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COMPARISON OF VARIOUS SEGMENTATION ALGORITHMS IN IMAGE PROCESSING

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Abstract-Image Segmentation has played an important role in Computer vision it is used for object tracking and to identify image boundaries. The different algorithms used in Image segmentation are Clustering-based, Region-based and Edge based. In this paper we have compared certain input data with these algorithms. The experimental results shows that Region based segmentation are the best.

Keywords –Image segmentation, Laplacian, K-means clustering.

I. INTRODUCTION

The main goal of image segmentation is domain independent partitioning of an image into a set of disjoint regions that are visually different and has meaning with respect to some characteristics or computed property, such as grey level, texture or color to enable easy image analysis. The two basic properties of the pixels in relation to their local neighborhood are discontinuity and similarity which is used in many segmentation methods. A pixels value changes from 0 to 1 if it belongs to the object.The segmentation methods that which are relatively related on discontinuity property of pixels are taken as boundary or "edges based techniques" and that are based on similarity or homogeneity are region based techniques. Unfortunately, edge based and region based techniques always fail to give user preferred results. The usage of image segmentation is done in various platforms or application but using single method cannot provide the desired result. It's all because that the images containing different property and some other factors also like sound, brightness etc. put stress on the images, and it is impossible to apply a single segmentation method and also a single evaluation technique for all types of imagery.

This paper is to show the analyses of the results of various segmentation algorithms, using the results obtained from subjective evaluation, on the various types of images and particularly on gray level images. Bottom-up image segmentation continues to be a challenging problem despite a sustained research effort that spans several decades. Many algorithms have been proposed and also demonstrated on handful of images in these recent years, but to ask the real question that is, that, how these comparing of these algorithms with one another has not been addressedproperly. This is mostly because of the unavailability of algorithms during that time comparing to recent years of a suitable, standard set of images and associated ground-truth, as well as the lack of publicly available implementations of major segmentation algorithms (figure 1).

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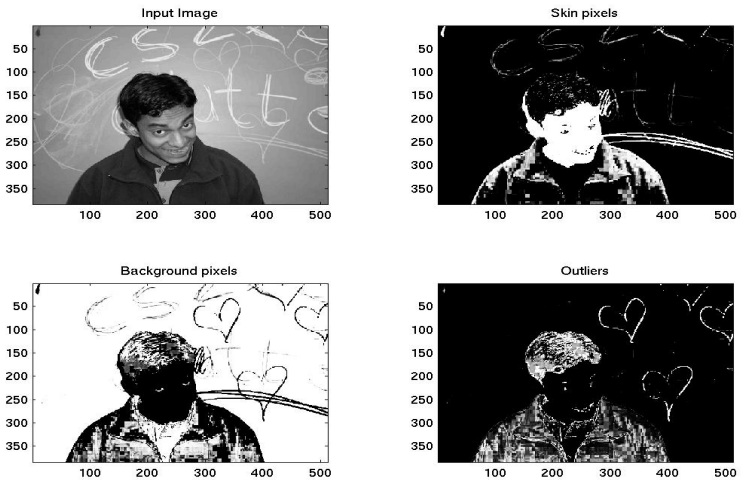

Figure 1Image segmentation process.

II.LITERATURE SURVEY

Rozykumari*et al*. (2014) [1] have proposed an image Segmentation method called Cluster based technique using pixels. “Image Segmentation is defined the paper as a process of image processing and understanding. It is also defined as the process of dividing the image into parts based on homogeneity. The purpose of image segmentation is to make the representation of an image simpler into something that is more meaningful and easier to understand”. In this process the data set or say pixels are replaced by cluster or pixels might belong to same part because of the same replications and it is known as Clustering based method. The survey shows that the existing techniques, the main focus is on regions which are complex and therefore work has not been implemented for the images with mixed regions. The effects of the regions on the segmentation have been sorted out by many researchers. The effects that colors have on results in segmentation have also been not counted. So in coming years it will propose a new integrated Edge preserving smoothing, region growing and FELICM based image segmentation algorithm to improve the accuracy of the segmentation procedure further. The main motivation that has been the backbone of the proposed approach in the paper is simple and effective. So at First the edge preserving smoothing will filter the objects available in digital image so that the detection of complex objects can also be easily found. No matter, the use of HSV has the ability to segment the color images in efficient manner.

Krishna Kant Singh and Akansha Singh. (2014)[3] have proposed a paper on image Segmentation .Here the Authors say that “Image segmentation has become a very important task in Present days. Presently, the world computer vision has become an interdisciplinary field and its characteristics can be mentioned or used in any area be it might be in medicals, electronics, remote sensing and so on. So, in this case to find a appropriate segmentation algorithm based on users application and the type of inputted image is very important. So in this, the authors explanation and suggestion is that, on a few application particular segmentation algorithm take into consideration and the type of image inputted like gray scale, color and text”

Sujatasaini and Komal Arora (2014)[3] have proposed a paper on image Segmentation whose paper specifies that study based representation of different segmentation approaches. Across the study of the various methods the result has been told that watershed technique along with the edge detector operator will be used in future references. The segmentation of image is the most important part of the image processing model. Mentioning a single technique will not be able to provide a better result so in our future work, we will use the watershed technique along with the edge detector operator to improve technique for the image segmentations.

III. EXISTING SEGMENTATION METHODS

Threshold based segmentation -Threshold and slice techniques are used for the image segmentation. They are applied directly in to an image, but also can be merged with pre-, post-processing techniques.In Threshold based segmentation it does not require prior information of the image. It is cheap comparing with others. Threshold based segmentation which is used for implementation is comparatively fast and simple. And also it can be used for real time implementation, But Threshold based segmentation will not work well for an image with broad and flat valleys or without right peak. Threshold method is highly noise sensitive. And also wrong choice may result into over or under segmentation.

A. *Edge based segmentation–*

This technique is used to detect edges in an image that which are assumed to represent boundaries of an object, and used for objects identification.

B. *Region based segmentation–*

This is where an edge based technique may try to find the boundaries of the object and then locate the object itself by filling them in, a region based technique takes the opposite approach, by starting in the middle of the object and then "growing" outward until object boundary is met.Gives best result when compared with any other segmentation methods. It is also very flexible to choose between interactive and automatic technique for image segmentation, flows from inner region to outer region generating object boundaries clearly. It also gives accurate result than any other method when all the seed selection is proper. It is comparatively expensive in memory or also in computation time. It is a difficult task to decide stopping criteria for segmentation. Noisy seed Leeds to flawed segmentation.

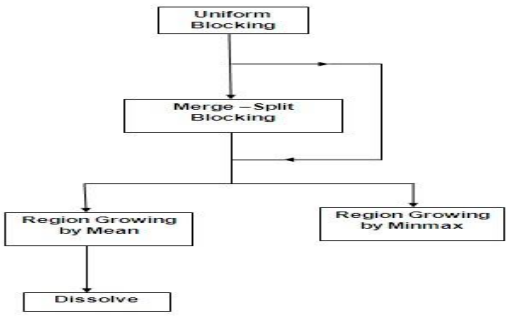

Figure 2 Block Diagram of Region Growing Algorithms

C. *Clustering techniques–*

Although the technique of clustering is sometimes used as a synonym for image segmentation techniques, we also use it here to express techniques that are primarily used in exploratory data analysis of high-dimensional patterns that are to be measured. In this context, clustering technique will attempt to group same patterns together that are similar in some forms. This type of goal is very same to what we are trying to do when we image segmentation is to be done, and also some clustering techniques can readily be applied for segmentation of image.

K mean method is computationally faster for small value comparisons. It reduces false blobs and eliminates noisy spots and also it is more homogeneous, clear result regions are obtained. It is difficult to give value of k when there is fixed number of clusters. It is also very sensitive to initialization condition of cluster number and center. But the fault is that it does not work well when the wide clusters are used .It is very expensive method.

IV. ALGORITHMS FOR IMAGE SEGMENTATION

A. K-means clustering

The main objectives of *K*-means clustering algorithm is of dividing the image into *K* segments and also minimizing the total with segment of variance. *K variable* should always be set before executing the algorithm.

The variance within-segment σ_w^2 is defined by

$$\sigma_w^2 = \sum_{i=0}^{K-1} h_i \sigma_i^2,$$

Training where h the $i = grey\%v \in S$values $ih(v)$is in the probability range Si), σ that 2 $_{=}$a% random $v \in Si(v-pixel\mu i)2h$belongs (v) $isthe$to $variance$segment $ofi(greycon-ii$values of segment i, and μ_i=$\%v \in Syh(v)$is the mean grey value in segment i. All definitions are as before in the case with a single threshold.

1. Initialization: distribute the $K-1$ thresholds over the histogram. (For example in such a way that the grey value range is divided into *K* pieces of equal length.) Segment the image according to the thresholds set. For each segment, compute the 'cluster center', *i.e.*, the value midway between the two thresholds that make up the segment.
2. For each segment, compute the mean pixel value μi.
3. Reset the cluster centers to the computed valuesμi.
4. Reset the thresholds to be midway between the cluster centers, and segment the image.
5. Go to step 2. Iterate until the cluster centers do not move anymore (or do not move significantly).

Image segmentation using Thresholdaims to partition an input image into pixels of two or more values through comparison of pixel values with the predefined threshold value T individually. Failure to find the most suitable algorithm to determine the threshold value(s) T the result might be one or all of the following

- The segmented region might be smaller or larger than the actual
- The edges of the segmented region might not be connected

Over or under-segmentation of the image (arising of pseudo edges or missing edges).

B. Edge-based segmentation

Given an image f,

1. Compute an edginess image ∇f from f. Any preferred gradient operator can be used for this.
2. Threshold ∇f to an image $(\nabla f)t$, so we have a binary image showing edge pixels.
3. Compute a Laplacian image Δf from f. Any preferred discrete or continuous Laplacian operator may be used.
4. Compute the image $g = (\nabla f)t \cdot sgn(\Delta f)$.

The sgnoperator returns the sign of its argument. The result image g will therefore contain only three values: 0 at non-edge pixels of f, 1 at edge pixels on the bright side of an edge, and −1 at edge pixels on the dark side of an edge.

The image g contains the boundaries of the objects to be segmented. This is used to work on the final steps of the algorithm.Boundary imagesare turned into a segmented imagesolid object h iscontained. If the image is traversed g from right to left, two adjacent pixels with values −1 and 1 means we move into an object, and the values 1 and −1 means we move out of one. The image h can therefore be created by setting all pixel values to zero, except for those pixels that are between the transitions $1 \rightarrow -1$ and $-1 \rightarrow 1$ in each line of g, which are set to 1. If unique values are desired for each separate segment, a labeling algorithm can be run on h.

In the edge-based segmentation (figure 3). Top left: original 400 × 350 artificial image with added noise. Top middle: edginess image; computed using a scale space operator (fw) with σ = 1 pixel. Top right: same image after thresholding. Bottom left: sign of Laplacian image. Laplacian image computed using a scale space operator (fii) with σ = 1 pixel. Bottom middle: product of Laplacian sign and threshold edge image. Bottom right: result after filling in of the boundaries as in the algorithm above. The noise was added to the original image to show some of the artifacts that they cause: notches in the edges of segmented objects, and lines where the filling algorithm encounters erroneous sign transitions. If no or less noise is added to the original, the segmentation result is perfect.

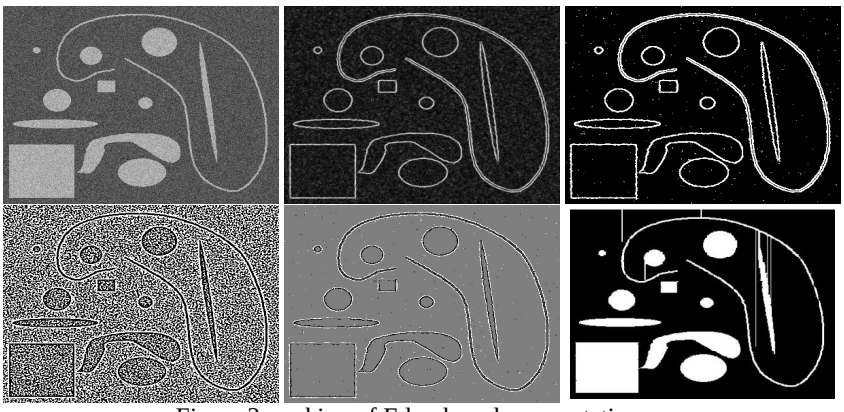

Figure 3 working of Edge-based segmentation.

Segmentation using Edge based is used to locate pixels in the image that always correspond to the edges of the objects.It is then taken that,after all it is a boundary of a region or an object and then it is closed and that the numbers of interested objects will be same as to the number of boundaries in an image. For precision of the segmentation, the perimeter of the

boundaries detected must be slightly equal to that of the object in the image inputted. For instance, these methods has problem with image which are:

- Edge-less processing
- Very noisy
- Boundary that are very smooth

Other problems of these techniques are from the failure to manage gradient function accordingly thus produces undesirable results.

C. Region growing

The data structures that which is used to keep track of set of seeds is usually a "*stack*". Two operations are defined on a stack: *push*, which pushes the pixel on the top of the stack, and *pop*, which takes a pixel from the top of the stack.

In the algorithm, the image is called *f*, the seed has coordinates (*x,y*) and grey value $g = f(x,y)$. The region growing is done by setting each merged pixel's grey value to a value h (which must not equal g). The pixel under investigation has coordinates (a,b). The algorithm runs:

1. push (x, y)
2. as long as the stack is not empty do

(a) pop(a, b)

(b) if$f(a, b) = g$then

i. set $f(a, b)$to h

ii. Push$(a - 1, b)$

iii. Push$(a + 1, b)$

iv. Push$(a, b - 1)$

v. Push$(a, b + 1)$

The region in an image can be extracted by choosing all pixels with grey value h. To make sure that whether the result is correct or not, we must be able to select h to be a value that is not present in the real image prior to running the algorithm. The statement that decides if a pixel should be merged ('if $f(a, b) = g$') can be modified to use a different merging criterion. A simple modification would be to allow merging of pixels that are in a certain range of grey values ('if $l < f(a,b) < h$'). An example of this is shown in figure 4.

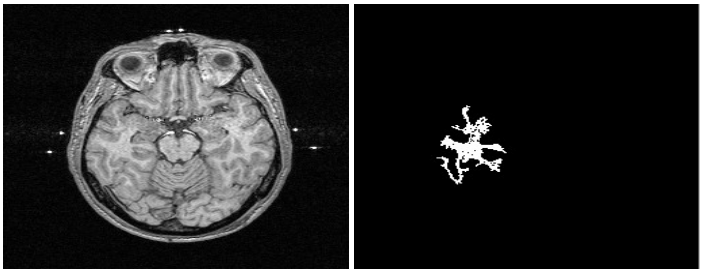

Figure 4 the Region growing algorithm

V. RESULTS

Comparative study of these methods using some standard parameters such as: speed, computation complexity, automaticity, noise resistance, multiple object detection and accuracy is done for Threshold based methods, Region based methods and cluster based

method. The experimental result shows that Threshold and Cluster based method is comparatively faster than region based method and when checked for computation complexity is rapid for Region and cluster where it is less for threshold. Noise resistance is moderate for cluster based where it is less for the rest. Cluster based is automatic to produce results where the rest is semi-automatic. The accuracy of the segmentation is fine and good only with the region based methods. The experimental analyses described are shown in the Table-1.

Table-1: Experiment result for the 3 segmentation methods.

Parameter	Threshold based Method	Region based Method	Cluster based Method
Speed	**Fast**	**Slow**	**Fast**
Computation Complexity	**Less**	**Rapid**	**Rapid**
Automaticity	**Semi auto**	**Semi auto**	**Automatic**
NoiseResistance	**Less**	**Less**	**Moderate**
Accuracy	**Moderate**	**Fine**	**Moderate**
Multiple Object Detection	**Poor**	**Fair**	**Fair**

VI. CONCLUSION

In this paper we have spoken about different types of algorithm used in the segmentation of the image processing. Different techniques developed for image segmentation are composed. Region growing methods gives better result in comparison with other segmentation methods**.** We here used many algorithms for image segmentations such as K-mean clustering algorithms, edge based algorithms and region growing algorithms , And conclude that region based method is widely used for image segmentation.

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