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# Evaluation of Color Image Segmentation Novel Methods

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**ABSTRACT**: Due to the commencement of computer technology image-processing techniques have become increasingly in an extensive variety of applications. Image segmentation is a standard subject in the field of image processing and also a hotspot of image processing techniques. Image segmentation, i.e. identification of homogeneous regions in the image, has been the subject of considerable research buzz over the last three decades. With the improvement of computer processing capabilities and the increased application of color image, the color image segmentation are more and more apprehensive by the researchers. Several general-purpose algorithms and techniques have been developed for image segmentation and 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 scenes, has received much fewer attention of scientific community. Since there is no general solution to the color image segmentation problem, these techniques often have to be combined with domain knowledge in order to effectively solve a color image segmentation problem for a problem domain. The segmentation process could be augmented by some additional knowledge about the objects in the scene such as geometric and optical properties. This paper presents a comparative study of the basic image segmentation techniques related to color image segmentation.

**KEYWORDS**: Color Object Detection, Color Image Segmentation, Feature Extraction, Feature Matching, Thresholding and Edge Detection.

## I. INTRODUCTION

Images are the most important medium of conveying information. The concept of machine learning lies in understanding the images and extracting the useful information from the images. For better understand of images, segment the image into multiple regions and identify objects in each region. Image Segmentation finds a wider application in the field of pattern recognition and high-level image analysis. In early days color image segmentation are done only by converting to gray scale images and applying the existing algorithm implemented for gray scale images. In recent years color image segmentation aroused more and more attention and algorithms are emerged based on RGB images. Color image segmentation finds a wider application in the field of video surveillance, face recognition, object detection, fingerprint recognition, content based image retrieval and medical imaging. While applying color image segmentation, the major issues to be considered are choice of the color space model and suitable segmentation technique.

Color plays a vital role in pattern recognition and computer vision. A color space is a geometrical representation of color in a 2D- 3D space. A wide variety of color models used are RGB, YIQ, YUV, HIS, HSL, CIE, YCbCr. All the color models have their own applications of usage with its merits and demerits. HSL color model is good for color image segmentation while YCbCr color model finds wider applications in both image and video processing. The most common color image segmentation methods are histogram based or edge based segmentation. The promising segmentation techniques are spatial clustering and region based segmentation method. In histogram based segmentation technique, a histogram is created based on the input image. The peaks and valleys in the image histogram are used to identify regions in the image. Edge based segmentation discover the object edges present in the image. In feature space clustering approach, intensity value is found for each pixel and the image pixels are grouped into clusters. Region-based segmentation includes region growing, region-splitting and region merging to split the image into multiple

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regions. Color Image Segmentation partition the image into distinct regions of similar pixels based on pixel property. It is the high level image description in terms of objects, scenes and features including backgrounds. The success of image analysis depends on segmentation dependability.
Image segmentation as the processing of partitioning a digital image into multiple segments has wide applications, such as image retrieval, medical inspection, and computer forensics etc. Clustering methods as one solution are applied on a single or multiple feature spaces of an image such as color, intensity, or texture, in order to group similar pixels that share certain visual characteristics. Given a particular color image, not all features from a color space, such as RGB, HSV, or Lab, are equally effective in describing the visual characteristics of segments in the image. Generally, most of the segmentation techniques for gray scale images such as Histogram Thresholding, Edge Detection, Feature Clustering, Fuzzy Methods, Region Based Methods, and Neural Networks have been extended for color image segmentation by using RGB color space system or other color space like CYM, HSI, etc. Anyway, recently, there is a shortage in the comprehensive surveys on color image segmentation. Color images can convey more information than gray scale images. Color image segmentation is a method of mining one or more unified regions that are homogenous.

The organization of this paper is as follows: In the next section, related works belongs to proposed techniques were discussed. In section (2), a different type of segmentation methods has been introduced. The proposed novel technique for color image segmentation which is the basic contribution of this paper has been discussed in section (3). Finally, the conclusion section may be seen in section (4).

## II. RELATED WORK

Firas Ajil Jassim, Fawzi H. Altaani proposed a novel algorithm for color image segmentation based on combining two existing methods in such a novel way to obtain a significant method to partition the color image into significant regions. On their first phase, the traditional Otsu method for gray channel image segmentation were applied for each of the R,G, and B channels separately to determine the suitable automatic threshold for each channel. After that, the new modified channels are integrated again to formulate a new color image. The resulted image suffers from some kind of distortion. To get rid of that distortion, the second phase includes the median filter to smooth the image and increase the segmented regions. This process looks very significant by the ocular eye. Experimental results were presented on a variety of test images to support the proposed algorithm.

Soumya Dutta, Bidyut B. Chaudhuri quoted that the Color image segmentation is an important but still open problem in image processing technology. In their work, they applied FCM to the image and the cluster centers are obtained. Quite similar to the famous TSK fuzzy control model, they form several rules (IF-THEN like) for pixel classification. The results obtained from the rules are plotted as a histogram. An effective histogram peak detection and valley extraction (PDVE) algorithm is applied to the histogram and thresholds are extracted from the histogram for segmentation. The method is unsupervised and no prior knowledge of number of regions to be segmented is required. The experimental results show that their proposed approach can find homogeneous areas effectively, and with high accuracy.

Song Gao, Chengcui Zhang, and Wei-Bang Chen described a projective clustering algorithm HCPC (Hill-Climbing based Projective Clustering) based on the framework of EPCH and the idea of hill-climbing algorithm for color image segmentation. It not only avoids the problem of using histogram to estimate the local data distribution in EPCH, but also extends the hill-climbing algorithm with the ability of finding clusters in subspaces. Moreover, their algorithm processes images directly at pixel or object level, resulting in an overall better segmentation than histogram-based algorithms, and is more scalable than hill-climbing algorithm when the dimensionality of the feature space is high. Their current algorithm still has a lot of room for improvement. For example, they simply set a similarity threshold to merge similar signatures, and use a minimum cluster size requirement to remove trivial clusters. HCPC is essentially a general projective clustering algorithm. The criterion that is used to remove trivial clusters may not be the optimal strategy in image segmentation, because one cluster may contain several spatially disconnected segments. One possible improvement is to remove trivial segments rather than removing trivial clusters.

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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.

## III. PROBLEM DISCUSSION

**Edge Detection**
It detects edges of objects present in input image using edge detection technique. The Edge Detection technique detects the edges of the objects. So, we can easily separate the objects in given image. Then, the second phase is image segmentation, in which each object is separated by labelling each region and finally the third phase is shape recognition that identifies the shape of each object or region of an image and recognizes the object. Advantage of object detection through edge detection is changes in lighting and color usually do not have much effect on image edges. Different edge detectors are Sobel, Prewitt, Canny, etc. The disadvantages of Sobel and Prewitt are sensitivity to the noise, in the detection of the edges and their orientations. The increase in the noise to the image will eventually degrade the magnitude of the edges. Canny edge detector is able to produce single pixel thick, continuous edges, ability to detect strong and weak edges and its insusceptibility to noise interference. Canny edge detection algorithm has a better performance, but it is costly when compared to Sobel, Prewitt and Robert's operator and is cost-effective.

**Color Detection**
Color provides more powerful information for object detection. In RGB image, each pixel has three color components: red, green, and blue. Amount of mixing of these three colors determines value of pixel. Image is a collection of pixels; each pixel is a combination of red, green, and blue colors. So it is difficult to process each pixel; hence, we need color model for robust detection. In HSV image, each pixel has only one color which is represented by Hue component. Saturation and value components determine how much amount of black and white color is added into that color; it helps to differentiate object with other color so we use HSV color model for object detection.

**Feature Matching**
In RGB image, each pixel has three color components: red, green, and blue. Amount of mixing of these three colors determines value of pixel. In HSV image, each pixel has only one color, which is represented by hue, saturation, and value components determining how much amount of black and white color is added into that color. We need to convert HSV image to binary image for specific object detection. Contours are white areas in binary image. We will find each contour and calculate their area based on the area we will detect object. SIFT features are used to increase the detection speed. The scale invariant feature transform (SIFT) algorithm for image features generation which are invariant to image translation, scaling, rotation, and partially invariant to illumination changes and affine projection. Features of an image are interesting key points. Key points histogram values are used to index the image by using supervised learning techniques such as k-mean clustering.

**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. Actually, the basic behaviour 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

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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.

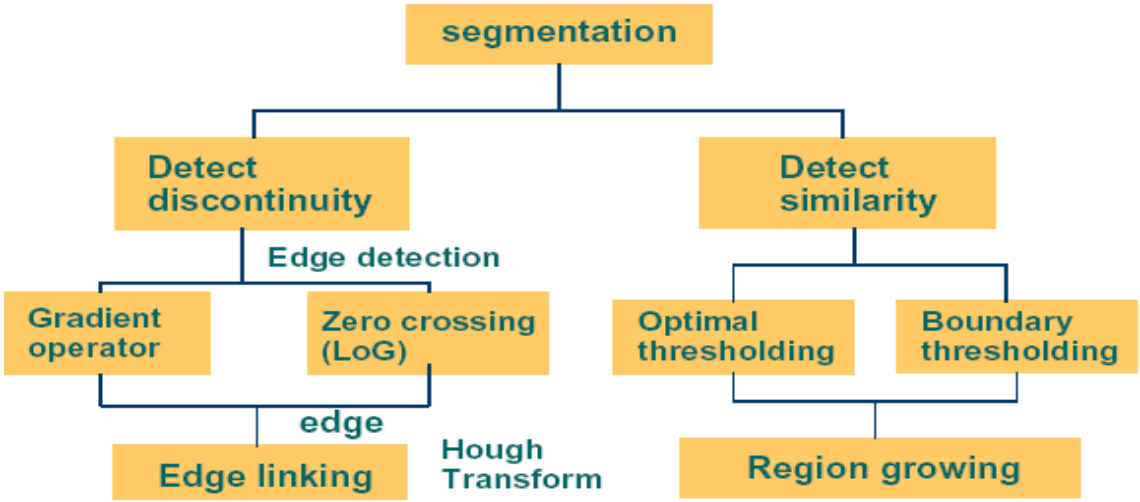


**Figure 1: Segmentation Techniques**

## IV. RESULTS DISCUSSION

Recently, there are a large number of color image segmentation techniques. Basically it can be classified into four general categories: Pixel-based, Edge-based, Region-based, and Model-based techniques. Actually, the basic behaviour of these techniques can be divided into three concepts. The first concept is the similarity concept like Edge-based techniques. Alternatively, the second concept is based on the discontinuity of pixel values like Pixel-based and Region-based techniques. Finally, a complete different approach is the third concept which is based on a statistical approach like Model-based techniques. In the third concept, segmentation is implemented as an optimization problem. Different kinds of Segmentation techniques are introduced and several results are discovered under color images. Here we expect combining two or more techniques produce effective results compared to single technique. In that point of view, Otsu method is taken and further noise removal and Thresholding features are included. Generally, Otsu method is one of the oldest methods in image segmentation and it is treated as a statistical method according to its probabilistic execution. It must be mentioned that the Otsu method is one of the best automatic thresholding methods and the basic principle in Otsu method is to split the image into two classes which are the objects and the background. The automatic threshold is obtained through finding the maximum variance between the two classes. Practically speaking, let I=[1,L] is the range of greyscale levels of image f(x,y) and pi is the probability of each level. The number of pixels with gray level i is denoted fi, giving a probability of gray level i in an image as: (1) Nf p i i. Then, the automatic threshold t that divides the range into two classes which are C0 = [1,…, t] and C1=[t+1, L]. It also revised for color images with some modified averages. After splitting the classes, noise removal and proposed techniques are recommended for Thresholding region.

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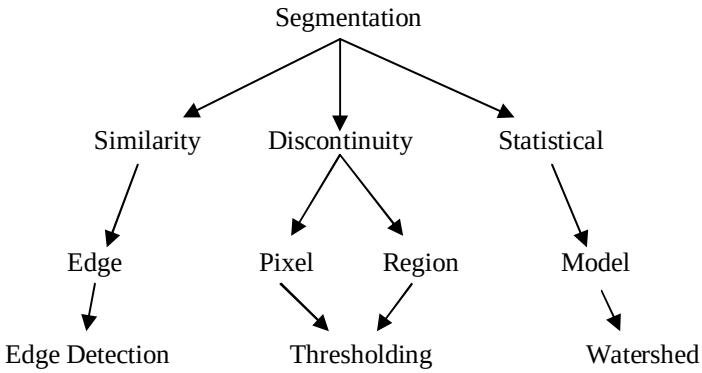


**Figure 2: Segmentation properties**

Region based methods are based on continuity in objects. These techniques divide the entire image into sub regions depending on some rules like all the pixels in one region must have the same gray level. Region-based techniques rely on common patterns in intensity values within a cluster of neighbouring pixels. The cluster is referred to as the region, and the goal of the segmentation algorithm is to group the regions according to their anatomical or functional roles. Using thresholding technique regions can be classified on the basis range values, which is applied to the intensity values of the input image pixels. Thresholding is computationally economical and fast, it is the oldest segmentation method and is still widely used in simple applications. Using range values or threshold values, pixels are classified using either of the thresholding techniques like global and local thresholding. Global thresholding method selects only one threshold value for the entire image. Local thresholding selects different threshold values for different regions. To segment complex images multilevel thresholding is required.

## V. CONCLUSION AND FUTURE WORK

A new approach for color image segmentation has been presented that is based on the hybridization between the classical Otsu method for color segmentation and noise removal. 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. Here Traditional Otsu Method is combined with segmentation properties such as noise removal, noise detection, Thresholding etc. Compared to single method processing, combining methods with good combinations produce much better results. The implementation of Otsu method to the R,G,B channels alone will produce some kind of noise and to get rid of this noise a filtering and noise removal process was proposed. The implantation of filter must be careful because it may cause some blurring in image when increasing the window size. The main conclusion comes here is that the increase in window size will increase the interior homogeneity of the regions and objects inside the image. Hence, in this paper, a 5x5 windows size seems to be rational when applied to a variety of test images. Moreover, this method is too easy to implement concerning its simplicity and high rapidity. This paper concludes that color image segmentation using filtering and noise removal along with classical Otusu method 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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