ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

SEGMENTATION USING MASKING METHODS IN COLOUR IMAGES: AN APPROACH

E.Boopathi Kumar & Dr. V.Thiagarasu
Research Scholar, Department of Computer Science, Gobi Arts & Science College, Tamilnadu, India.
Associate Professor, Department of Computer Science, Gobi Arts & Science College, Tamilnadu, India.

DOI: 10.5281/zenodo.268693

ABSTRACT

Image segmentation is one of the popular methods in the field of Image processing. It is the process of grouping an image into units that are consistent with respect to one or more characteristics. Segmentation in gray images has lots of methods and it has several algorithms to represent it. But images giving more information in scenes i.e., colour images have few numbers of methods to segment. So, this paper represent colour image segmentation methods in the literature and getting to prepare novel segmentation method with combined form of masking, thresholding and noise removal methods. Otsu method is one of the best and classical Thresholding method used in colour image segmentation. It uses various combinations of masks to scan over the image to detect the correct boundary. Otsu method divide the segmentation tasks in two or more modules and make the process easily. In the same way this paper discusses about fuzzy membership functions mask to scan the image with few combinations and include noise removal method to produce the output image in well defined manner.

KEYWORDS: Segmentation, Masking Methods, Color Segmentation, Fuzzy Membership Functions, Noise removal, Thresholding, Otsu method.

INTRODUCTION

Image segmentation is the first step in image analysis and pattern recognition. It is a critical and essential component of image analysis and pattern recognition system and it is one of the most difficult tasks in image processing to determine the quality of the final result of analysis. Image segmentation is a process of dividing an image into different regions such that each region is, but the union of any two adjacent regions is not, homogeneous. The problem of image segmentation has been known and addressed for the last 30 years. The general description of an image in everyone mind is the list of objects in an image and their positions. But when we deeply examine an image it depicts shadows of an object, differences in the color brightness of an object. Image segmentation is the process of partitioning an image into regions that are in some sense homogeneous, but different from neighboring regions. Segmentation is the first key step in object recognition, scene understanding and image understanding. Segmentation of an image can be done on the basis of some characteristics such as color, objects that are present in the entire image. The level to which the separation is carried depends on the problem being solved. The result of image segmentation is a group of different segments that mutually cover the entire image. Image segmentation algorithms are based on one of the two basic properties of the intensity value i.e. discontinuity and similarity. There are different approaches for different type of images.

The first approach represents Histogram thresholding, second approach is Edge based and the last one is region based approach. In histogram thresholding different gray or color ranges are represented to made regions of an image. In the second approach, different edge detection operators are used and also the edges are joined if the regions are not connected. In the third approach images are partitioned into regions which are similar according

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

to a set of predefined criteria. By concerning the image segmentation as the challenge of partitioning pixels into different clusters based on color similarity and spatial relation, we propose our color image segmentation method. It is a segmentation of an image based on colors in it. According to this method, RGB image is firstly converted to hsv image. HSV color space is used because it gives the color according to human perception. After that the image is converted to 3 rgb planes then the pixels belonging to same color are merged together.

This paper is organized in five sections. Section I give an introduction about the topic. Related works are represented in section II. Steps for proposed algorithm are discussed in section III. Section IV discusses the results of the proposed method and Section V gives Conclusion.

MASKING METHOD

Color is perceived by humans as a combination of tristimuli *R* (red), *G* (green), and *B* (blue) which is usually called three primary colors. From *R, G, B* representation, we can derive other kinds of color representations by using either linear or nonlinear transformations. Several color spaces, such as *RGB, HSI, and CIE* are utilized in color image segmentation, but none of them can dominate the others for all kinds of color images. Selecting the best color space still is one of the difficulties in color image segmentation. Red, green, and blue components can be represented by the brightness values of the scene obtained through three separate filters (red, green, and blue filters). Any color can be expressed by these three color bases. *RGB* is the most commonly used model for the television system and pictures acquired by digital cameras. Video monitors display color images by modulating the intensity of the three primary colors (red, green, and blue) at each pixel of the image. *RGB* is suitable for color display, but not good for color scene segmentation and analysis because of the high correlation among the *R*, *G*, and *B* components. By high correlation, we mean that if the intensity changes, all the three components will change accordingly. Also, the measurement of a color in *RGB* space does not represent color differences in a uniform scale; hence, it is impossible to evaluate the similarity of two colors from their distance in *RGB* space. Color image has been recognized that human eye can discern thousands of color shades and intensities but only two-dozen shades of gray. It is quite often when the objects cannot be extracted using gray scale but can be extracted using color information. Compared to gray scale, color provides information in addition to intensity. Color is useful or even necessary for pattern recognition and computer vision. Also the acquisition and processing hardwares for color images have become more available and accessible to deal with the computational complexity caused by the high-dimensional color space. Hence, color image processing has become increasingly more practical. As mentioned before, the literature on color image segmentation is not as extensively present as that on monochrome image segmentation. Most published results of color image segmentation are based on gray level image segmentation approaches with different color representations. Texture is considered to be the major problem for all segmentation techniques, thus much more discussion was made on texture analysis than on color representation, and the problems of feature extraction in images with textural variations are discussed particularly. Below figure 1 shows the flow of the work of this paper. It focuses on two major groups of segmentation techniques: boundary formation and region formation. Segmentation approaches are categorized into four classes: pixel based segmentation, area based segmentation, edge based segmentation and model based segmentation. A brief conclusion is drawn based on the analysis of the literature available. Most gray level image segmentation techniques can be extended to color images, such as histogram thresholding, clustering, region growing, edge detection, fuzzy approaches and neural networks. Gray level segmentation methods can be directly applied to each component of a color space, and then the results can be combined in some way to obtain a final segmentation result. However, one of the problems is how to employ the color information as a whole for each pixel. When the color is projected onto three components, the color information is so scattered that the color image becomes simply a multispectral image and the color information that humans can recognize is lost. Another problem is how to choose the color representation for segmentation.

Each color representation has its advantages and disadvantages and there is no single color representation that can surpass others for segmenting all kinds of color images. In most of the existing color image segmentation approaches, the definition of a region is based on similarity of color. This assumption often makes it difficult for

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

any algorithms to separate the objects with highlights, shadows, shadings or texture which cause in homogeneity of colors of the objects' surface.

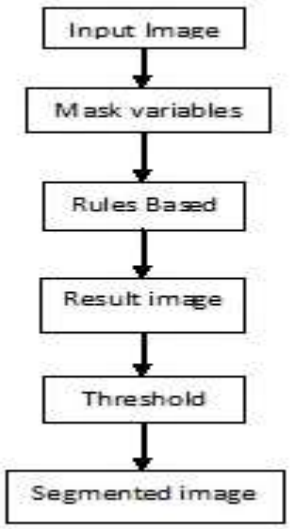

Figure 1: Work Flow

Segmentation may be also viewed as image classification problem based on color and spatial features. Fuzzy inference system contains two types of inference methods such as Mamdani and Sugeno with some modalities. This paper represents Mamdani inference system with their membership functions. Fuzzy membership function can be included in inference system which is suitable for input methods. It also contains five types of editors, in that two are read only tools and remaining three are described below.

Fuzzy Inference System Editor

The Fuzzy Inference System (FIS) Editor displays information about a fuzzy inference system. To open the FIS Editor, type the following command at the MATLAB prompt. The FIS Editor opens and displays a diagram of the fuzzy inference system with the names of each input variable on the left, and those of each output variable on the right, as shown in the next figure. The sample membership functions shown in the boxes are just icons and do not depict the actual shapes of the membership functions.

Membership Function Editor

The Membership Function Editor is the tool that lets you display and edits all of the membership functions associated with all of the input and output variables for the entire fuzzy inference system. The Membership Function Editor shares some features with the FIS Editor, as shown in the next figure. In fact, all of the five basic Graphical User Interface (GUI) tools have similar menu options, status lines, and Help and Close buttons.

Rule Editor

Constructing rules using the Graphical Rule Editor interface is fairly self evident. Based on the descriptions of the input and output variables defined with the FIS Editor, the Rule Editor allows you to construct the rule statements automatically, From the GUI:

- Create rules by selecting an item in each input and output variable box, selecting one Connection item, and clicking Add Rule. Can choose none as one of the variable qualities to exclude that variable from a given rule and choose not under any variable name to negate the associated quality.
- Delete a rule by selecting the rule and clicking Delete Rule.
- Edit a rule by changing the selection in the variable box and clicking Change Rule.
- Specify weight to a rule by typing in a desired number between 0 and 1 in Weight. If not specify the weight, it is assumed to be unity.

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Impact Factor: 4.116
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Rule Viewer

The Rule Viewer displays a roadmap of the whole fuzzy inference process. It is based on the fuzzy inference diagram described in the previous section. The three plots across the top of the figure represent the antecedent and consequent of the first rule. Each rule is a row of plots, and each column is a variable. The rule numbers are displayed on the left of each row. Click on a rule number to view the rule in the status line.

Surface Viewer

Upon opening the Surface Viewer, three-dimensional curve is shown and that represents the mapping from food and service quality to tip amount. Because this curve represents a two-input one-output case, it will show the entire mapping in one plot. When move beyond three dimensions overall, it will start to encounter trouble displaying the results. Accordingly, the Surface Viewer is equipped with drop-down menus X (input): Y (input): and Z (output): that select any two inputs and any one output for plotting. Below these menus are two input fields X grids: and Y grids: that specify how many x-axis and y-axis grid lines want to include. This capability allows keeping the calculation time reasonable for complex problems.

MEMBERSHIP FUNCTIONS

A Membership Function (MF) is a curve that defines how each point in the input space is mapped to a membership value (or degree of membership) between 0 and 1. The input space is sometimes referred to as the universe of discourse, a fancy name for a simple concept. One of the most commonly used examples of a fuzzy set is the set of tall people. In this case, the universe of discourse is all potential heights, say from 3 feet to 9 feet, and the word tall would correspond to a curve that defines the degree to which any person is tall. If the set of tall people is given the well-defined (crisp) boundary of a classical set, it might say all people taller than 6 feet are officially considered tall. However, such a distinction is clearly absurd. It may make sense to consider the set of all real numbers greater than 6 because numbers belong on an abstract plane, but want to talk about real people; it is unreasonable to call one person short and another one tall when they differ in height by the width of a hair. The only condition a membership function must really satisfy is that it must vary between 0 and 1. The function itself can be an arbitrary curve whose shape can define as a function that suits from the point of view of simplicity, convenience, speed, and efficiency. A membership function for a fuzzy set A on the universe of discourse X is defined as μ_A: X → [0, 1], where each element of X is mapped to a value between 0 and 1. This value, called membership value or degree of membership, quantifies the grade of membership of the element in X to the fuzzy set A. Membership functions allow to graphically represent a fuzzy set. The *x* axis represents the universe of discourse, whereas the *y* axis represents the degrees of membership in the [0, 1] interval.

Types of Membership Functions

- Triangular
- Trapezoidal
- Gaussian
- Generalized Bell
- Piecewise linear
- Sigmoid
- S – shaped curve
- Z – shaped curve

The simplest membership functions are formed using straight lines. Of these, the simplest is the triangular membership function, and it has the function name trimf. This function is nothing more than a collection of three points forming a triangle. The trapezoidal membership function, trapmf, has a flat top and really is just a truncated triangle curve. These straight line membership functions have the advantage of simplicity.

RESULTS AND DISCUSSION

Segmentation involves separating an image into regions corresponding to objects. It usually tries to segment regions by identifying common properties. Similarly, it identifies contours by identifying differences between regions which is in the form of edges. The simplest property that denotes pixels in a region can share is said to be intensity. So, a natural way to segment such regions is through Thresholding with the separation of light and

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Impact Factor: 4.116
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dark regions. It creates binary images from gray-level ones by turning all pixels below some threshold to zero and all pixels above that threshold to one. In this work, Fuzzy Inference System produce image result by scanning the given input image with the help of masks. After that, thresholding is included for the masking result. Here output of Fuzzy Inference System is taken as input for Thresholding process. Masking can be done through fuzzy membership functions with respect to fuzzy rules. Here rules can be formed on the basis of If-Then statements and it frames the mask for scanning. Formed mask can be used to slide over the input images to find the edges as basic step.

Basically, Edge detection process can be done through following process.

- Compute the local derivative.
- Magnitude of the 1st derivative can be used to detect the presence of an edge.
- The sign of the 2nd derivative can be used to determine whether an edge pixel lies on the dark or light side of an image.
- Zero crossing of the 2nd derivative is at the midpoint of a transition in gray level, which provides a powerful approach for locating the edge.

In this work, first order derivative is used to detect edges effectively. It detects edges by looking maximum and minimum in 1st derivative of the image. Applying a first derivative to resultant image in the direction of important variation enhances the visibility of small steps and other details.

Table 1: Advantage and disadvantage of Color Image Segmentation Methods

S.No	Methods	Advantages	Disadvantages
1	Histogram	Works well with low computation complexity	Did't consider the spatial details
2	Edge Detection	Gives better results for images having good contrast between regions	Less unaffected to noise than other techniques
3	Fuzzy	Fuzzy IF-THEN rules can be used to perform approximate inference	The computation involved in fuzzy approaches could be intensive
4	Neural Networks	Fully utilize the parallel nature of neural networks	Training time is long
5	Pixel	Easy to identify objects with pixel by pixel.	Effective only with black and white edges.
6	Region	Partitioning the regions with respect to Objects.	Gives accurate results when adding one or more techniques.
7	Model	Segmenting with respect to Statistical analysis.	Difficult to process color attributes due to large amount of pixel values.

Above table discuss the advantages and disadvantages of traditional segmentation techniques and point out the result views in the form of accuracy obtained.

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CONCLUSION

In this paper, segmentation algorithm for color images based on Thresholding and noise removal are described. Additionally, fuzzy membership function's masking methods are proposed which is based on rules and that gives some likely results. A brief introduction to color image segmentation and fuzzy segmentation approach is discussed. The development based on the applications of fuzzy operators, properties and mathematics are presented, and segmentation based on IF-THEN rules is predicted as a promising research area in the near future. Suitable membership functions are chosen based on the parameters likely to assign for the variables. It concludes that triangular membership function must satisfy all the conditions (Because, it contains three variables format) which suits for implementation.

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