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Automated Cervical cancer Segmentation using 3 Level Distcrete Wavelet Transform & ABC Algorithm

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ABSTRACT

Cervical Cancer is one of the most dangerous diseases which threaten women all over the world, since it has no symptoms at the earlier stage. Hence automated cervical Image Segmentation aims in pre-learning or analysis of the cervical cancer without any surgical method. However this results in earlier detection and treatment of cervical cancer in women and saves life. This paper proposes a method for segmenting the nucleus of cervical cell by preprocessing using 3 level-DWT and segmenting by Artificial Bee colony Algorithm. For the experimental analysis, cervical cell images are used. The experimental results show the performance of the proposed system.

Keywords : Discrete Wavelet Transform, Artificial Bee Colony , cervical cancer, co-occurrence matrix, Grey Entropy.

I. INTRODUCTION

All segmenting a cell region either as single or more cells results in establishing the true structure of that nucleus as well[10][11]. Usually, Cytology Screening is followed for pre-cancer scanning to know the nature of cancer cell status in advance[15]. Since screening of cytological slides needs higher concentration by Cytotechnologists for extended pixels contribution. The basic screening process takes into account the ability to increase the level of productivity and thereby lowering the presence of noise which is successfully achieved by Automation Assisted Reading (AAR)[1]. Partitioning of the cell region into segments as nucleus shows the screening process to be painless and less costly compared to manual methods. Watershed treats the input image as a continuous field of basins (low intensity pixel regions) and barriers (high intensity pixel regions), and outputs the barriers, which are the cell boundaries of all the cells in the image. The technique of cell segmentation[5][8][9] is desired in the field of medical research to aid the analysis of biomedical images by delineating round objects and obtaining information about size, area, or shape of the object to locate their positions or measure useful properties. The aim of proposed algorithm is to predict the symptoms of cancer cells accuracy by segmentation. Most of segmentation of nucleus in cervical cell followed few techniques as follow :Gradient Vector Flow Snake (GVF) was implemented by Li et al., and Guan et al [2][7][13]. A fluid dynamics based approach [3] and a graph cut[4][12] method which involves local and global scheme results in early detection through segmentation.Clustering approach using Fuzzy C-means clustering[5],K-means [6],and Adaptive threshold[7]were proposed for cervical cancer segmentation. Unsupervised segmentation and classification for cervical cell was performed for single and overlapping cell [18]. The investigation and behavior analysis of honey bee swarm lead to an optimization algorithm called Artificial Bee Colony (ABC)which was introduced in the year 2005 by Karaboga and Basturk. [14][16][17].It focuses on issues of real world problems, Since population based search is examined and food source is updated with highest new value until the end of the search both local and global search is connected and produces optimistic results. In this paper the segmentation process is accomplished in two stages. The First stage is pre-processing. The given input image is decomposed using Discrete Wavelet Transform (DWT).This aids in eradicating noise, through low pass filter by lower frequency component followed by segmentation through ABC .The Whole paper motivates the segmentation process by two levels. First is preprocessing by DWT and second is segmentation by ABC Algorithm. The performance of proposed segmentation algorithm is analyzed in terms of sensitivity, specificity, Mean, Standard Deviation.

II. Methodology

In pre-processing apply DWT for decomposing the original image. This results in obtaining low frequency component image and high frequency component image. The low pass filter is applied to the low frequency images to eliminate noise in the image. High frequency images are the gradient images. Then apply normalization for both images, Followed by the co-occurrence matrix. The final step of pre-processing is gray entropy model. Then the second part is nuclei segmentation. In nuclei segmentation this paper proposes ABC segmentation algorithm. Block diagram of the proposed system is shown below

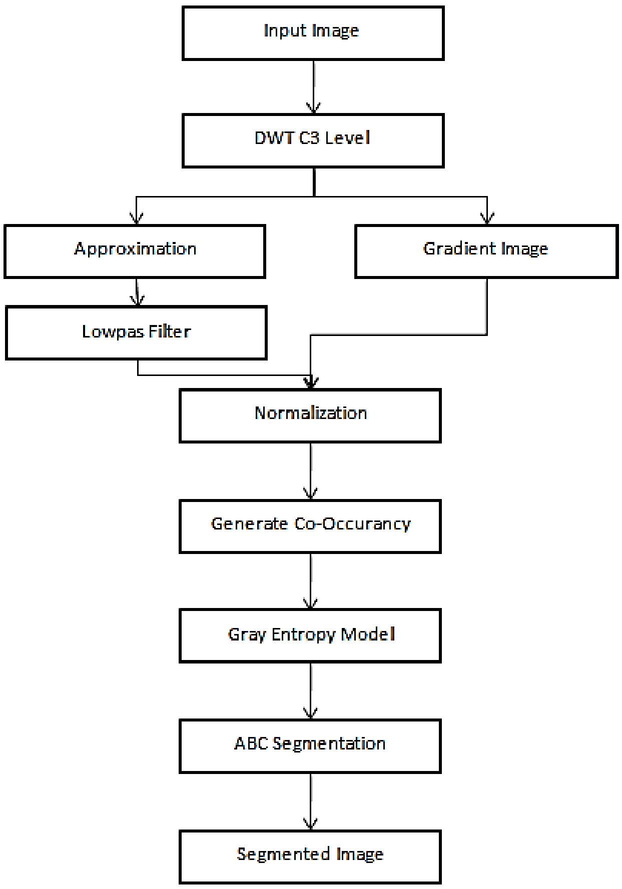


Figure 1. Block diagram for cervical cell segmentation using DWT and ABC Algorithm

III. Nuclei Segmentation

The First stage of this paper is pre-processing which is explained below.

Discrete Wavelet Transform

The DWT is used to decompose the original image in to sub image. The 3 level DWT is decomposed into 4 frequency districts which is one low-frequency district(LL) and three high-frequency districts(LH,HL,HH). If the information of low-frequency district is DWT transformed, the sub-level frequency district information will be obtained. Where, L represents low-pass filter, H represents high-pass filter. An original image can be decomposed of frequency districts of HL1, LH1, HH1. The low-frequency district information also can be decomposed into sub-level frequency district information of LL2, HL2, LH2 and HH2. By doing this the original image can be decomposed for n level wavelet transformation. End of this transform we get two types of image approximation and gradient image. Approximation image is low pass filtered image and gradient image is a high pass filtered image.

Low pass filter

By applying low pass to the low frequency component, the noise is removed. Low pass filters are used for smoothing and noise reduction. The simplest low-pass filter just calculates the average of a pixel and all of its eight immediate neighbors. The result replaces the original value of the pixel. The process is repeated for every pixel in the image.

Normalization

S. No.	Images	Existing System	Propose d System
1	Img1	88.23	97.45
2	Img2	88.45	96.23
3	Img3	87.12	97.24
4	Img4	85.26	98.43
5	Img5	88.15	98.14

Normalize the filtered image I and Gradient Image G.

Co-Occurance Matrix Creation

A co-occurrence matrix is the distribution of co-occurring pixel values in a matrix defined over an image. I retains spatial information .It reduces the matrix comparatively but the input size remains larger for future feature based implementations. After the normalization we get two normalized images I and G followed by co-occurrence matrix.

$$C = |c_{ij}|_{LXL^1} \qquad (1)$$

The probability values of the co-occurrence matrix is represented as

$$p_{ij} = \frac{c_{ij}}{\sum_{i=0}^{L-1} \sum_{j=0}^{L^1-1} c_{ij}} \qquad (2)$$

Grey Entropy Model

In grey entropy first computed the Shannon conditional entropy using below equation

$$H(E|O) = \sum_{i=0}^{s} \sum_{j=t+1}^{L^1-1} p_{ij}^{Q_2} \log_2 p_{ij}^{Q_2} \qquad (3)$$

$$H(E|B) = \sum_{i=s+1}^{L-1} \sum_{j=t+1}^{L^1-1} p_{ij}^{Q_3} \log_2 p_{ij}^{Q_3} \qquad (4)$$

After preprocessing the image is segmented using ABC algorithm which is explained below.

ABC Algorithm

The proposed **Cervical Image Segmentation by using DWT and ABC algorithm** is described below:

Cervical Image Segmentation by using DWT and ABC algorithm

Input:Cervical Cell Images
Output:Nuclei segmented Images
Begin
For images 1 to m
Do
//Preprocess Stage
Decompose the input Image by 3 level DWT;
Approximate the Low level and gradient the High Level image;
//Perform Segmentation after Preprocessing
Randomly distribute food source;
Find new food source FS_i;
The Fitness of each employed bee is calculated using fitness function and
the highest value is updated accordingly;
Onlooker bee selects a food source and calculates fitness number;
Related food source is compared and analyzed ;
If(Once the new food source has higher value)
Delete the previous one(PS_i);
Save the updated(FS_i);

IV. Result and discussion

The results of watershed segmentation is compared with proposed DWTand ABC Algorithm.The results show that the proposed algorithm better than the previous one by different metrics as shown below.

Table I True Positive Value

S. No.	Images	Existing System	Proposed System
1	Img1	88.23	97.45
2	Img2	88.45	96.23
3	Img3	87.12	97.24
4	Img4	85.26	98.43
5	Img5	88.15	98.14

Table II True Negative value

S. No.	Images	Existing System	Proposed System
1	Img1	11.77	2.55
2	Img2	11.55	3.77
3	Img3	12.88	2.76
4	Img4	14.74	1.57
5	Img5	11.85	1.86

Table III Sensitivity Value

S. No.	Images	Existing System	Proposed System
1	Img1	0.886549	0.965712
2	Img2	0.861234	0.953622
3	Img3	0.845697	0.964491
4	Img4	0.842357	0.973687
5	Img5	0.852364	0.964711

Table IV Specificity Value

S. No.	Images	Existing System	Proposed System
1	Img1	0.056894	0.025734
2	Img2	0.064523	0.038046
3	Img3	0.054289	0.027828
4	Img4	0.053268	0.015873
5	Img5	0.056489	0.018927

Table V Mean Value

S. No.	Images	Existing System	Proposed System
1	Img1	0.328	0.349
2	Img2	0.3126	0.3512
3	Img3	0.3268	0.3548
4	Img4	0.3287	0.3612
5	Img5	0.3145	0.3584

Table VI Standard Deviation Value

S. No.	Images	Existing System	Proposed System
1	Img1	0.017	0.023
2	Img2	0.0168	0.0235
3	Img3	0.0175	0.0256
4	Img4	0.0185	0.0259
5	Img5	0.0152	0.0289

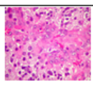
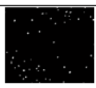
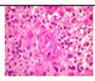
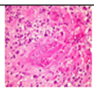
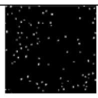
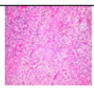
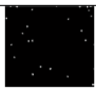
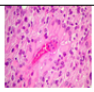
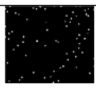
Table VII Range Value

S. No.	Images	Existing System	Proposed System
1	Img1	0.3400	0.3000
2	Img2	0.3458	0.3124
3	Img3	0.3568	0.3189
4	Img4	0.3612	0.0356
5	Img5	0.3584	0.3145

Table VIII Processing Time(secs)

S. No.	Images	Existing System	Proposed System
1	Img1	67	11
2	Img2	72	10
3	Img3	89	14
4	Img4	60	9
5	Img5	69	12

Table IX Image after segmention Process

Input Image	Input Cervical Image	Segmented Image by applying ABC Algorithm
Image1		
Image 2		
Image 3		
Image 4		
Image 5		

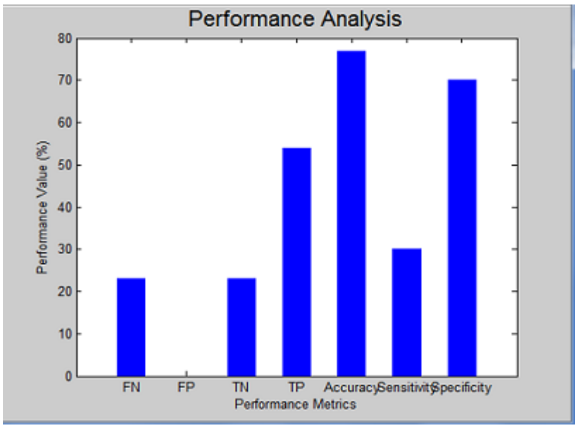


Figure 2. Performance Analysis of Block diagram for cervical cell segmentation using DWT and ABC Algorithm

V. Conclusion

The experimental results shows the performance of the ABC segmentation algorithm. The DWT and ABC segmentation algorithm provides high efficiency and very less computation time.The resultant sensitivity value highest value than the watershed transform. At the same time the processing time of the DWT and ABC is lower than the watershed transform.

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