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Region of Interest Prediction using Segmentation

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Abstract: ***Segmentation separates an image into different sections badsed on the desire of the user. Segmentation will be carried out in an image, until the region of interest (ROI) of an object is extracted. Segmentation reliability predicts the progress of the various segmentation techniques. In this paper, various segmentation methods are proposed and quality of segmentation is verified by using quality metrics like Mean Squared Error (MSE),Signal to Noise Ratio (SNR), Peak- Signal to Noise Ratio (PSNR), Edge Preservation Index (EPI) and Structural Similarity Index Metric (SSIM).***

Keywords: ***Segmentation, ROI, EPI and SSIM***

I. INTRODUCTION

In the modern world, there are many new technologies are emerging in the field of image processing, especially in image segmentation. In this paper, important segmentation methods like color, texture, morphological operation based segmentation, power-law transformation based segmentation and watershed based segmentation are described. The efficiency of the image will be measured with different metrics. PSNR: The PSNR value must be high to produce high quality image. SSIM : Comparison between two images can be predicted by SSIM. EPI: The EPI value must be high to maintain edges.

II. RELATED WORK

Segmentation is a process of representing image in an effective manner to analyze. The region of interest is determined using segmentation. The result of image segmentation is a set of patterns received from the cluster of image. The segmentation will be carried out based on the aspects like color, intensity, or texture. Color-based methods are based on the perception of the homogenous and non homogeneous property of the color of the image. Clustering method, extract homogeneous color regions based mostly on color similarity of the image. The desired regions are identified using spatial information and geometrical constraints as specified in Pillai.A.V., et. al.(2013)[1]. Hill Climbing algorithm provides the parameters for deciding on the number of clusters[2]. Hase.H., et.al.(2001)[3],developed a connected component primarily based technique for color scripts. The image is separated into many binary images depends on the histogram analysis. Character string in an image will be identified based on mean and standard deviation. Kim.K.I., et. al.(2003)[4],grasp that SVM features competently depends on kernel functions. A Continuously Adaptive Mean Shift algorithm(CAMSHIFT) is implemented for localization of desired image.

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This paper describes various segmentation techniques, such as Color based Segmentation, Texture based Segmentation, Morphological based Segmentation, Power-Law transformation based segmentation and Watershed based segmentation.

III. IMPLEMENTATION

Selections of proper segmentation methods are very important to get accurate output. The quality of the segmentation is determined from the calculation of quality metrics.

3.1. Colour Based Segmentation

For colour based segmentation [5,6] the image is segmented based on the colours present in the image. Clavelli et al. [7] considered the color information and spatial distribution of characters for segmentations. Components are connected based on Red Green Blue (RGB) color similarities in adjacent pixels.
For example consider the input image given in figure 1.

Figure 1. Input image for colour based segmentation.

The above image consists of three major colours. The colour based segmentation splits the regions with different colours separately. The output image is given in figure 2.

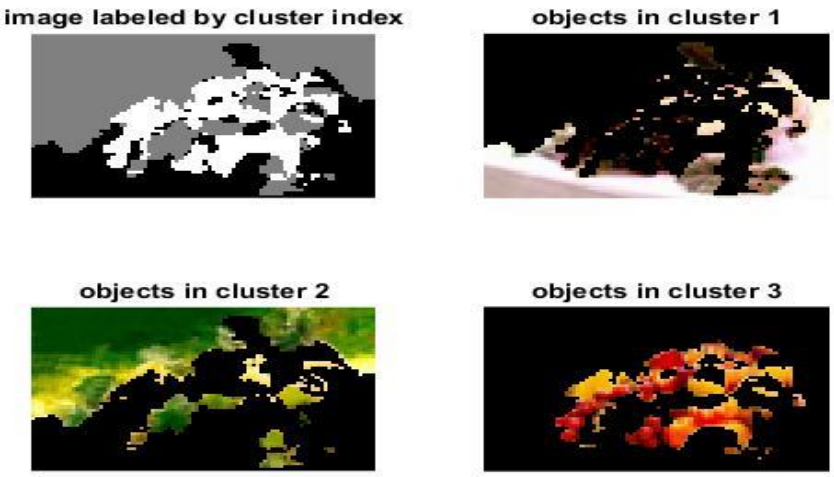

Figure 2. Output image for colour based segmentation

The quality metrics for the above outputs are given in Table 1.

Table 1. Quality metrics for colour based segmentation

Quality Metrics	Cluster 1	Cluster 2	Cluster 3
MSE	669.0342	659.1766	705.4010
SNR	19.9080	19.4554	19.6062
PSNR	20.4635	20.0812	20.2624
EPI	0.6435	0.6737	0.6668
SSIM	0.8950	0.8983	0.8903

3.2. Texture Based Segmentation

In texture based segmentation method the image is segmented based on the textures present in the image. The Wavelet transform is used for Texture based segmentation.Wavelet transform uses a pair of high and low pass filters to molder the image into orientation and wavelet coefficients called sub bands. Dyadic decomposition can be used to identify textures effectively. Textured image is classified into regions to determine homogeneous textured region.For example consider the image shown in figure 3.

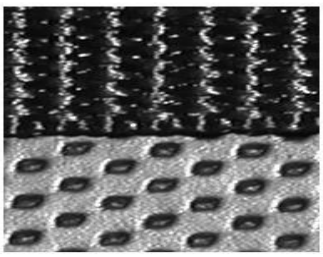

Figure 3. Input image for texture based segmentation

In the above image, two textures are present, one in the upper portion and the second one in the lower portion. The texture based segmentation extract the two textures separately as shown in figure 4.

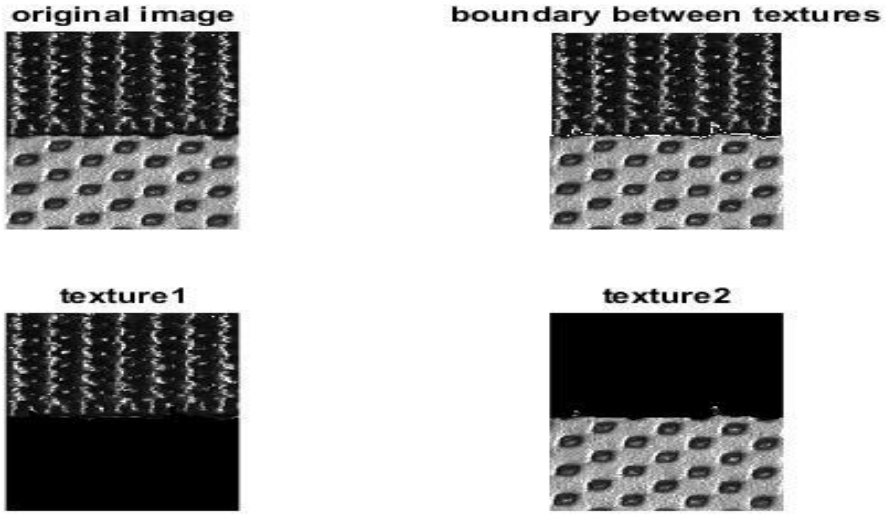

Figure 4. Output image for texture based segmentation

The quality metrics for the above outputs are given in Table 2

Table 2. Quality metrics for texture based segmentation

MSE	574.2320
SNR	19.1890
PSNR	20.7466
EPI	0.6725
SSIM	0.8405

3.3. Morphological Operation Based Segmentation

Morphological operation based segmention [8] is mainly based on two operations, first one dilation and second one erosion. Morphological technique process the images primarily based on shapes. In morphological operation, output image depends on structuring element. By selecting the range and pattern of the neighborhood, make a morphological function that is prone to precise patterns in the input image.

Dilation and erosion are the significant morphological operations. In dilation,object boundaries in an image are increased by adding pixels. In erosion, object boundaries in an image are decreased by removing pixels.The addition and removal of pixels in an image are determined by the size and frame of the structuring element.

According to Vaddi.R.S.,et. al.(2011) [9]the boundaries of each region can be determined by subtracting the eroded image from the initial image.

In text information extraction system, the resulting image consists of text regions and small non-text regions in the form of binary.To remove the small non-text regions, morphological operation is used. The dilation operator is applied in the system to connect the text regions and mark the boundary boxes around the text region.

Consider the following input image given in figure 5.

Figure 5. Input image for morphological operation based segmentation

The morphological based segmentation output is shown in figure 6.

Figure 6. Output image for morphological operation based segmentation

The quality metrics for the above outputs are given in Table 3

Table 3. Quality metrics for morphological operation based segmentation

Quality Metrics	Eroded output	Dilated output
MSE	623.5608	646.9517
SNR	18.4358	19.1840
PSNR	20.1187	20.2483
EPI	0.7674	0.7940
SSIM	0.8905	0.8804

3.4. Power-Law Transformation Based Segmentation

In power-law transformation based method the segmentation is based on power-law that is variation in one quantity is in the power of variation in another quantity. Power-law transformation based segmentation is applied to the input given in figure 7.

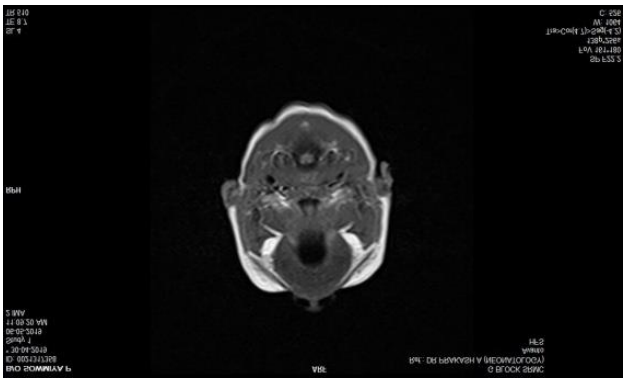

Figure 7. Input for power-law transformation based segmentation

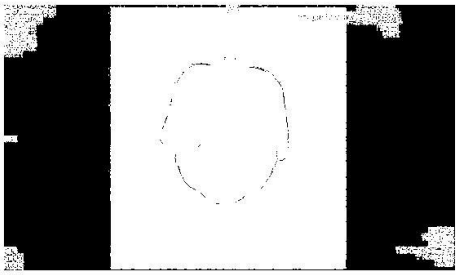

Figure 9. Output for power-law transformation based segmentation

The quality metrics for the above outputs are given in Table 4.

Table 4. Quality metrics for power-law transformation based segmentation

MSE	653.8644
SNR	18.8525
PSNR	20.2331
EPI	0.7098
SSIM	0.8990

3.5. Watershed Based Segmentation

Watershed is a transformation defined on a grayscale image.There are two groups in watershed algorithms. Algorithms are used in the first group to create the flooding process.Watershed points are directly determined by the second group. Regional minima from the image is predicted and starting from minima, region growing is obtained. Consider the input given in figure 10.

Figure 10. Input image for watershed based segmentation

The output of watershed transform is shown in figure 11.

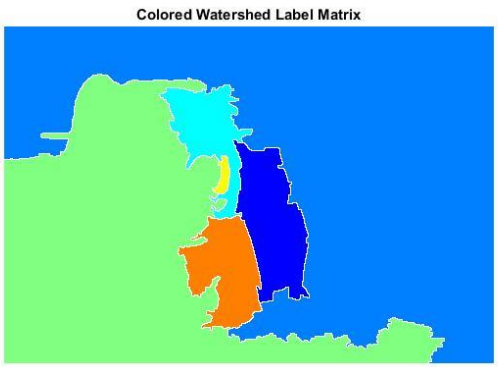

Figure 11. Output for watershed based segmentation

If the output is super-imposed on the original image the image is shown like figure 12.

Figure 12. Watershed labels super-imposed on the original image

The quality metrics for the above outputs are given in Table 5.

Table 5. Quality metrics for watershed transformation based segmentation

MSE	500.0728
SNR	18.7667
PSNR	21.2042
EPI	0.6186
SSIM	0.7805

IV. CONCLUSION

In this paper five techniques are implemented to various images, and their quality metrics MSE,SNR,PSNR,EPI and SSIM are calculated. Segmentation algorithm will be selected based on the values of Quality metrics and application. Among the quality metrics discussed in this paper, except MSE all other parameters value should be high to identify the quality of an image. Depends on the quality metrics, segmentation algorithm will be selected to predict the quality of an image

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