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Image Enhancement at Different Colorimetric Levels of Colorspaces with Improved Multiscale Watershed Segmentation Approach for Uterine Cervical Cancer Cell Image Segmentation in Different Grading Measures and Levels of CIN- Cervical Intraepithelial Neoplasia

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ABSTRACT

Experts commonly do visual study of cervix tissue abnormality during diagnosis. The core objective of this paper is to follow automated segmentation of input image into various stages of detectable parts which pay a way to understand the impact of cancerous images from different stages like CIN1, CIN2, CIN3 grades of Cervical Intraepithelial Neoplasia. This paper includes a study and analysis of different color spaces like YES, XYZ, XYZ1, I1I2I3, YCgCr, YDbDr, YIQ, LSM, LSLM and K by implementing Improved multiscale watershed segmentation.

KEY WORDS: Cervical Cancer, Colour Model, Multiscale Watershed Technique

1. INTRODUCTION

Developing countries nowadays show a high map of increase in Uterine Cervical cancer for women than globally. After converting the input image into various elements of colour spaces, a threshold is applied to get a binary image. A product of the resultant image is obtained. This binary image is multiplied with the color converted image to obtain the product image. The intensity image is complemented, threshold and merged with the product image and smoothened. Usually it shrinks the local minima by using extended minima function. The gray scale image undergoes segmentation by watershed algorithm based on Hill Climbing technique.

2. PROPOSED SYSTEM

Improved Multiscale Watershed Segmentation: The immersion-based watershed implementing flooding was proposed by Vincent and Soille, queue based was proposed by Meyer with a basic minimum value initially and further process is based on label recursively. The following figure explains the step by step methodology of implementation procedure.

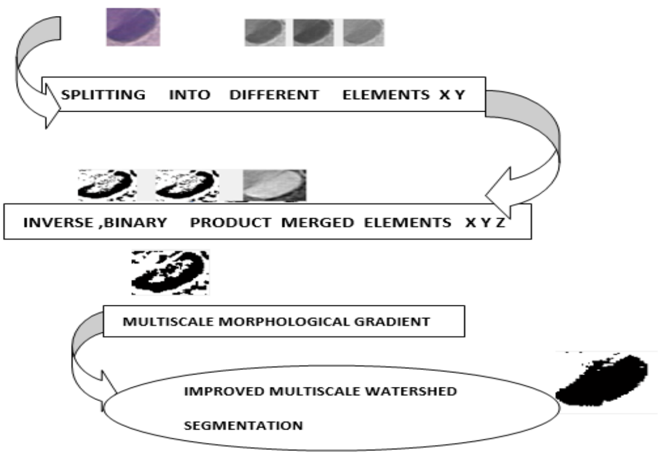

Fig 1. Image segementation for different colorsapce

Multiscale Watershed segmentation Algorithm: Segmentation in Colour Spaces (YES, XYZ, X1Y1Z1, I1I2I3, YCgCr, YDbDr, LSLM, KL, YIQ, LAB, LCH, LUV)

- Get the input image
- Conversion of the basic given input image (RGB) to other color space models as follows YES,XYZ, 1Y1Z1,I1I2I3,YCgCr,YDbDr,LSLM.KL,YIQ,LAB,LCH,LUV.
- Multiply binary image with product image.
- Apply multiscale gradient to reduce local minima
- Resultant image is segmented by improved multiscale watershed segmentation.

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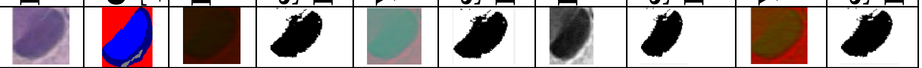
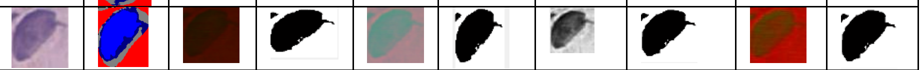
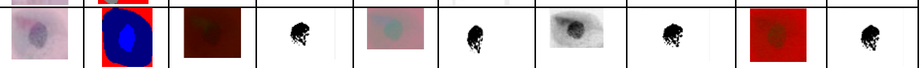
3. RESULTS AND DISCUSSION

Table.1. Performance Analysis and evaluation measures for different color spaces

S.NO	Color Space	Jaccord Coefficien	Accuracy	Sensitivity	Specificity	Error Rate	Precision Rate	Recall Rate	F-Measure	BCR	MCC
1	LSLM	100	61.4	65.4	63.2	38.5	65.4	61.3	64.2	64.3	4.76
2	HSI	56.5	56.5	56.5	53.1	43.4	56.9	52.7	51.3	54.8	2.36
3	KL	52.4	52.5	53.8	50.8	47.4	52.7	49.8	50.4	52.3	2.14
4	YIQ	50.9	47.5	49.9	49.2	52.4	48.8	47.3	50.0	64.3	2.04
5	LSM	55.7	52.3	54.	53.9	47.6	53.6	52.1	54.7	54.8	2.92
6	YCgCr	98.5	95.1	97.8	96.8	4.83	96.5	94.5	97.6	52.3	5.1
7	YDbDr	92.4	89.0	91.4	90.3	10.9	90.3	88.8	91.4	49.5	4.2
9	XYZ	62.1	58.7	61.0	60.4	41.2	60.0	58.5	61.2	97.1	3.2
10	I1I2I3	74.3	70.9	73.3	72.6	29	72.2	70.7	73.4	91.0	3.2
11	CIE LAB	100	96.7	99.0	98.3	3.2	98.0	96.4	99.1	58.7	5.24
12	CIE LCH	81.4	78.0	80.3	79.6	21.9	79.3	77.8	80.4	60.7	2.43
13	CIE LUV	83.5	80.1	82.4	81.7	19.8	81.4	79.9	82.5	72.9	2.98

Table.2. Uterine cervical cancer cell segmentation using improved multiscale watershed segmentation algorithm for color spaces

Image	Input Image	Ground Truth	LAB	Segmented Image	Y Cg Cr	Segmented Image	LSLM	Segmented Image	Y Db Dr	Segmented Image
CIN 1										
CIN 1										
CIN 2										
CIN 2										
CIN 3										

Screening involves detection of a disease for people which may result in positive or negative based on the report generated finally. If the people being diagnosed may be identified to be affected by disease then the result shows the expected person as diseased which is positive. In other case if the person is not affected then it is negative. Generally, there is a possibility of match or mismatch of test results for each subject actual status. The following are the number of measurements generally used in evaluation process for classification accuracy.

True positive = Correctly predicted with targeted disease
False positive = Wrongly predicted with targeted disease
True negative = Correctly predicted and rejected
False negative = Incorrectly predicted and rejected

$$\textbf{Sensitivity}=\left(\frac{TP}{TP+FN}\right)*100.......................................(1.1)$$

$$\textbf{Specifity}=\left(\frac{TP}{TP+FP}\right)*100...(1.2)$$

$$\textbf{Jaccord Coefficient} = 1-\left(1-\left(\frac{TN}{TP}\right)*100\right)........ (1.3)$$

$$\textbf{Accuracy} = \left(\frac{TP+TN}{TP+TN+FP+FN}\right)*100..................................(1.4)$$

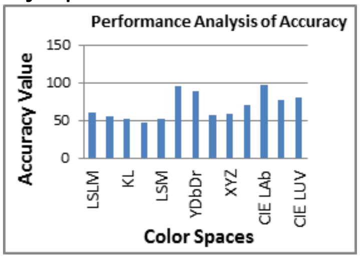


Figure.2. Performance Analysis of Accuracy

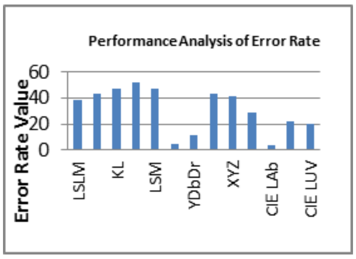


Figure.3. Performance Analysis of Specificity

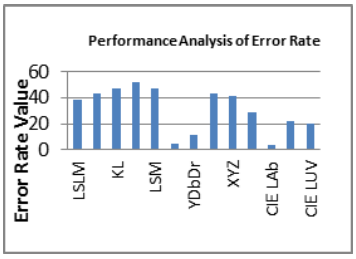


Figure.4. Performance Analysis of Error Rate

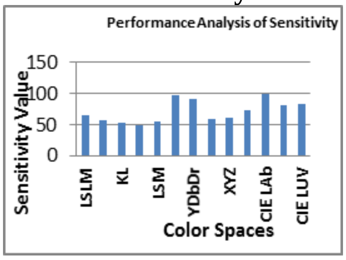


Figure.5. Performance Analysis of Sensitivity

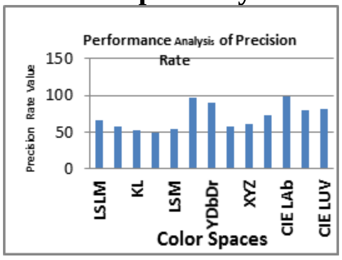


Figure.6. Performance Analysis of Precision Rate

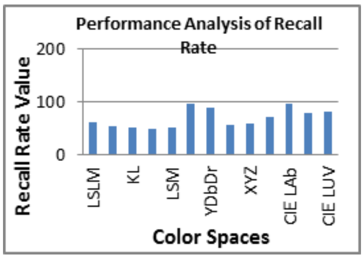


Figure.7. Performance Analysis of Recall Rate

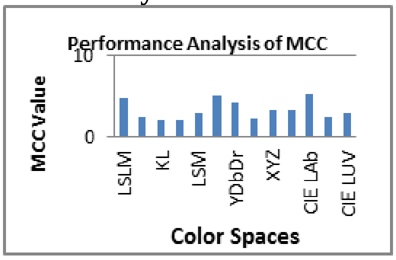


Figure.8. Performance Analysis of F-Measure

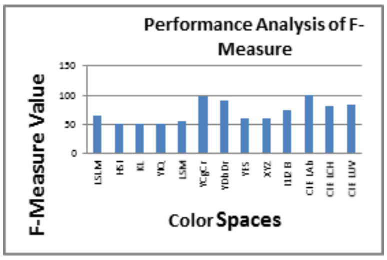


Figure.9. Performance Analysis of BCR

This part of the paper identifies the performance of improved watershed segmentation for different color spaces and compares it with ground truth. The proposed method is implemented in MATLAB software.Error rate (ER), Precision rate (PR), Recall rate (RR) FMeasure (FM) are the evaluative measures tabulated in Table 1. The comparative study is made using these color spaces to find which colour space produces the best results. The results produced by various color spaces are shown in Tables 2 and the performance analysis is shown in the Fig 2 through 9 in the graph. Of all the colour spaces reviewed the YCgCr produced better results as compared to other colour spaces with the segmentation accuracy.

4. CONCLUSION

In this study, an adaptive threshold and improved multiscale watershed segmentation technique is used to segment the cervical cells at different grade levels for various colour spaces like YES, XYZ, XYZ1, I1I2I3, YCgCr, YIQ, LSLM, CIE LAB, CIE LCH, KL CIE LUV. The results showed that the given image is segregated as different level of elements based on the color spaces opted followed by an adaptive threshold. The image is complemented, threshold and merged. Finally smoothened which results in expected output.

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