Efficient Classification of Breast Lesion based on Deep Learning Technique

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Abstract--- In this paper, a new method for Classification of Breast Cancer Images using deep Learning Algorithm are proposed. The Classification Algorithm appears as various features extracted from Healthy Breast images and Unhealthy Breast images. The segmentation algorithm is Deep learning and then Classification Tool is ANN [Artificial Neural Network]. Algorithms are performed and different features are extracted. The features are Breast Image Mean, Breast Image Standard Deviation, Breast image Peak Signal to Noise Ratio [PSNR], breast image Contrast to Noise Ratio [CNR]. ANN tool showing breast image results.

Keywords--- Deep Learning, Greedy Algorithm, Morphological Operators, Breast Database, ANN Classification Tool

I. INTRODUCTION

OUR Work in this paper mainly Deep learning Based Breast cancer segmentation using breast cancer[Calcification] Images, also classify the breast images using ANN tool. The Classification performs by using the features which is extracted from breast images. The features are Mean, Standard Deviation, SNR [signal to noise ratio], CNR [contrast to noise ratio].

In section II explains over all work flow of deep learning algorithm. The Section III & IV analyze the filtering and enhancement algorithm. Section V explains a Morphological performance and section VI Analyze the ANN tool performance.

II. DEEP LEARNING ALGORITHM

Figure 1: Breast Database

Deep Learning Algorithm methods are an evolution of conventional neural network [1],[2]. These approaches generally involve various non-linear transformations of the data with the objective of contribution to abstracts and appropriate representations [3]. These methods are becoming popular, generally the exceeding traditional approaches includes handcrafted features for data representation and machine learning methods are used for learning task [4],[5].

Method of Pixel Points

One of the advance algorithms in unsupervised deep learning is the method of pixel points. In the method of pixel point, the unknown parameters (of pixels) in the model are related to the pixel points of one or more casual pixel points, and thus, these unknown parameters can be predicted given the pixel points. The pixel points are mostly predicted from breast regions in an observed way. The basic pixel points are first and second order pixel points for a random pixel points, the first order pixel points is the mean pixels, and the second order pixel points is the covariance matrix (when the mean is zero). Higher order pixel points are mostly represented using tensors which are the generalization of matrices to higher orders as multi-dimensional pixels.

Method of Descriptors Analysis

The method is to estimate the k unknown pixels $\theta_1, \theta_2, \dots, \theta_k$ describe the diffusion $f_w(\omega; \theta)$ of the random pixels or variables W . Assume the first k pixel points of the true diffusion can be expressed as function θ^s :

$$\mu_1 \equiv E[W] = g_1(\theta_1, \theta_2, \dots, \theta_k) \quad (1)$$

$$\mu_2 \equiv E[W^2] = g_2(\theta_1, \dots, \theta_k) \quad (2)$$

$$\mu_k \equiv E[W^k] = g_k(\theta_1, \dots, \theta_k) \quad (3)$$

Sumrise Breast image region pixel region n is pinched, resulting in the values $\omega_1, \dots, \omega_n$ for $j=1, \dots, k$ let

$$\mu_j = \frac{1}{n} \sum_{i=1}^n \omega_i^j \quad (4)$$

Be the j^{th} breast sample moment, an estimate of μ_j . The method of pixel points estimator for $\theta_1, \dots, \theta_k$ denoted by $\check{\theta}_1, \dots, \check{\theta}^k$ is defined as the result to the equation is

$$\check{\mu}_1 = g_1(\check{\theta}_1, \dots, \check{\theta}_k) \quad (5)$$

$$\check{\mu}_2 = g_2(\check{\theta}_1, \dots, \check{\theta}_k) \quad (6)$$

$$\check{\mu}_k = g_k(\check{\theta}_1, \dots, \check{\theta}_k) \quad (7)$$

Mean

The probability distribution of random pixels X the mean is equal to sum over every possible pixel values.

$$\mu = \sum xP(x) \quad (8)$$

x denoted total number of pixels values of image.

An analogous formula applies to the case of a 2D Breast Pixels probability distribution. Not every 3D Breast pixels probability distribution has a defined mean.

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Gradient Linear Mapping

Figure 2: Gradient Linear Images

A Gradient Linear Mapping [10] algorithm performing a like as a affine Transform [6] of Euclidean pixels space which moves every pixel points by a fixed distance in the same direction in the breast images. The breast image every pixels are shifted the origin of coordinate[7] regions in the images.

$$B_{r(i,j)} = p + v \quad (9)$$

III. FILTERING

In this section we have used a nonlinear filtering. This filter used to reduce noise in the Breast data base. This process used to improve segmentation level. Mainly the median filter performing every pixels [includes rows and columns][9] are replaced by median pixel of the overall image.

$$Bimg\ mid = \frac{pixels\ in\ x}{pixels\ in\ y} \quad (10)$$

$$pixl(x) = \frac{pixel\ width\ h}{2} \quad (11)$$

$$pixel(y) = \frac{pixel\ height}{2} \quad (12)$$

Above Equation (10) mention as Breast image median formula.

Figure 3: Median Filter Image

IV. ENHANCEMENT

MCLAEH Enhancement algorithm is used in this section. This algorithm performing a histogram based enhances a breast images. So pixels are easily smoothed and then also to limiting a contrast level in every pixels.

This techniques mostly limiting contrast level in the image. So these techniques need some parameters from breast images. The parameters are mean of the image and then initial threshold values of image. The threshold image before apply mean selection of image. This technique also used to contrast level of the image. Contrast difference find to the original

image. This technique helps to improve the transformation function of each pixel which is derived from a neighborhood breast region.

T – intensity threshold value

P_{Tl} – Pixel Intensity lower threshold value

P_{Th} – Pixel Intensity Higher threshold

$$Mean = Tmean(Br\ Img) \quad (13)$$

$$MCLAHE = \frac{img - v_{min}}{v_{max} - v_{min}} \quad (14)$$

V. MORPHOLOGICAL OPERATION

Morphological algorithm part of work is the Gray level Breast images are layer by layer analysis. The layers are extracted from Breast data's. the layers are Red layer, Green layer, Blue layer. All kind of this layer applied to image smoothing operation, then this details data's are applied to morphological operator like canny algorithm and also to enhance breast edge border to use Prewitt algorithm [11].

Canny Algorithm Working

1. Apply Gaussian Filter process
2. Find intensity gradients of the image
3. Apply suppression to image
4. Find potential edges
5. Extract edges from above steps

Gaussian Filter Equation

$$G = \sigma^2 * e^{-(i-k-1)^2 + (j-k-1)^2} \quad (15)$$

Gradient

$$G = \sqrt{G^2 x + G^2 y} \quad (16)$$

Figure 4: Canny Algorithm Image

Figure 5: DL Outer Border Image

Figure 6: Dilated DL Image

Figure 7: Breast Cancer Segment Region

VI. ANN CLASSIFICATION

Artificial Neural Network based classification algorithms [8] are implemented to classify the Breast data base Classification [12] database are two types, Healthy Breast database and Unhealthy Breast database. Classification is mainly performs based on testing and training database features extraction process. The feature includes mean values of breast image, standard deviation of breast image, CNR of breast image, PSNR of breast image, and SSIM of breast images. This all kind of features extracted from both testing and also training database. The ANN algorithm background process is the based on features the database are classifying as class. The class like positive and negative element. This mathematical element based the database are classified.

Mean

$$m = \frac{1}{mn} \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} [I(i,j) - K(i,j)]^2 \quad (17)$$

PSNR

$$psnr = 10 \cdot \log_{10} \frac{\max i^2}{m} \quad (18)$$

CNR

$$cnr = \frac{|S_A - S_B|}{\sigma_o} \quad (19)$$

SSIM

$$SSIM(x,y) = \frac{(2\mu_x\mu_y + C1)(2\sigma_{xy} + C2)}{(\mu_x^2 + \mu_y^2 + C1)(\sigma_x^2 + \sigma_y^2 + C2)} \quad (20)$$

μ_x -average of x

μ_y -average of y

σ_x^2 -variance of x

σ_y^2 -variance of y

σ_{xy} -covariance of x and y

$$c_1 = (k_1L)^2$$

$$c_2 = (k_2L)^2$$

L- Dynamic range of the pixel value

$$k_1 = 0.01 \text{ and } k_2 = 0.03$$

DSSIM

$$DSSIM(x,y) = \frac{1 - ssim(x,y)}{2} \quad (21)$$

x-pixel value of rows,

y-pixel value of columns.

VII. ALGORITHM WORKING MODEL

Figure 8: Algorithm for DL with ANN

VIII. OUTPUT PERFORMANCE

Input Breast Image

Figure 9: Input Breast Image

Figure 10: Filtered Image

Figure 11: DL Mapping Image

Figure 12: Gradient Image

Figure 13: Sobel with Gradient Image

Figure 14: DL Masked Cancer Region

DLL with Morphological Image

Figure 15: Binary Mask

Figure 16: Dilated Binary Image

Figure 17: Holes Filled Image

Figure 18: Breast Region

Figure 19: DL Breast Segment Region

IX. COMPARISON FEATURE PERFORMANCE

Comparison performances of Breast segmentation feature algorithm are shown in table IX. This table is briefly explained about segmentation of breast cancer region. In this paper we have analysis breast image segmentation DL with NN algorithms are performed and it's tested from above tabulation. This tabulation mentioned as different features by breast images. They features are Peak to noise ratio(PSNR), Signal to noise ratio(SNR), Mean, Standard deviation (STD), Contrast to noise ratio(CNR), SSIM. This features peacefully extracted and they are performed. And also the variation is differentiated.

Table 1: Comparison Feature Performance

Feature	SVM	DL	ANN	Proposed
Mean	12	11	7.5	7.56
PSNR	1.0	1.2	1.55	2
STD	5.2	4.2	5.3	4
CNR	13	7	5	5.5
SSIM	0.2	0.33	1.2	2.3

X. CONCLUSION

In this paper, a segmentation approach is performed by DL with ANN segmentation algorithms. The segmentation algorithm mainly to segment breast images, and then extracting cancer region from breast images. The algorithm result shows that the various features from various algorithms and its all are parameters are evaluated. Mainly compared features by segmentation level algorithm.

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