

Efficient and Effective Transition Regions Based on Threshold Filter Approaches for Image Segmentation

Arushi Banerjee^{1*}, Vineeta Saxena Nigam²

¹Department of Electronics and Communication Engineering, UIT-RGPV, Bhopal

²Department of Electronics and Communication Engineering, UIT-RGPV, Bhopal

Corresponding Author: arushibanerjee@gmail.com

DOI: <https://doi.org/10.26438/ijcse/v7i5.14761480> | Available online at: www.ijcseonline.org

Accepted: 29/Apr/2019, Published: 31/May/2019

Abstract— In this paper, some transition region based segmentation approaches have developed to perform image segmentation for grayscale and colour images. In computer vision and image understanding applications, image segmentation is an important pre-processing step. The main goal of the segmentation process is the separation of foreground region from background region. Based on the output of the segmentation result, segmentation can be categorized as global segmentation or local segmentation. The global segmentation aims for complete separation of the object from the background while the local segmentation divides the image into constituent regions. For any image consisting of foreground and background, some transition regions exist between the foreground and background regions. Effective extraction of transition region leads to a better segmentation result. Therefore, efficient and effective transition regions based on threshold filter approaches for image segmentation for both grayscale and colour images.

Keywords: - Image Segmentation, False Positive Rate (FPR), False Negative Rate (FNR), Misclassification Error (ME)

I. INTRODUCTION

Technological advances in digital imaging, computer processors and mass storage devices fuelled the growth of image processing. The huge volume of digital image data produced everyday has become more and thus these could ever be examined manually. Electronically perceiving, analyzing and understanding the image and process it according to the specific human requirements has become a challenging task. For image analysis and understanding, the image segmentation is a key step of image processing and computer vision. A qualified segmentation is a prerequisite for subsequent processing such as scene understanding, parameter measurement and object recognition etc. In this paper, efforts are made to develop methods to yield effective segmentation.

The process of segmentation is a difficult task in image processing when the images are of non-trivial type [1]. The success of segmentation depends on the various factors such as the algorithm used for the said purpose, the nature of “foreground and background” in an image, the lighting conditions in which the image formation occurred, the requirement of the user etc. The algorithm used for bio-medical image segmentation differs from that used for natural image segmentation as the images generated for biomedical analysis differ from that of the images generated from the natural scenery.

Similarly, the lighting conditions for natural image formation are different than that of underwater images. But image segmentation is applied for various applications such as handwriting recognition, biometrics, satellite image analysis for weather forecasting, disease classification etc. So, a number of segmentation processes are developed by various researchers where each is appropriate for a particular application. So, it remains still a challenging problem from image processing perspective. Image segmentation is a set of operations applied to a digital image for extracting objects from the image or dividing the image into meaningful regions based on certain characteristics of the image such as intensity, colour, texture etc. for extraction of information from the input image. The segmentation can be local segmentation (concerned with specific part or region of the image) or global segmentation (concerned with segmentation in the whole image, consisting of a large number of pixels) [2]. The example of local segmentation and global segmentation is shown in Figure 1 and Figure 2 respectively. “In global segmentation, the foreground is separated out from the background.” Separating the foreground from background is an important pre-processing in image analysis. The main purpose is to acquire some useful information in the image for higher level image processing. In this thesis, the research work is focused on global image segmentation [3, 4].

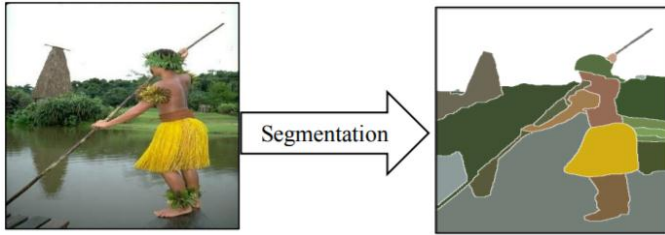


Figure 1: Example of local segmentation

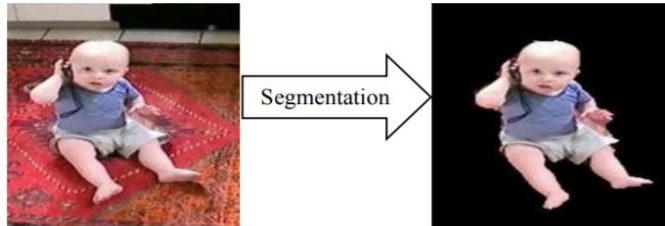


Figure 2: Example of global segmentation

II. TRANSITION REGION BASED IMAGE SEGMENTATION TECHNIQUES

“Transition region based” technique was introduced by [5] which comes under unsupervised segmentation technique category. This is not solely based on histogram concept, rather a hybrid technique based on both region based and thresholding approach. Transition region is geometrically a 2-dimensional plane which separates the object part from the background. For illustration, Figure 3 shows the transition extraction of Eagle image from its original gray image. The transition regions are shown in white, whereas the “foreground and background” are shown in black. Literally, the transition regions separate the foreground from background.

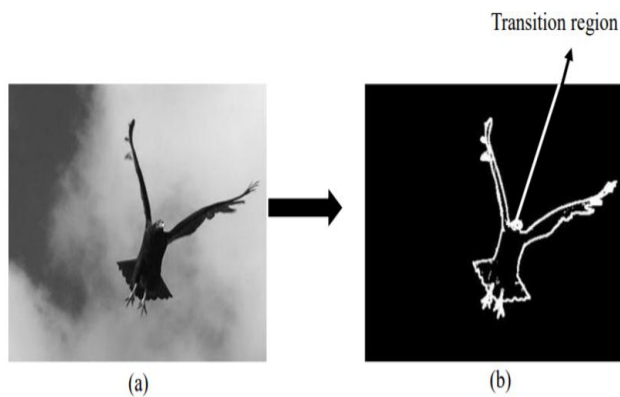


Figure 3: Illustration of transition region: (a) original image, (b) binary image with transition region

The initial transition region has the 3 following properties:

- (a) Region property: transition region has several pixels width near non step edges whereas single pixel width near step edges.
- (b) Boundary property: located “between object and background” and covers around the object.
- (c) Gray level variation: gray levels in the transition region usually change frequently and intensively, which leads to abundant information for describing the transition region.

The method developed in [6] is based on Effective average Gradient (EAG). But gradient-based approaches are sensitive to noise and it is applicable to sudden sharp level changes rather than frequent gray level changes.

III. PROPOSED METHODOLOGY

The Proposed method is developed for “segmenting single as well as multiple objects from images.” The method utilizes local variance and a global “threshold to determine the transition region.” The images contain both homogeneous regions as well as complex regions. The homogeneous regions have less variance as compared to complex regions. So, in our method, we have used local variance as a descriptor to extract transition region. “Transition region based” segmentation methods developed previously work well with images containing a single object. Further, existing methods do not achieve better segmentation results in varying intensity conditions “between object and background.”

The proposed method uses five steps to perform segmentation. At first, it considers the local variance and global threshold to determine the transition regions. As transition regions are multi-pixel width, the threshold filter operation is used for extract edge and background and foreground image de-noising. “The edges thus obtained ‘undergo edge linking process to yield continuous edges i.e. object contours.

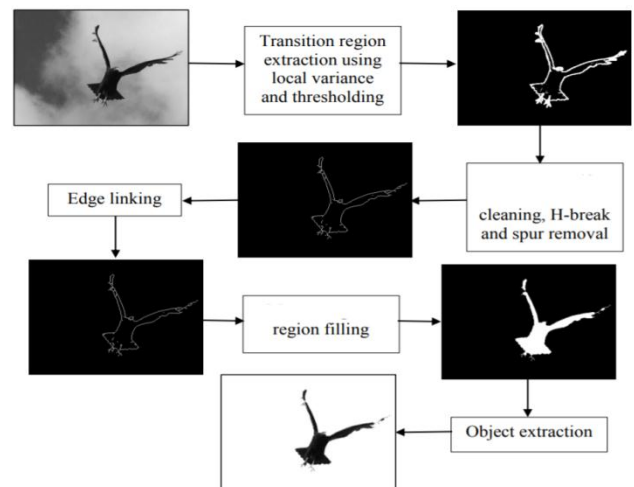


Figure 4: Segmentation steps of the proposed method for Eagle image

The region filling operation is then performed on object contours to get object regions.” Finally, object regions are utilized for object extraction from the original gray image. The segmentation steps of the proposed method are given in in Figure 4.

Initially, the transition region extraction is done. Basically these are the 2- dimensional regions located in image plane and lie between object regions and background regions. The pixels lying within the transition regions have ‘intermediate gray levels “between object and background”.’ Out of many existing developed descriptors suggested by different researcher’s transition region extraction, it has been found ‘that “local variance is important” descriptor for finding transition regions. The area which contains edges and fine details has higher variance as compared to homogeneous regions. Hence, for the abovementioned reasons, we have used local variance as descriptor for transition region extraction. In a “m×m local” neighborhood centered “at pixel p(i, j) , the local variance can be’ obtained as”

$$Lv(i, j) = \frac{1}{(m^2 - 1)} \sum_{x=1}^m \sum_{y=1}^m (f(x, y) - \bar{f})^2 \tag{1}$$

Where, (x, y) denote a local coordinate in a given neighborhood of the sub-image \hat{f} and \bar{f} is gray level mean of that neighborhood given by

$$\bar{f} = \frac{1}{m \times m} \sum_{x=1}^m \sum_{y=1}^m f(x, y) \tag{2}$$

Threshold Filter

The threshold filter calculation is the point at which a chose window contains just 0 and 255 esteem then the reestablished esteem is either 0 or 255(again uproarious), drives us to proposed. In this calculation we chose pixel esteem 0 and 255 values then the preparing pixel is supplanted by mean estimation of the chose window. The detail of the calculation is given underneath.

Algorithm:

Step 1: Select a 3 x 3 matrix size according to the 2-D window size. Assume that the processing pixel is P_{ij}, which lies at the center of window.

Step 2: If 0 < P_{ij} < 255, then the processing pixel or P_{ij} is uncorrupted and left unchanged.

Step 3: On the off chance that P_{ij} = 0 or P_{ij} = 255, then it is considered as tainted pixel and four cases are conceivable as given underneath.

Case 1: In the event that the chose window has all the pixel esteem as 0, then P_{ij} is supplanted by the Salt clamor (i.e. 255).

Case 2: On the off chance that the chose window contains all the pixel esteem as 255, then P_{ij} is supplanted by the pepper commotion (i.e. 0).

Case 3: In the event that the chose window contains all the esteem as 0 and 255 both. At that point the handling pixel is supplanted by mean estimation of the window.

Case 4: On the off chance that the chose window contains not all the component 0 and 255. At that point dispose of 0 and 255 and locate the middle estimation of the rest of the component. Supplant P_{ij} with middle esteem.

Step 4: Rehash step 1 to 3 for the whole picture until the procedure is finished.

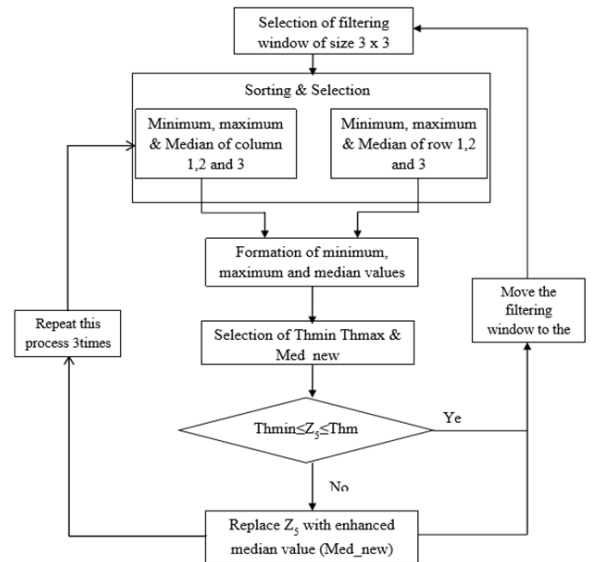


Figure 5: Flow Chart of Threshold Filter

IV. SIMULATION RESULT

As shown in table 1 the error, smoothness, uniformity and processing time are obtained from the proposed image segmentation using fuzzy canny method algorithm.



Figure 6: simple background & simple foreground Original Image

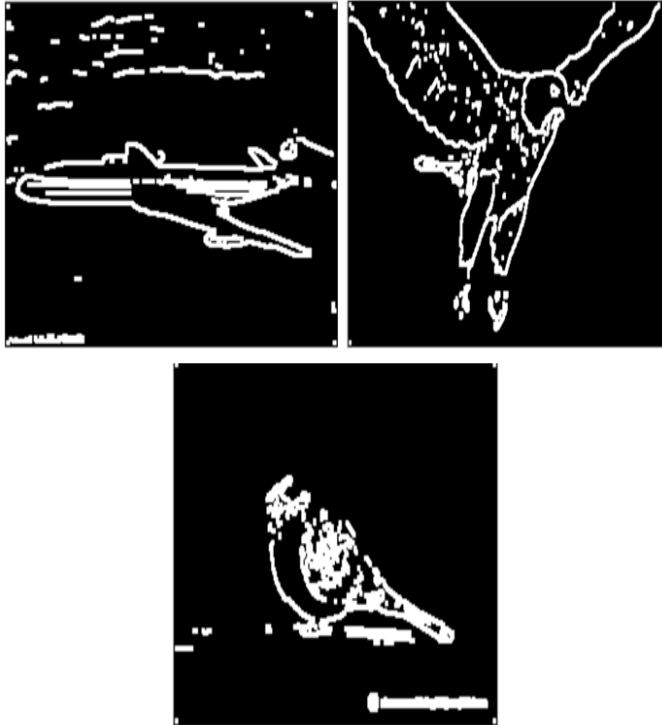


Figure 7: Output Image of simple background & simple foreground

Table 1: Results of simple background & simple foreground Image

Image	ME		FPR		FNR	
	Previous Algorithm	Proposed Algorithm	Previous Algorithm	Proposed Algorithm	Previous Algorithm	Proposed Algorithm
Airplane Image	0.0179	0.0163	0.0089	0.0072	0.1670	0.1503
Eagle Image	0.0065	0.0058	0.0047	0.0043	0.0378	0.0297
Bird Image	0.0274	0.0271	0.0192	0.0185	0.1684	0.1582

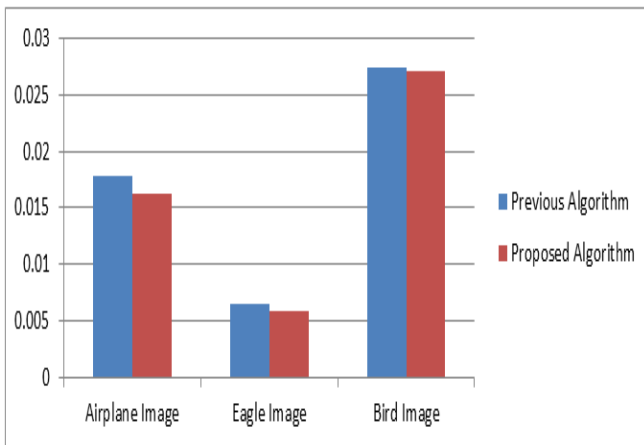


Figure 8: ME of the simple background & simple foreground Image

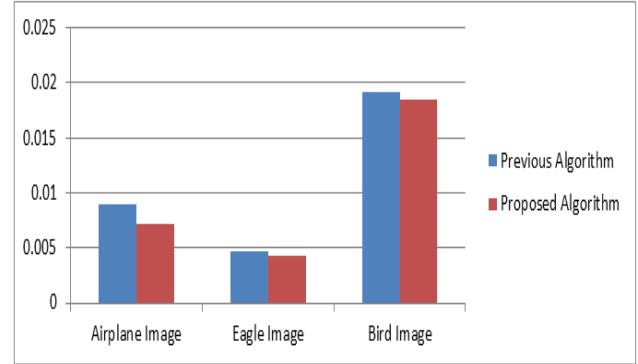


Figure 9: FPR of the simple background & simple foreground Image

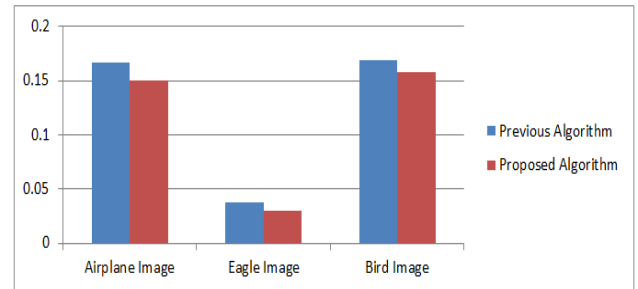


Figure 10: FNR of the simple background & simple foreground Image

From the analysis of the results, it is found that the proposed image segmentation using threshold filter gives a good smoothness for simple background & simple foreground Image.

V. CONCLUSION

The performance of developed “transition region based” approaches for both grayscale and colour images are compared and analysed with existing segmentation approaches for different types of images. It can be inferred from the discussion that a single method cannot yield better performance for all types of images. The developed image segmentation based threshold filter is providing improvised Performance parameters such as Misclassification Error (ME), False Positive Rate (FPR) and False Negative Rate (FNR) for different images compared with previous algorithm.

REFERENCE

- [1] Priyadarsan Parida, Nilamani Bhoi and Priyanka Dewangan, “Color Image Segmentation Based on Transition Region and Morphological Processing”, WiSPNET Conference, IEEE 2017.
- [2] Priyadarsan Parida and Nilamani Bhoi, “Transition region based single and multiple object segmentation of gray scale images”, Engineering Science and Technology, an International Journal, Elsevier 2016.

- [3] I Made Oka Widyantara ; I Made Dwi Putra Asana ; N.M.A.E.D. Wirastuti ; Ida Bagus Putu Adnyana, "Image Enhancement Using Morphological Contrast Enhancement For Video based Image Analysis", International Conference on Data and Software Engineering (ICoDSE), IEEE 2016.
- [4] Ashwani Kumar Yadav, Ratnadeep Roy and Rajkumar, "Thresholding and morphological based segmentation techniques for medical images", International Conference on Recent Advances and Innovations in Engineering (ICRAIE), IEEE 2016.
- [5] Ravi Kiran Boggavarapu and Pushpendra Kumar Pateriya, "Efficient method for counting and tracking of moving objects through region segmentation", International Conference on Computational Intelligence and Computing Research (ICCC), IEEE 2016.
- [6] Soma Dey and Rajat Subhra Goswami, "A morphological segmentation and curve-let features extraction on text region classification using SVM", International Conference on Computational Intelligence and Computing Research (ICCC), IEEE 2015.
- [7] L. Ramya ; N. Sasirekha, "A robust segmentation algorithm using morphological operators for detection of tumor in MRI" International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), IEEE 2015.
- [8] Vahid Khodadadi ; Emad Fatemizadeh and S. Kamaledin Setarehdan, "Overlapped Cells Separation Algorithm Based on Morphological System using Distance Minimums in Microscopic Image", 22nd Iranian Conference on Biomedical Engineering (ICBME), IEEE 2015.
- [9] Anindya Gupta ; Olev Martens ; Yannick Le Moullec and Tönis Saar, "Methods for Increased Sensitivity and Scope in Automatic Segmentation and Detection of Lung Nodules in CT Images", International Symposium on Signal Processing and Information Technology (ISSPIT), IEEE 2015.
- [10] D. Chudasama, T. Patel, S. Joshi, G. Prajapati "Survey on Various Edge Detection Techniques on Noisy Images" , IJERT International Journal of Engineering Research & Technology ISSN: 2278-0181 Vol. 3 Issue 10, October-2014.
- [11] Er. Komal Sharma, Er. Navneet Kaur, "Comparative Analysis of Various Edge Detection Techniques", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 12, December 2013.
- [12] S. Patel, P.Trivedi, V. Gandhi and G. Prajapati, "2D Basic Shape Detection Using Region Properties" IJERT International Journal of Engineering Research & Technology, Vol. 2 Issue 5, May-2013.