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An Efficient Methodology for Breast Tumor Segmentation using Duck Traveler Optimization Algorithm

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ABSTRACT

Breast cancer identification is essential to accumulate one's life. Breast malignancy is normal and is considered as the second perilous illness everywhere on the world because of its demise rate. Influenced can endure if the sickness analyze before the presence of major physical changes in the body. Presently a day, mammographic (X-beam of bosom locale) pictures are generally utilized for untimely uncovering of bosom malignant growth. Mammography is the most effective methodology for identification of bosom malignant growth at beginning phase. Microcalcifications are small splendid spots in mammograms and can frequently get missed by the radiologist during analysis. The presence of microcalcification bunches in mammograms can go about as an early indication of bosom malignant growth. This paper presents a totally Region of interest (ROI) framework for recognition of microcalcification groups in mammograms. Anisotropic Filter (AF) is utilized as a preprocessing step which improves the differentiation among microcalcifications and the foundation. For the binarization cycle a programmed

threshold is determined by utilizing Kapur and Otsu methods.DTO algorithm is proposed for advancing the edge esteems and portioning the tumor area in the breast.

1. Introduction

Cancer is the anomalous, wild, consistent replication of cells which will unavoidably prompt the development of a tumor. Breast malignant growth structures in the tissues of the breast. It spreads mostly through the lymphatic framework. Breast tumors are arranged into two gatherings, for example, malignant (harmful) and benign (not-destructive). Roughly 1 out of 8 ladies (13%) will be determined to have obtrusive breast malignant growth in the course of their life and 1 of every 39 ladies (3%) will pass on from breast disease [1]. Breast malignancy is the second most normal disease worldwide after cellular breakdown in the lungs, the fifth most basic reason for malignancy passing, and the main source of malignancy demise in ladies [2].Different scientists study to which is the most effective technique to distinguish the breast malignant growth in the previous stage by recognizing Computerized Tomography (CT), Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET), Mammography which comprises of film and computerized types, Ultrasonography and Tomosynthesis. The exceptional outcomes accomplished and furthermore acknowledge by all the analyst is screening mammography [3, 4]. Mammography is clinical imaging in which the breasts are examined utilizing a low-portion X-beam [5]. A few analysts are inspired to create computer aided analysis (CAD) frameworks to get more solid and exact diagnostic solutions to mammogram images [6]. For Tumor location from mammograms, numerous specialists have contributed their calculations [7-10].

Threshold based, Histogram based, Region based, edge based, Cluster based, Watershed based segmentation techniques are considered as a six broad classifications of image segmentation [11]. In medical image segmentation seeded region growing algorithm reports best solutions [12]. In traditional methodology for focused breast tumor segmentation by manually select the seed point values and threshold values given the true positive results are small [13]. To minimizing the false positive results, well –organized Customized Automation of Seeded Region Growing (CASRG) algorithm is introduced for Breast Tumor (BT) segmentation. Right time with right person give their learning point is called as an experience. It is similar to customized automatic seed point selection such as right number of seed points with right location in the breast point is called as CASRG and it gives minimum false positive only.

In this research, seed points applied for Mammogram picture segmentation was executed. Gauge the automatic extraction of ROI is accomplished by Preprocessing. In preprocessing the anisotropic diffusion is assumes a significant part for enhancing the image quality. An enhancement has been done to the division approach by applying some morphological tasks after multilevel thresholding. The doctors analyze the mammogram which contains the breast cancer; the outline was added in the input image using biomarkers. The proposed Customized Automation of Seeded Region Growing (CASRG) calculation has been applied on more than one mammogram pictures taken from MIAS dataset. The experimental results show the efficiency of proposed duck traveler optimization algorithm for mammogram image segmentation.

2. Study Area

The important task of image segmentation is mine the secreted information from input images from MIAS database [14]. The two basic left and right breast combinations lead totally 322 images in MIAS database. The two broad categories are normal and abnormal. In normal there are 208 images and in abnormal both benign 63 and malignant 51 images are available. Asymmetry, architectural distortion, ill defined masses, speculated masses, circumscribed masses and microcalcification belong to the abnormal classes. Portable Greymap (PGM) image format with (1024*1024) pixel size of all the images are digitized at 200 micron pixel edge. All the images include position (left/right), groups (fatty glandular, dense glandular, fatty) comes under the sub groups (normal/abnormal) abnormal type (benign/malignant). The mammogram images contains some noise, labels, artifacts include patient's id, location of any abnormality for example centre of a circle nearby the tumor region. Thus image preprocessing takes vital role in image segmentation after acquiring the input images.

3. Objective of the Research

The main aim of this research work was to optimize the threshold values during cancer segmentation, based on the food foraging behavior, and imprinting of duck flock.

The objectives of this research work are,

- To generate a Customized Automation of Seeded Region Growing (CASRG) algorithm for breast tumor segmentation.
- To propose Duck Traveler algorithm for Optimization of seed points.
- To test the effectiveness of the proposed technique with the true positive and false negative metrics.

4. Literature Review

Rolf Adams and Leanne Bischof in reference [15] propose their new calculation Seeded Region Growing (SRG) for picture division. Their proposed strategy demands the information such as number of seeds, either singular pixels or regions, which will control the arrangement of regions into which the picture will be fragmented.

A.Mehnert and P.Jackway [16] utilizing the upside of adams technique and propose an Improved Seeded Region Growing (ISRG) calculation dependent on LIFO strategy and need line strategy. Here the creators demonstrate ISRG is pixel order independent. Thus it is considered for strong division and no adjusting boundaries so speed the execution is conceivable.

F.Jianping et.al [17] plan an automatic SRG calculation, alongside a boundary-oriented equal pixel naming procedure and an automatic seed point determination technique. A seed following calculation is proposed for automatic moving item extraction. The creator shows without the need of changing boundaries, the proposed calculation gives the promising outcomes.

F.Jianping et.al [18] proposes a novel automatic picture division technique. Shading edges in a picture are first gotten consequently by joining threshold and isotropic technique for edge indicator. Beginning seeds for SRG taken as centroids and gives the principle mathematical structure in an information picture.

Z.Pan,J.Lu [19] presents another Bayesian investigation based a new Bayesian-investigation based region developing calculation for clinical picture division can heartily and successfully portion clinical pictures. In particular, the methodology studies homogeneity standard parameters in a nearby neighbor region. Utilizing the multi slices Gaussian and anisotropic channels as a preprocess reduces a picture's noise.

To make the segmentation totally automatic, H.D.J. Shan and Y.W.Cheng [20] propose another automatic seed point choosing technique for region developing algorithm. The initial step of region growing is choosing the seed point which is inside the breast lesion. The vast majority of the region growing techniques require physically choosing the seed point which needs human association.

A.Q.A.Faris, N.U.Kalthum, N.A.M.Isa, I.L.Shuaib [21], an automatic computer supported location framework for breast Magnetic Resonance Imaging (MRI) tumor division will be introduced. The examination is centered on tumor segmentation utilizing the altered automated initial seed and threshold developing approaches. Preceding that, some pre-processing procedures are included. Breast skin is identified and erased utilizing the coordination of two calculations; to be specific the level set active contour and morphological thinning.

Y.L.Chang, X.Li [22] proposes a straightforward, yet broad and powerful, region growing structure for picture segmentation. The region growing cycle is guided by regional component analysis; no parameter tuning or from the earlier information about the picture is required. To choose if two regions ought to be merged, rather than comparing the difference of region feature implies with a predefined threshold, we adaptively evaluate region homogeneity from region include feature distributions. This outcomes in a calculation that is robust as for different picture qualities. Their consolidation model likewise minimizes the quantity of merge rejections and results in a quick region growing cycle that is amiable to parallelization.

For the automated segmentation of organs in Abdominal MR picture the creators J.Wu, S.Poehlman, Michael D.N, V.Markad Kamath [23] another texture component based seeded region growing calculation is proposed. Co-occurrence element and semi-variogram texture component are extricated from the picture and the region growing calculation is run on these element spaces. With a given Region of Interest (ROI), a seed point is naturally gotten dependent on three homogeneity measures. A threshold value is then gotten by taking a lower value.

In the references [24-27] the automated seed point selection based on adaptive region growing algorithm was clearly expanded by various authors in an efficient way.

Neeraj S & Jyoti B [28] shows a mix of choice techniques for Efficient Seeded Region Growing with improved execution to spot breast cancer. It was seen that the proposed calculation gives 94.6% and 95.3% True Positive Fraction (TPF) if there should be an occurrence of MIAS and DDSM pictures, separately. The boundaries show that the given calculation gives preferable outcomes over the already accessible strategies.

A) PREPROCESSING

In generally the initial step of image acquisition which comes from different sources consists of noise in input image. The next step of image segmentation needs cleaned data for processing. The main purpose of preprocessing is that minimizes the complexity and maximizes the accuracy of the given algorithm to the specified problem solving.

B) ANISOTROPIC DIFFUSION

Perona et.al proposed the anisotropic diffusion to achieve smoothing and preserving the boundary regions in a clear manner [29]. Anisotropic diffusion conquers some significant constraints of straight and nonlinear isotropic channels:

- improves noisy edges and stream like structures
- represses diffusion at edges
- More adaptable because of the bigger number of boundaries
- Its answer is novel and constantly subject to the underlying picture. The utilization of anisotropic dissemination, as seen in [30].

C) ROI Mining

Mammogram pictures are hard to work out, and a Region of Interest (ROI) of the pictures is important to improve the nature of the pictures and make the component extraction more solid. The ROI is the editing of the necessary region from the mammogram pictures. This part presents the pre-handling strategies applied to the pictures before the segmentation. Before the first part, otsu's thresholding is applied to getting the black and white image for considering only the breast area in a white color and other areas in black color. The first part is after deleting background image processing. The second portion is getting only the breast image. The final part contains getting the breast and muscle image.

1) Black and white image

The trimming activity was utilized to cut the dark pieces of the picture just as the current antiques. The foundation comprises of the data about the date, see, and sensible data of the picture. Getting the black and white image using otsu's thresholding method segments the breast region in white color.

2) After deleting background image
In background image of breast the time that the mammograms were taken, patient id, naming labels are available to see.

3) Getting only the breast image
In this part, the unwanted information from input mammogram is removed.

4) Getting the breast and muscle image
Suppression of background removal gives only the desired mammogram like breast and muscle image.

5) Pectoral muscle removal
With the help of ROI mining elimination of pectoral muscle is possible. The seed point is consequently determined in this cycle by finding the data about the direction of the mammogram picture. The underlying seed point is chosen with the way that pectoral muscle is consistently present in the upper corner in a picture.

D) CLAHE for mammogram

Contrast Limited Adaptive Histogram Equalization (CLAHE) is a variant of *Adaptive histogram equalization (AHE)* which takes care of over-amplification of the contrast. Apply CLAHE to mammogram image to enhance the contrast of mammogram.

```
Inputimage=imread('mdb003.pgm');
Contrastimage=adapthisteq(Inputimage,'clipLimit',0.03,'Distribution','rayleigh');
figure,imshow(Inputimage);
figure,imshow(Contrastimage);
```

2. Breast Tumor Segmentation using Duck Traveler Optimization Algorithm

Duck Traveler is a new meta-heuristic Optimization algorithm based on swarm intelligence of duck flock. It is mainly influenced by duck's tolerant and imprinting behavior. Ducks are known as lucky and lovable bird while comparing all other bird. The first method of duck flock is saving their Offspring from predators by using imprinting (static) character. Then the second mechanism is to find out the food place in foraging (dynamic) behavior. The basic two principles of swarming are exploration and exploitation. The static behavior of duck flock exhibits in an exploration and the dynamic exhibits in an exploitation field. Both of them are used for highlights the cancer region using ROI method. Breast tumor segmentation, a continuous optimization problem is solved using duck traveler optimization algorithm.

$$\boldsymbol{A} = \boldsymbol{D}^{\boldsymbol{s}+\boldsymbol{1}} = \boldsymbol{DTO}(\boldsymbol{D}^{\boldsymbol{s}}, \boldsymbol{P}(\boldsymbol{s}), \in (\boldsymbol{s})) \quad (1)$$

D^{s+1}=new solution vector;
D^{s} =current solution vector

$P(s)$=Parameters P=(P_1……, P_u)

$\in (s)$=random variables $\epsilon = (\epsilon_{1\ldots\ldots}, \epsilon_v)$

s =Scheduled time

An algorithm DTO tends to generate a new and better solution D^{s+1} to a given problem from the current solution D^s at iteration or schedule s. Mathematically speaking, a random walk can be written as

$$\boldsymbol{R_{s+1} = R_s + p_s} \quad (2)$$

R_s=existing solution; s=steps and p_s=perturbation

$$\boldsymbol{D_i^{s+1} = D_i^s + \mu_{0e^{-\Upsilon r^2 ij}}(D_j^s - D_i^s) + \alpha\epsilon_i^s}$$

(3)

The next generation can be updated by using the optimality function given below:

Maximize the performance of

$$\boldsymbol{\xi = DTO\ (\Phi, p, \varepsilon)} \quad (4)$$

Let fs = 1, 2, . . . , n is n food sources, which can be considered as the nodes of a graph. Let β_{jk} be the decision variable for connecting food source j to food source k (i.e., an edge in the graph from node j to node k) such that $\beta_{jk} = 1$ means the duck travel starts at j and ends at k. Otherwise, $\beta_{jk} = 0$ means no connection along this edge. Therefore, the cities form the set V of vertices and connections form the set E of edges. Let d_{ij} be the distance between food path j and food path k. Due to the symmetry, we know that $d_{jk} = d_{kj}$, which means the graph is undirected. The objective is to minimize

$$\boldsymbol{fs = j, k \in E, j = kd_{jk}\ \beta_{kj}}$$

(5)

The position of the duck concerned just limiting the separation of voyaging and boosting speed to discover the prey. Speed>Distance=Capturing the prey in minimum time. Therefore, the optimality can be achieved through minimizing the distance (travelling) and maximizing the speed of (find out the prey) by duck flock.

$$\boldsymbol{S > D = P}$$

(6)

Where S stands for Speed and D represents the Distance used for achieving P that means Prey. Force concerned only for catching food.

$$\boldsymbol{F = m * a}$$

(7)

Here, m is used to denote the duck weight and which is used to calculate the distance/time^2 for updating speed (a).

3. The DTO Algorithm

To summarize the observations from ducks' foraging behavior, the following tasks are presented.

Task 1: A duck population comprises of several groups. Each group containing a number of ducks that optimizes the food search activity using their stack of intelligence.
Task 2: Based on the height of the neck+head, the duck uses that information to select the hunting region.
Task 3: They travel as a flock and follow their local guide which has fed in most food in the last location.
Task 4: After a number of tasks, ducks return to the surface to share with its local affiliates, via communication of exploitation, the locations and abundance of food sources.
Task 5: If the food support is less for the ducks of a given group to live, in part of the group migrates to another place via communication for exploration.
Task 6: Based on the satisfaction of end criteria, output the optimal solution. Otherwise, go to Task 2.**Pseudo code of** Duck Traveler Optimization (DTO)
D_g means the greatest duck; D_1 and D_2 are two temporary ducks in duck flock.i.e D=(D_1, D_2,…. D_n). DP_{ij} i.e P_i=(P_1, P_2,…. P_n) means the probability of food foraging speed (f_{ij}) i.e (j=1,2,…..,n_i). robustness() is a function to calculate the fitness value of the ducks. recompense() and reprimand() are two functions used to realize the competitive mechanism. Where n & n_i = number of ducks in the duck flock; P_i= the survival rate of the ith duck.

```
If imax> ifinal
Set Dg= D1= D2= Φ;
Initialize DPij=1/ni;
arbitrary();
robustness();
greatest();
recompense();
reprimand();
Set Dg= Pick_greatest();
Do {
D1= Pick_ arbitrary();
D2= Pick_ arbitrary();
If robustness (D1) ≥ robustness (D2)
{
recompense(D1);
reprimand(D2);
Dg= D1;
}
Else

{

recompense(D2);

reprimand(D1);

Dg= D2;

}

}while end condition is satisfied;

Return Dg;
```

5. Naive Bayes Regression classifier

Naive Bayes Regression (NBR) classifier is often used in medical image segmentation to segment the cancer region because of its features like simplicity, robustness and smoothness. In addition to these characteristics many modifications is applied by image processing, information retrieval, prototype detection, geometric investigation and machine learning to make it more flexible. Usually Naive Bayes Regression Classifier can be applied largely in Medical image segmentations especially in Region of interest to identify the faulty seed points in the selected seed points. This analyzes the region-to-region of every tested mammogram in the input image to determine the status of seed points in the specified region. The main advantages of using Naive Bayes Classifier are it does not require any extra procedure and it simply suggests for faulty seed points. Hence, the classifier feature set is extended with the intelligence duck flock based seed point detection.

$$D(k)=D(k-1)+fk(k)-fl(k)-Df(k)-Dk(k); \quad (8)$$

Where D(k) is the food forage stage of duck flock at end of the month k (when k=1, D(k-1) is equal to D0, the initial food forage level); the forage level for the successive months D(k-1) will be the preceding month's end of the day's food forage level. fk(k) is the food capture and fl(k) is the food loss rate during month k. D(k) is the save food that might ultimately fall from the duck as a result of run over, during the month k. It is also important to take care of the feature that duck capacity should not be less than the lifeless storage space.

The constraints are enlisted in the following equations:

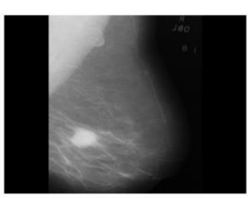
$$0 \leq Dk(k) \leq Df(k); \quad (9)$$

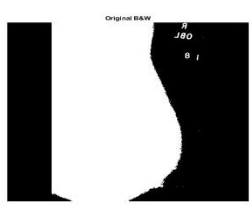
$$Dlifeless \leq D(k) \leq Dhigh; \quad (10)$$

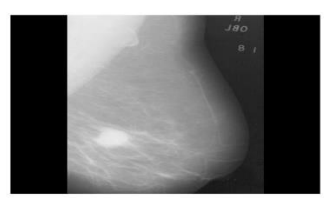
$$D(k) \geq 0; \quad (11)$$

where Dlifeless is the departed food forage and storage stage and Dhigh is greatest storage capacity of the duck flock.

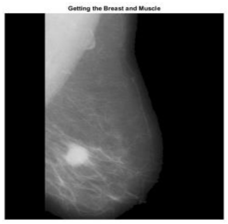
6. discussion of Results

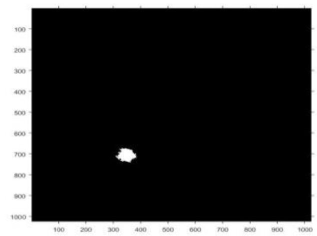


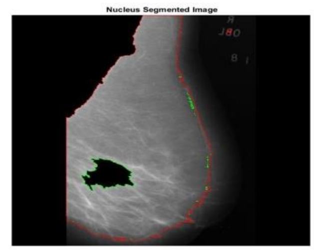




Input image **Black and White** **Gamma corrected image**







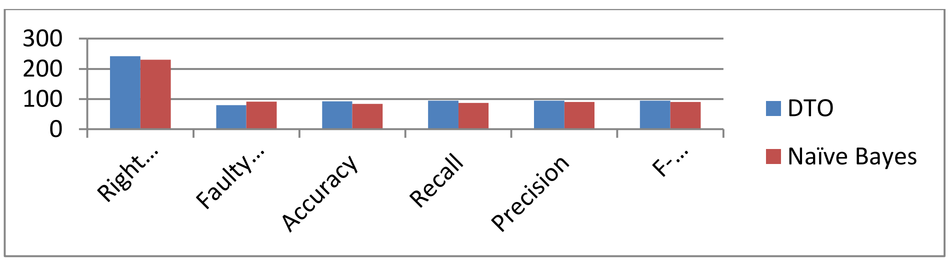
Breast and muscle image **Segmented Tumor region region** **Highlights the tumor**

Table 1 Quality Metrics on two methods

True Positive (TP): number of seed points a classifier appropriately allots to the duck flock.

- True Negative (TN): number of seed points a classifier does not assign to incorrect duck flock.
- False Positive (FP): number of seed points a classifier mistakenly assigns to duck flock.
- False Negative (FN): number of seed points that belong to the class but which the classifier approximately assigns to other duck flock.

Quality metrics applied on DTO and Naïve Bayes for showing efficiency of proposed algorithm



1)Input image 2)Anisotropic filter 3)Deleting background 4)Breast &Muscle 5)Breast image 6)Tumor Region**Conclusion**

In this research work, Through Duck Traveler Optimization based meta-heuristic algorithm, the tumor region segmented by using CASRG and ROI method. For enhancement the anisotropic diffusion filter is used for smoothing the inter-region of breast. Customized Automatic Seed Region Growing based Duck Traveler Optimization algorithm gives the highest accuracy 92% rather than naïve bayes 84%. Hence the proposed DTO method gives adequate results for mammogram image segmentation.

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