless cloning method. The results based on the seamless cloning suggest the improvement in terms of previous method in detection. In 2016, Changet al. [12] discussed the use of side scan sonar. They have presented underwater object detection for the removal of shadow effect. They have used fuzzy c-mean clustering (FCM) approach. It is used for clustering the shadow segmented region. They have also used Otsualgorithm for the threshold value selection. Their results are efficient in terms of effectiveness and robustness. In 2016, PanchalandGamit[13] discussed the cases of shadow detection. They have surveyed and discussed the related methodology with the application areas and domains. The main aspectual changes and the rate discussed are then attenuated and the directions with the comparative analysis have been presented. In 2017, Das andMeher [14] discussed about the computer vision applications. It includes classification, detection and recognition of objects. They have discussed the problem of poor tracking due to the shadow effect. They have proposed a model based on the fuzzy sets. It is useful in self-shadow detection. The detection parameters they have used are RGB ratio, color space and the intensity of the image. In 2017, Huang et al. [15] discussed about the high resolutionshadow detection algorithm in case of images. They have proposed a high resolutionshadow detection algorithm based on random walker approach. They have used Otsu for the threshold value detection and support vector machine (SVM) as the classifier for the pixel classification. Then random walker model has been used for the refinement in the initial classification map. In 2018, Yarlagadda and Zhu [16] discussed about visual processing. They have proposed an approach for the shadow detection based on the reflectance approach. They have identified characteristics and segments pairs based on this method. Their method requires less parameter. In 2018, Huanget al. [17] discussed GaoFen-2 (GF-2). It is a satellite which has been launched by China. They have discussed the problem of shadow and their detection so that high quality images can be extracted. They have proposed a combination of spectral, spatial and morphological attribute profiles. It is helpful in mapping building shadows of GF-2 images. They have applied local binary patterns for the texture analysis. They have provided an approach for the shadow detection in GF-2.

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The main objective of this paper is to use the combination of association rules for the pixel value separation, Otsu method for the boundary value detection and artificial bee colony (ABC) algorithm for the final shadow detection as the classifier.

II. METHODS

Our approach is the combination of association rules for the pixel value separation, Otsu method for the boundary value detection and (ABC) algorithm for the final shadow detection as the classifier. This method is divided into four parts: 1) Pre-processing 2) Associated pixels and boundary value extraction and segmentation 3) Gradient analysis and 4) ABC algorithm. First the data pre-processing has been performed. The gray scale images have been considered. The image data has been pre-processed to form the correlation matrix and the adjacent neighbour matrix. It is then associated based on the pixels with the boundary value condition. It is segmented based on the inner and extraneous boundary values. The boundary values are segmented to find the correlation to acquire the neighbouring pixels and the joint association. The gradient analysis has been done for the complete position mapping. This mapping provides the complete scaling of the gradients show that the complete sequence and the dimensions have been observed. The algorithm 1 shows the algorithm of our approach. Figure 1 shows the complete flowchart of our approach.

Algorithm 1: Artificial bee colony with boundary value segmentation algorithm

Step 1: Images as the initial data source.

Step 2: Boundary value extraction with the rule based aggregation.

For the variance minimization threshold value has been calculated based on Otsu method:

$\sigma_w^2(t) = w_0(t)\sigma_0^2(t) + w_1(t)\sigma_1^2(t)$

The notations used here are as follows:

w_0 and w_1 are the probabilities and σ shows the variance for the two classed 0 and 1.

Then the probability for each class has been computed as follows:

$w_0(t) = \sum_{i=0}^{t-1} p(i)$

$w_0(t) = \sum_{i=0}^{L-1} p(i)$

L shows the bin presented in the gray scale histogram.

Step 3: Now the population based on the pixels have been evaluated.

Step 4: The scout bees that is pixel in our case search for the similar segmented space.

Step 5: The fitness value is then calculated based on the memory and the neighbourhood search space:

$\upsilon_{m\,i} = x_{mi} + \phi_{mi}(x_{mi} - x_{ki})$

υ_{mi}shows the new pixel selection based on the segmentation.

x_{mi} shows the random trials.

ϕ_{mi} is the random number between negative and positive values.

Step 6: Then the probability value has been calculated based on the fitness value:

Let the fitness value as Fv and function value as Fve

There are two cases can be possible:

Case 1: Fve>0

$Fv = \frac{1}{2 \times Fve+1}$

Case 2: Otherwise

$Fv = 1 + fabs\frac{1}{Fve}$

$P_{ij} = \frac{Fv_i}{\sum_{i=1}^{N} Fv_i}$

Step 7: Object detection and tracking for shadow detection.

Step 8: Final N recognition and finish.

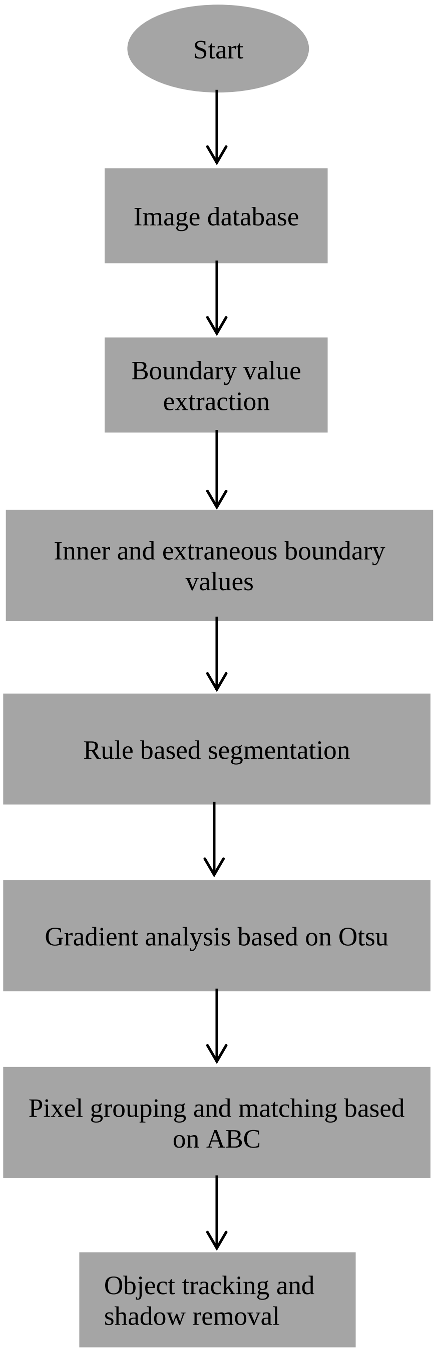

Figure 1: Complete flowchart of our approach

III. RESULTS AND DISCUSSION

This approach considered the images of IKONOS for the experimentation. The parameters considered here for the accuracy calculations are as follows:

Recall

Shadow: $\frac{True\ Positive}{True\ Positive + False\ Negative}$

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Non-shadow: $\frac{True\ Negative}{True\ Negative + False\ Positive}$

Precision

Shadow: $\frac{True\ Positive}{True\ Positive + False\ Positive}$

Non-shadow: $\frac{True\ Negative}{True\ Negative + False\ Negative}$

Accuracy:

$$\frac{True\ Positive + True\ Negative}{True\ Positive + True\ Negative + False\ Positive + False\ Negative}$$

Figure 1shows the recall value in case of Shadow. Figure 2 shows the recall value in case of Non-Shadow. Figure 3 shows the precision value in case of Shadow. Figure 4 shows the precision value in case of Non-Shadow. Figure 5 shows the overall accuracy by the proposed approach. Figure 6 shows the overall accuracy comparison. The results clearly show that our approach has shown significant improvement in case of precision, recall and overall accuracy. The efficiency provides the impact is the shadow detection.

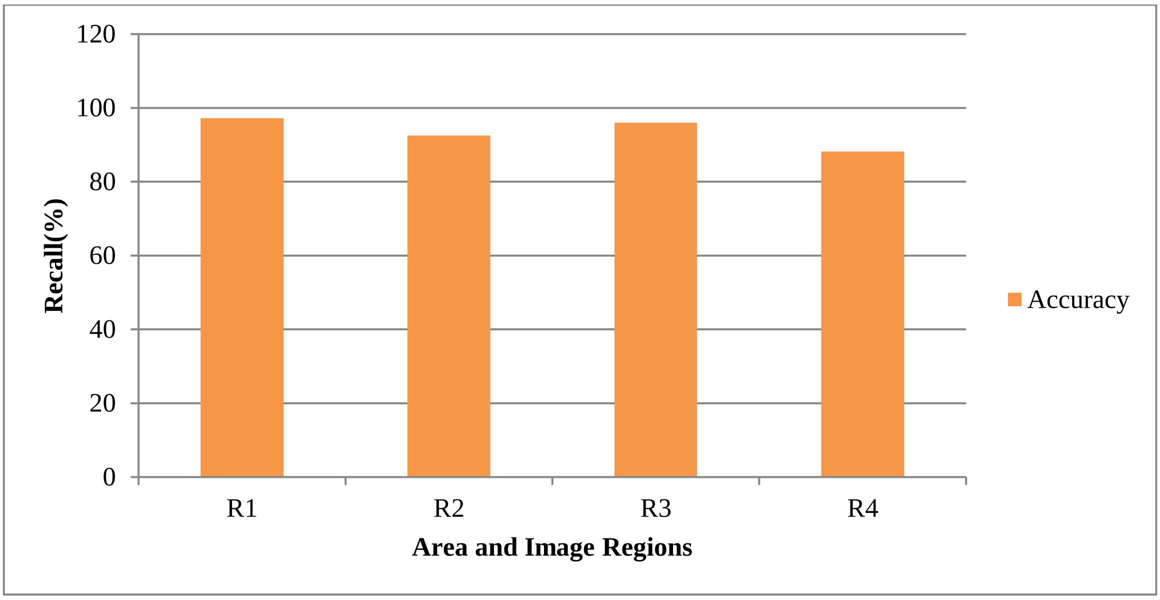

Figure 1: Recall value in case of Shadow

Figure 2: Recall value in case of Non-Shadow

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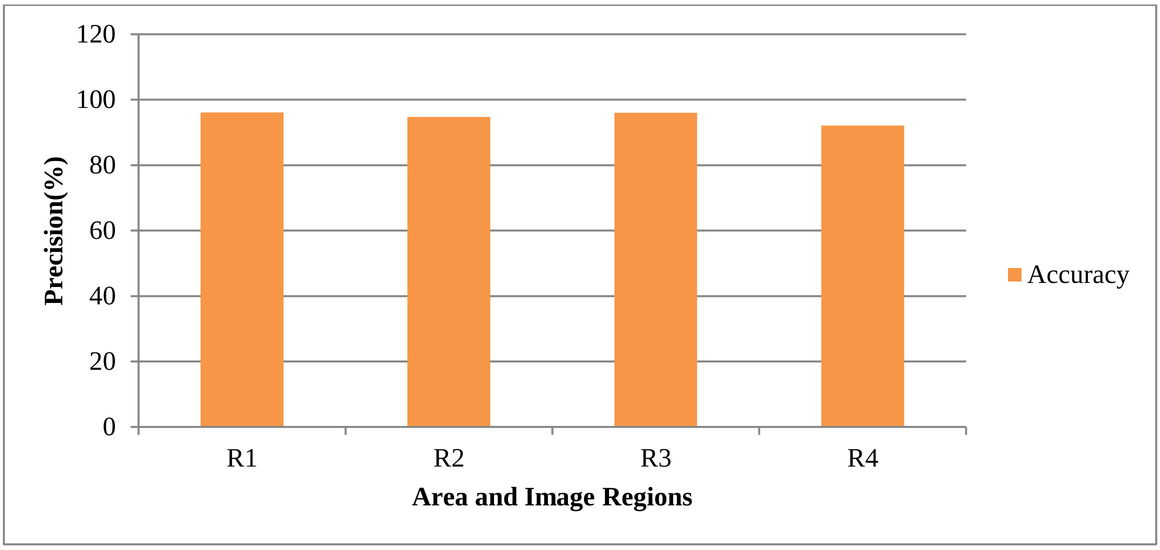

Figure 3: Precision value in case of Shadow

Figure 4: Precision value in case of Non-Shadow

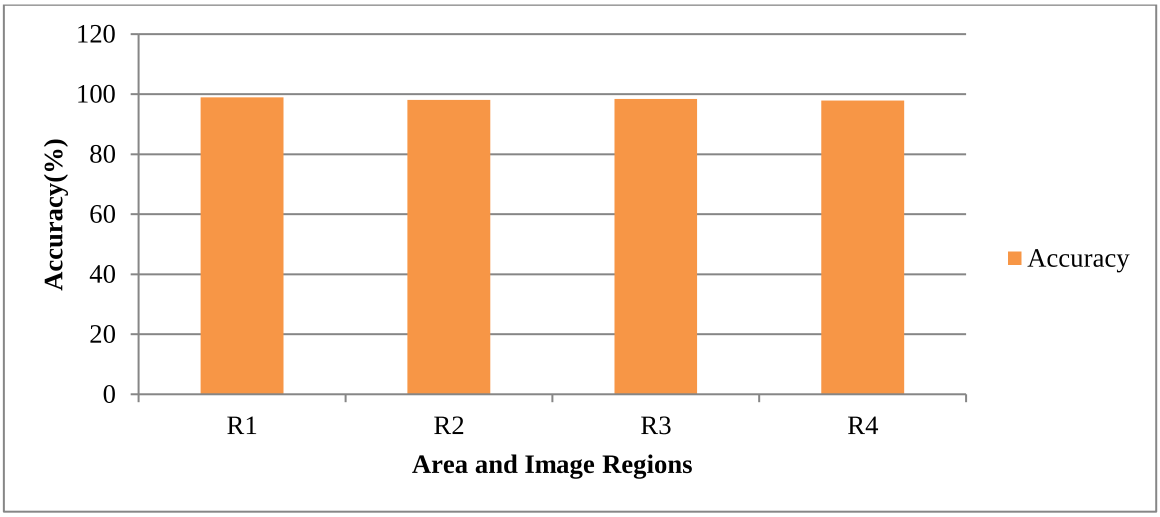

Figure 5: Overall accuracy by the proposed approach

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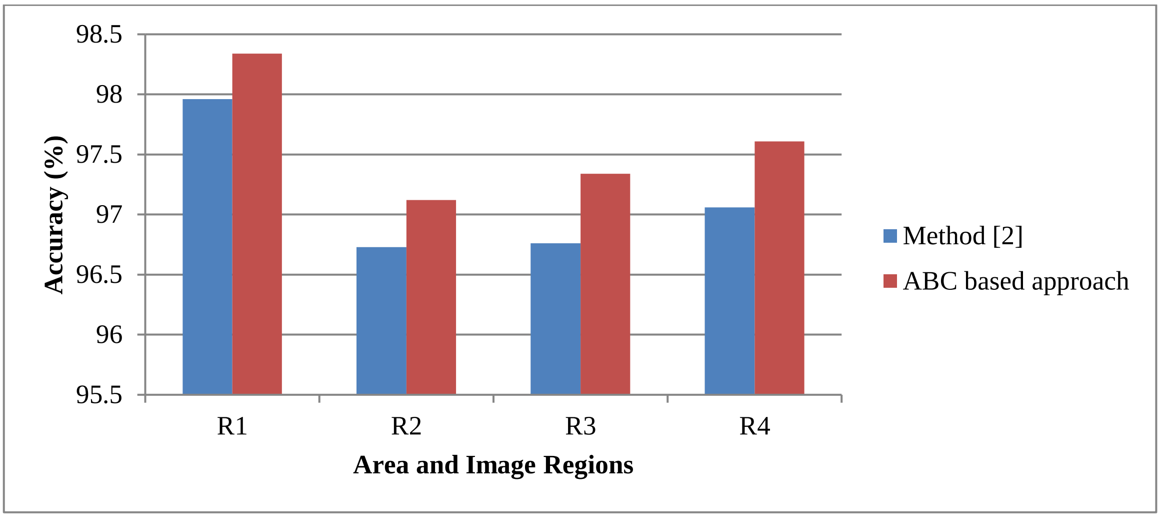

Figure 6: Overall accuracy comparison

IV. CONCLUSION

This study provides a way for the efficient shadow detection. Our approach provides an efficient way in handling the adjacent pixels by applying association rules. It provides the associative items in a same segment. Then boundary value threshold have been determined with the Otsu approach and gradient value decomposition. It provides the inner and extraneous range so that the object tracking can be done successfully. Then ABC algorithm has been applied on the segmented and associated pixels for the shadow detection. Our approach produces higher accuracy than the previous approach.

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