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COLOR IMAGE SEGMENTATION TECHNIQUES: A SURVEY

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ABSTRACT

Segmentation technique is one of the main steps in image processing used to distinguish different objects in the image which has been developed in order to make images smooth and easy to evaluate. Many algorithms have been elaborated for gray scale images. However, the problem of segmentation for color images, which convey much more information about objects in the image, has received much less attention of scientific community. While several papers of color image segmentation techniques were published, but those did not emerge. This work presents an extensive survey of algorithms for color image segmentation, a categorization of them according well defined list of attributes, suggestions for their improvements and descriptions of few novel approaches.

Keywords: Segmentation, Color Image Segmentation, Median Filter, Fuzzy logic, Otsu Method and Thresholding.

I.   INTRODUCTION

Image segmentation is one of the most important steps leading to the analysis of processed image data, which refers to grouping of similar pixels together and separating the particular portion of the image for the purpose of identification. Its main goal is to divide an image into parts that have strong correlation with objects or areas of the real world contained in the image. In computer vision, segmentation is the process of partitioning a digital image into multiple segments which gives more meaning and easier to analyze and is to cluster pixels into prominent image regions, i.e., regions corresponding to individual surfaces, objects, or natural parts of objects. Image segmentation algorithms are based on either discontinuity principle or similarity principle. The idea behind the discontinuity principle is to extract regions that differ in properties such as intensity, color, texture, or any other image statistics and the similarity principle is to group pixels based on common properties [1].

COLOR IMAGE SEGMENTATION

Color images can convey more information compared to gray scale images. Color image segmentation follows discontinuity principles to extract the regions based on color as its property. It is a method of mining one or more integrated regions that are homogenous. There are a large number of color image segmentation techniques based on segment properties. Segmentation properties can be classified into four general categories such as pixel-based, edge-based, region-based, and model-based techniques [2].
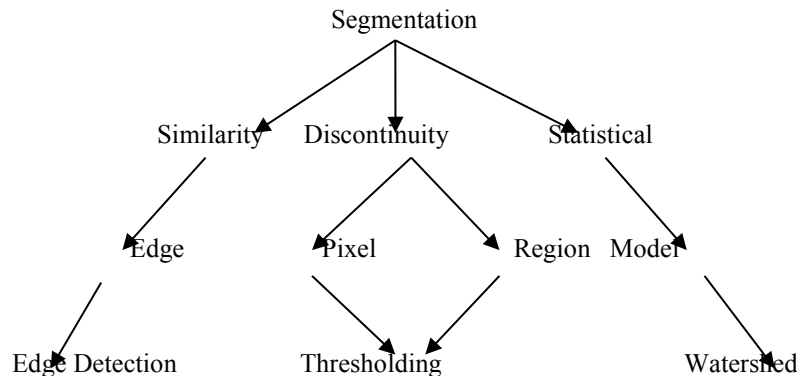

Figure 1: Segmentation properties

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Actually, the basic behavior of these techniques can be divided into three major concepts which are shown in above figure. The first concept is the similarity concept like edge-based techniques which involves edge detection in image. Alternatively, the second concept is based on the discontinuity of pixel values as same as pixel-based and region-based techniques. It is an effective concept which is accepted overall by all categories of applications. Finally, a complete different approach is the third concept which is based on a statistical approach like Model-based techniques. This technique provides approximate mathematical calculation in order of statistical way. There are various color models such as RGB, CMY, and HSV etc, which are considered to examine color segmentation process.

II. LITERATURE SURVEY

The Mathematical morphology provides a systematic approach to analyze the geometric characteristics of signals or images, and has been applied to many applications such as edge detection, object segmentation and noise suppression [3]. A powerful morphological tool for image segmentation is watershed transformation. Applying watershed transformation on gradient image could obtain an initial segmentation, but usually yields an over segmented result. The histogram of RGB information in the color image is built up and then using the geometric property of closing to find out the dominant clusters. A morphology based supervised segmentation has been introduced and its main concept is to create searching area where the real object resides by applying the morphological operators to the initial boundary given by the user. It is based on watershed transformation and proposes adaptive morphological operators.

Muhammad Waseem Khan stated that there is no perfect method for image segmentation because the result of image segmentation is depends on many factors, i.e., pixel color, texture, intensity, similarity of images, image content, and problem domain. Therefore, it is not possible to consider a single method for all type of images nor all methods can perform well for a particular type of image. Hence, it is good to use hybrid solution consists of multiple methods for image segmentation problem.

Color image segmentation is more useful than gray image segmentation since color is a unique feature which differentiates benign from melanoma easily [5]. Hence, it can be concluded that color images when segmented directly will give more accurate and clear result when compared to gray scale images. K-means clustering; Markov fields and Fuzzy C-means, Mean shift algorithm and JSEG algorithm are most widely used algorithms in color image segmentation to increase accuracy.

Image segmentation techniques such as Thresholding, edge based segmentation and region based segmentation have been presented by Jogendra Kumar. They also covered finding threshold value for their proposed methods. In the computer vision, Image segmentation is most of judging or analyzing function in image processing and analysis. Image segmentation refers to partition of an image into different regions that are homogenous or similar and inhomogeneous in some characteristics like color, intensity or texture.

Waseem Khan observed that a hybrid solution for image segmentation consists of two or more techniques is being the best approach to solve the problem of image segmentation.

Lokanayaki presented a brief outline on some of the most commonly used segmentation techniques like Thresholding, Region based, Model based, Edge detection. They mentioned its advantages as well as the disadvantages. Some of the techniques are suitable for noisy images which are proposed under Fuzzy rules based approach. It generates rule based window mask which is used to find the pixel intensities.

Variety of research techniques applied on image segmentation which is most significant for pattern detection and recognition by using edges, lines and points [9]. Techniques of image segmentation stated are utilized in numerous modern machines for face identification, image identification, pattern recognition etc. It has a promising and demanding opportunity as the universal segmentation algorithm and has become the center of attention of current research.

Savita Agrawal traces different segmentation techniques which are used for multichannel images. They investigate and compile some of the technologies used for image segmentation, which are well suited for gray scale images as well as multichannel images. Afterwards a bibliographical survey of currently utilizing color models for segmentation of multichannel images techniques is proposed and then a comparative analysis of different methods is analyzed.

Rozy Kumari focused on the clustering based segmentation techniques. The purpose of image segmentation is to make the representation of an image simpler into something that is more meaningful and easier to understand. The process in which a data set or say pixels are replaced by cluster, pixels may belong together because of the same color, texture etc is known as Clustering based method. They mainly focused on complex regions and conclude that no work has been done for the images with mixed regions. First of all edge preserving smoothing will filter the objects available in digital image so that the complex objects can also be easily detected. However, they conclude that, use of HSV has the ability to segment the color images in efficient manner.

Monika Xess provides an extensive overview of clustering based color image segmentation techniques and highlight two approaches to FCM algorithm for better segmentation results. Clustering based segmentation methodologies involve K-means and Fuzzy C-means clustering algorithm. K-means is faster when k is small and hence form tighter cluster, but it is quite difficult to predict k with fixed number of clusters. On the other hand Fuzzy C-means algorithm is comparatively better than K-means and a pixel can belong to more than one cluster, but it takes more computation time. Thus by analyzing new problem areas related to image segmentation further works can be done on basic K-means and Fuzzy C-means algorithm to obtain faster and accurate segmentation result.

Firas Ajil Jassim proposed a novel method for color image segmentation with a combination of two techniques. Otsu method carries out Thresholding and Median filter represents smoothing to get rid of noise. Masking method is used in the median filter to get correct segment object. Increasing window size results in blurring and it will clearly visible to human eye. Correct window to segment the image with the help of median filter is 15*15. Following figures shows segmented results with respect to different masking properties.

a) Original Image   b) 3*3 Mask   c) 5*5 Mask

d) 7*7 Mask   e) 9*9 Mask   f) 11*11 Mask

Following table describes Segmentation properties of both Similarity and Discontinuity principles by their perfomance basis.

Table 1: Advantage and disadvantage of Color Image Segmentation Techniques

S.No	Techniques	Positives	Negatives
1.	Edge Based	Produce Better results with gray scale images.	Effective only with black and white edges.
2.	Pixel Based	Easy to identify objects with pixel by pixel.	Same as edge based technique.
3.	Region Based	Partitioning the regions with respect to Objects.	Gives accurate results when adding one or more techniques.
4.	Model Based	Segmenting with respect to Statistical analysis.	Difficult to process each and every color attributes due to large amount of pixel values.

III. CONCLUSION

Segmentation techniques used in image segmentation especially on color image have been represented in this paper. Each technique described in this work has its own advantage and disadvantage based on segmentation properties. Many authors stated that combining two or more segmentation methods will produce effective results while applying to color images. On calculating performance analysis, masking method produce much better results with accuracy while comparing to other techniques. Variation in masking properties gives different types of results with respect to RGB and results proves that increasing window sizes makes images more blur. This paper concludes that color image segmentation using median filter produce better results in starting level window sizes and future work will carry on in same way by using Fuzzy rule based system.

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