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Lung Cancer Segmentation in CT Images Using Fuzzy-C Means Clustering and Artificial Bee Colony Algorithm

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Abstract*: *One of the challenging issues to most of the researches is to segment pulmonary nodules from the CT Lung images. This Research focus on rapid segmentation of pulmonary nodules from the CT Lung images based on Fuzzy-C Means Clustering and Artificial Bee Colony Algorithm. Classic 2D otsu algorithm is used for segmentation and Artificial Bee colony algorithm is used for finding optimum threshold values. Finally, FCM (Fuzzy-C Means) clustering is used over the CT segmented images to cluster the images.

Index Terms*: *CT Lung Images, Segmentation, ABC Algorithm, FCM Clustering.

I. INTRODUCTION

In the human respiratory system lungs are considered as primary organs. There are two lungs, right and left lung and the lung tissues can be affected by various diseases, like lung cancer, pneumonia by exposing to dust, coal and adult respiratory distress syndrome. Pulmonary function tests can be used to identify any global changes happened in lung function. But they can't perform early detection of diseases and unable to separate the disease location [1, 2]. Early detection and assessment of pulmonary nodules is very important to enhance the life span of the victim.

CT imaging is the usual for lung imaging, which provides some of the advantages when compared to other imaging techniques like high resolution, brilliant contrast resolution, and using which 3D volume of the thorax can be collected completely [3].

In this study we proposed using artificial bee colony algorithm and FCM algorithm for segmenting lung CT images.

II. ABC ALGORITHM

In this algorithm[12] artificial bees are clustered into three groups employed, onlooker bees and the scout bees. In a honeybee colony half of the population consists of employed bees and rest includes onlooker bees. In the searching process, some of the bees perform random search for food in a specific area. Once food source is found these bees get back to the colony with nectar and leave nectar and intimate the location of the food source with rest of the bees.

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Bee colony now enters into a new iteration cycle, following steps are involved in every iteration:

a) Employed bee will now become onlooker or continue to be employed bee.

b) Some of the onlookers in the colony will try to follow employed bees to further search for some specific memorized food sources.

c) Scout bees will do a random search based on the following probability for generating food sources from the memorized ones.

$$Pi=fi/\sum_{k=1}^{sn} Fk \quad -(1)$$

where f_i is the food source fitness value

Computational steps:

A) Prepare the Population.
B) Repeat the process
C) Employed bees must be Placed on the food source.
D) By relaying on the nectar values onlooker bees must be located on the food sources.
E) Scouts will be sent in search for the new food sources.
F) Best found food source locations must be remembered
G) Repeat the process until all the necessities are satisfied.

III. TWO-DIMENSIONAL OTSU METHOD

One dimensional Otsu method [9] was used for lung CT image segmenting, but it gave good results only for images with high contrast. This problem is addressed in Two-Dimensional Otsu method which gave good results with high or low contrast images.

The image is represented with function f(x,y) with size M*N, gray level local average and gray level of the pixel is used in the two dimensional thresholding technique, gray level local average can be represented with the function g(x,y)[4].

Joint probability mass function pij is given by

Pij=rij/M*N where I,j=0,1,2…L-1 (2)

Pij be the two Dimension histogram of the image.

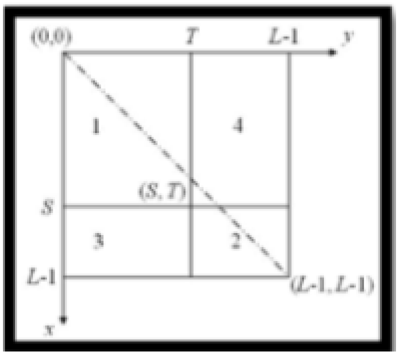

Figure 1 Two-Dimension Histogram

Gray level in the figure 1 is represented with x-coordinate and local average of gray level is represented with y-coordinate.

Gray level of the object of the pixel and the object background of the pixel differentiate from its gray level local average. First and second quadrants contains the background and object class distribution [4].

$p_0(s,t)=\sum_{i=0}^{s}\sum_{j=0}^{t} pij$ -(3)

$P1(s,t)=\sum_{i=s+1}^{l-1}\sum_{j=t+1}^{l-1} pij$-(4)

And the class mean levels are

$\mu_0=(\mu_{00}, \mu_{01})^T$ –(5)

$\mu_1=(\mu_{10}, \mu_{11})^T$ –(6)

$T_r,S_B=(\mu_i(s,t)-p_0\,\mu_{ro})^2+(\mu_j(s,t)-p_0\,\mu_{r1})^2/p_0(1-p_0)$ -(7)

Where $\mu i(s,t)=\sum_{i=0}^{s}\sum_{j=0}^{t} i.\,pij$

$\mu i(s,t)=\sum_{i=0}^{s}\sum_{j=0}^{t} j.\,pij$

t_r,S_B is maximized to select the threshold vector

IV. FUZZY C-MEANS CLUSTERING

Bezdek and Dunn proposed FCM algorithm for clustering [5]. Pattern recognition is the main application area of this algorithm . By minimizing the cost function, this algorithm is responsible for producing Optimal c partition.

$J_{FCM}(U,V)=\sum_{k=1}^{n}\sum_{i=1}^{c} Uikm\ d2(Xk,Vi)$ -(8)

Where X is the p-dimensional vector space data set, and n specify data items count and c specify clusters count.

V. EXPERIMENTAL RESULTS

Using ABC algorithm segmentation of the lung is done and for the efficient segmentation a limit of 100 is set to food source, can't be improved over a quantified bound of trails by their employed bee.The input lung image is given below

Figure 2 Input CT Lung Image

After segmentation the image is given below

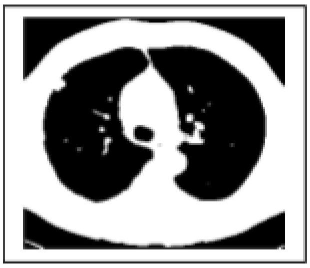

Figure 3 Segmented Image

After the clustering of the image is done

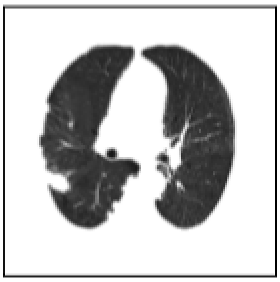

Figure 4 Clustered Image

VI. CONCLUSION

Fast Segmentation of CT Lung Image is proposed in this paper using FCM Clustering algorithm and ABC Algorithm. Artificial Bee Colony algorithm is used to enhance the quality of segmentation and the clustering is used to strengthen the nodules present in the Lung Images.

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