

AUTOMATIC DOMINANT REGION SEGMENTATION FOR NATURAL IMAGES

A.Kalaivani¹, S.P.Surender Nath², Dr.S.Chitrakala³

¹ Research Scholar, Easwari Engineering College,
kalaivanianbarasan@rediffmail.com

²Anna University, Chennai, spsuren3@gmail.com

³Anna University, Chennai, chitra@cs.annauniv.edu

ABSTRACT

Image Segmentation segments an image into different homogenous regions. An efficient semantic based image retrieval system divides the image into different regions separated by color or texture sometimes even both. Features are extracted from the segmented regions and are annotated automatically. Relevant images are retrieved from the database based on the keywords of the segmented region. In this paper, automatic image segmentation is proposed to obtain the dominant region of the input natural images. Dominant regions are segmented and results are obtained. Results are also recorded in comparison to the JSEG algorithm.

KEYWORDS

Color Image Segmentation, Dominant Region, Edge Detection

1. INTRODUCTION

Machine vision systems are composed of two sub-systems which are classified as low-level vision and high-level vision systems. Low level vision systems perform image processing operations on the input image to produce an output image of reduced noise or with certain enhanced features. Object recognition or scene interpretation can be done at the high level vision systems. Segmentation acts as a bridge between these two subsystems.

Image Segmentation is a most important step in image analysis and pattern recognition. Image Segmentation is a most difficult task in image processing. Image segmentation is the process of dividing the images into different regions based on specific criteria which may be color, texture or even both. According to [1], "the image segmentation problem is basically one of psychophysical perception and not susceptible to a purely analytical solution".

A formal definition of image segmentation is as follows [2]: If $P()$ is a homogeneity predicate defined on groups of connected pixels, then segmentation is a partition of the set F into connected subsets or regions (S_1, S_2, \dots, S_n) such that

$$\bigcup_{i=1}^n S_i = F \text{ with } S_i \cap S_j = \emptyset \text{ (} i \neq j \text{)} \quad (1)$$

The uniform predicate $P(S_i) = \text{true}$ for all regions, S_i and $P(S_i \cup S_j) = \text{false}$ when $i \neq j$ and S_i and S_j are neighbors.

Color Image Segmentation mainly depends on two properties of the intensity values. The former property is discontinuity where the images are partitioned on sharp changes in intensity. The latter property is similarity in which the image is partitioned based upon a predefined similarity criteria. Taking into account of these properties several image segmentation techniques have been proposed. Choice of the techniques mainly depends on the problem consideration.

1.1 Color Image Segmentation Applications

Color Image segmentation partition the given input color image into homogenous regions. Image segmentation is the first important step in image analysis. Image analysis includes wide applications in video surveillance, image retrieval, medical imaging analysis and object classification. Color image segmentation finds a place in many multimedia application such as indexing and management of data and also in the dissemination of information in the network.

1.2 Color Image Segmentation Approaches

Color Image segmentation divides the image pixel based on image features. While using color images, image pixels are represented by various number of color spaces such as RGB, XYZ or LUV. Color image segmentation attracted researchers, due to providing more information on color images available in a large repository in web and also the speed of processing color images through PCs. Color Image Segmentation techniques can be classified as edge based segmentation, thresholding based segmentation, region based segmentation, clustering based segmentation and graph based segmentation.

Edge based segmentation specify segmentation based on the edges of the image. Thresholding is very simple which is used to separate objects from the background. The different types of thresholding algorithms are adaptive thresholding and otsu thresholding. Region based segmentation is the one in which regions of similar pixels are grouped together. Two efficient algorithms are seeded region growing and region split and merge methods.

A good segmenter should produce homogenous and uniform regions based on color or texture. The boundaries of each segment should be spatially accurate, smooth but not ragged. Adjacent regions should be different based on region characteristics.

In this paper, we consider the problem of color image segmentation of dominant region based on color for natural images. The rest of this paper is organized as follows. In Section 2, related work carried on color image segmentation are discussed. In Section 3, the proposed algorithm for automatic dominant region segmentation algorithm are presented. In Section 4, provides the experimental results and discussion. Conclusion are given in Section 6.

2. LITERATURE REVIEW

Siddhartha Bhattacharyya [9] discussed the classical methods of image segmentation ranging from filtering methods to statistical methods. Color Image segmentation done using latest technique such as neural networks, fuzzy logic, genetic algorithms and wavelet decomposition are also presented. Gajendra Singh Chandel [14], analyzed various segmentation algorithms such as

edge-based segmentation, thresholding based segmentation and Region Based Segmentation Algorithms. Polak[8]. specify an evaluation metric for image segmentation of multiple objects. Nilima Kulkarni[13] presented color thresholding method for image segmentation of natural images. Muthukrishnan presented edge detection techniques for image segmentation. Felci Rajam[11] proposed SRBIR system which retrieves images based on semantic content by extracting the dominant foreground region in the image and learning the semantic concept with the help of SVM-BDT.

3. PROPOSED ALGORITHM OVERVIEW

Color Image Segmentation is used to identify region of interest and objects in the scene which are beneficial to image annotation or image analysis. For identifying the dominant region for natural images, natural color images of different object classes are taken as the input image. In any type of image the dominant region occupies most of the image foreground. So, segmentation of dominant region can easily identify the object.

Firstly, the input RGB color image is indexed and then converted into a gray scale image . Secondly, various image preprocessing techniques such as median filtering, range filtering are carried out to eliminate noise. The quality of the input image is enhanced by applying image sharpening technique. Thirdly, edges are detected from the preprocessed image by applying canny edge detection technique. Fourthly, by applying gray threshold method , a foreground object is separated from the background. Fifthly, dominant region identification are done to identify dominant region and finally segmented color image with dominant object highlights are produced.

Proposed Algorithm for extracting dominant region from a given input RGB image is as below

- Step 1 : Input RGB image
- Step 2 : Generate an Indexed Image of an input image
- Step 3 : Convert RGB input image into a gray scale image
- Step 4 : Apply Preprocessing technique
- Step 5 : Detect edges of the object
- Step 6 : Separate foreground object from background object
- Step 7 : Identify and draw object boundaries
- Step 8 : Display the segmented foreground object

Proposed automatic dominant region image segmentation for natural images is depicted in the flowchart and is given in figure 1.

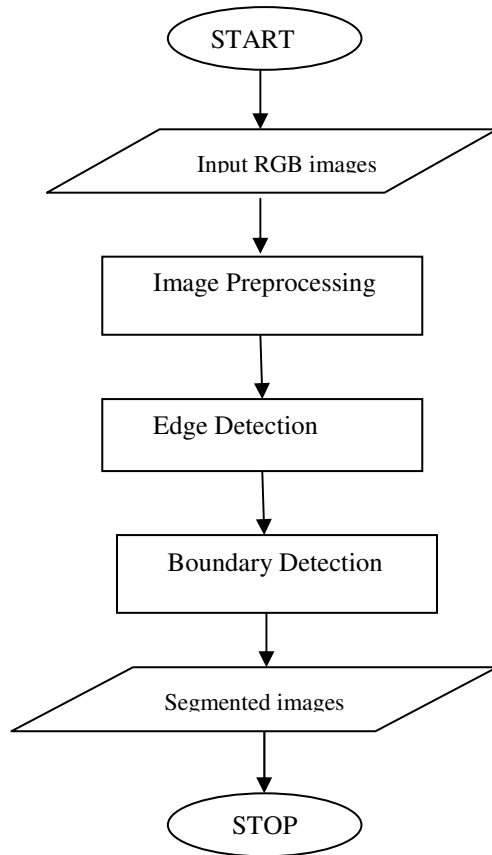


Fig . 1: Flowchart of the Proposed Algorithm

A given input RGB color image is converted into a gray scale image. The formula for converting RGB pixel to a gray pixel mapping the intensity value from 0 to 255 is given by equation 2.

$$\text{Intensity} = 0.29289 * \text{red} + 0.5870 * \text{green} + 0.1140 * \text{blue} \quad (2)$$

Image preprocessing is carried out to reduce image and improve image quality. The most popular median filtering is used for noise removal and preserve edges using 3*3 neighborhood. Median filtered of an gray image is returned as output image for further image preprocessing steps. The function for performing median filtering is `medfilt2()` which is given by

$$B = \text{medfilt2}(A) \quad (3)$$

Various other preprocessing techniques are applied such as sharpening and range filtering on the median filtered image. Edges are detected for the preprocessed image .A large number of edge detecting technique are available in which canny edge detection is ideal since it returns the threshold value on which the regions are segmented. The function for performing canny edge detection is as below :

$$F = \text{edge}(I, \text{'canny'}) \quad (4)$$

where I is the input gray scale image and F is the edge detected final image. Once the edges are detected, objects are identified by tracing the boundary. Final segmented objects are identified which is a black and white image. Color segmented image is obtained from the indexed image . Boundary is specified in white color to display the segmented image.

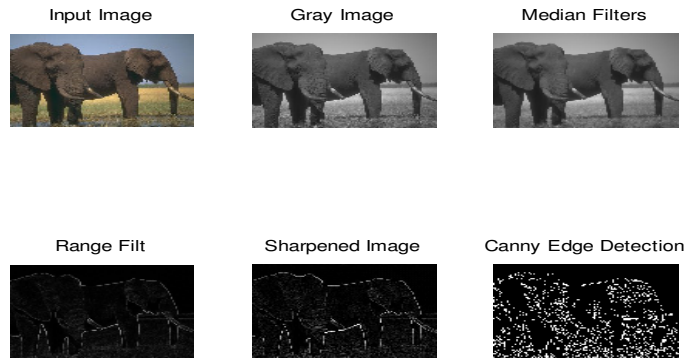


Figure 2: Stages of Image Segmentation- Image Preprocessing Stage

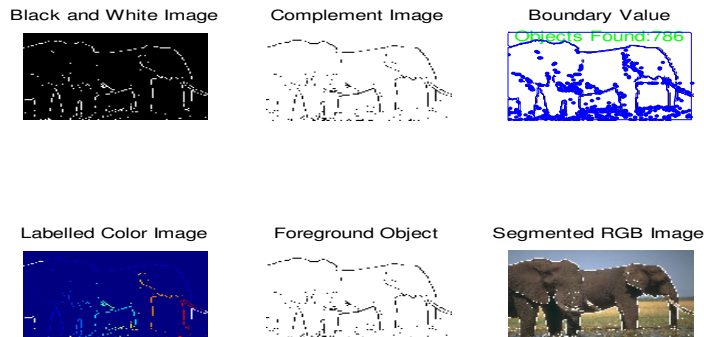

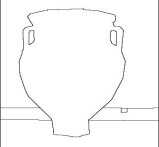

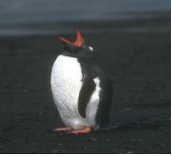
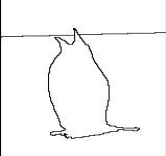


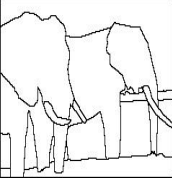


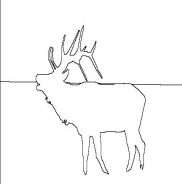






Figure 3: Stages of Image Segmentation- Edge Detection & Gray Thresholding

4. EXPERIMENTAL RESULTS AND DISCUSSION



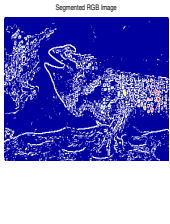


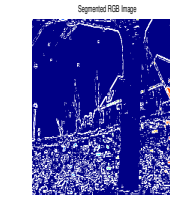


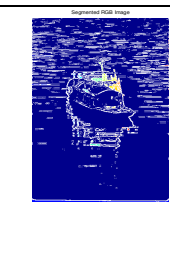


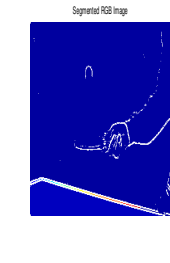
Berkeley Image Segmentation deals with benchmark datasets. Segmentation are done by the user with different number of segments. For the testing of the algorithm images are taken from these datasets and the segmented results are given in the table 1.

Table 1. Segmented Results of Benchmark Datasets and Proposed Algorithm

RGB Image	Original Image	Benchmark Result	Proposed Results
Jug			
Penguin			
Elephant			
Deer			
Tiger			

In region based Image retrieval system, most of the papers used JSEG image segmentation algorithm in which multi objects are segmented based on color and texture. But the algorithm deals with a lot of limitations such as shades due to the illumination, over segmentation. Visually, there is no clear boundary and is often over-segmented into several regions. Our proposed algorithm avoids the problem of over segmentation and a clear boundary is obtained for a dominating objects.

Table 2. Segmented Results of JSEG and Proposed Algorithm

Image Name	Original Image	JSEG Image	Proposed Results
Lizard			
Tree			
Boat			
Hand			

5. CONCLUSIONS

Color and texture are critical factors in human visual perception. Many segmentation approaches use both the factors to obtain homogenous regions for image segmentation. In this paper, a new approach for segmenting dominant region for natural images are proposed. Earlier algorithms such as Normalized Cut, JSEG, ICMAP algorithms all deal with a lot of computation and takes longer time to segment the image. Our Proposed algorithm is simple to implement and are able to get the desired segmented results for simple natural images concentrating on the dominant region. Our future work aims at classifying foreground region based on texture also. Regions can be separated and features can also be extracted for segmented regions. Further Image analysis can be done to come up with an efficient Image Retrieval System.

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