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Dental Image Disease Analysis Using PSO and Backpropagation Neural Network Classifier

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Abstract: ***There exists various segmentation techniques but it still remains challenging task every time due to use of different type of images in each application part. For dental image, segmentation process is applied to each tooth and their parts like root and crown of the required region of interest that carries the useful important information. In the presented work, particle swarm optimization technique is applied to segment the dental images in the input dental radio graphs. Further, the segmented dental images are analysed to detect the disease and its penetration based on different parameters as discussed in result methodology and result section. The disease analysis is made on the basis of textural parameters including entropy, contrast, homogeneity, energy and statistical parameters including standard deviation and variance. A back propagation neural network system is used as classifier for classification of dental diseases. The textural and statistical parameters are made input neurons in order to train the neural network and classification. The results are quite accurate in terms of accuracy in predicting the disease based on the used parameters.***

Keywords: PSO, Image Segmentation, Thresholding, Back[propagation Neural Network

I. INTRODUCTION

Dental Radiograph based human bio-metric information is the latest research area in the biometric identifier domain. The finger print and facial biometric suffers from the tampering problem as they are easy to manipulate. Even the face has the biggest threat of tampering. Face based biometric is not a reliable biometric as face is most susceptible to variation even by small change. However, dental profile is not possible to get tampered. No one would dare to get into it. As this being the costly affair and even the painful should be.

Following dental diseases are targeted in the presented thesis work:

Keratocyst

Ameloblastoma

Dentigerous cyst

However, the database generation using dental based bio-metrics features is not very common and needs a systematic arrangement as it involves the x-ray device for getting the profile. X-ray machines are now-a-days digitized and a digital x-ray of the dental profile may be obtained in just short time. But, the problem is that the taking dental profile is not volunteer in nature. The person under scanner made to be present forcefully.

II. RELATED WORKS

Yeo et al (2005) proposed a competitive learning Algorithm based on Neural Network Model to perform Image Segmentation. The Adaptive Resonance Theory (ART) and the Self- Organizing Map (SOM) has been taken as the basis for this process. [1].

Sobieranski et al (2009) performed an experimentation to describe that the distance metric could also be used as a factor for segmentation. In their experimentation the Mumford-Shah energy function and the Mahalanobis Distance were taken into account for the test. [2].

Tan and Isa (2011) proposed a hybrid mechanism which uses a combination of histogram thresholding and Fuzzy C-means algorithm for Image Segmentation. Initially, this method applies the histogram thresholding method to obtain all uniform regions in a color image. [3].

Zohra et al (2011) have proposed a methodology based on Gray Level Aura Matrices. Here, the segmentation is completely based on the Gray Level Aura Matrix (GLAM) which is derived from the Gray Level Cooccurrence Matrix (GLCM). [4].

The parameter of Multi-scale Roughness measure is used in Image Segmentation by Yue et al (2012). In most cases of segmentation, it is always the desire of a user to have a highly precise segmentation with low computational complexity. The usage of Roughness measure helps to achieve this which approximates the color histogram based on Rough Set Theory. [5].

Taiwo et al. (2013) proposed the technique of cellular neural network in medical image segmentation. In the segmentation of images, cellular neural network is an indispensable field. [6].

Fan et al. (2014) presented a multiregion segmentation based on compact shape prior. The research work presented in this paper is to support the procedure of customized design and manufacturing. As a very important preprocessing step for the industrial design of many applications, the 3D shape of real objects must be scanned and reconstructed in computer systems. [7].

Sprizl et al. (2015) presented a framework for the segmentation of human teeth contours for dental images. An active shape model has been proposed in this paper due to use of similar tooth structure by all the human beings. [8].

III. ALGORITHM

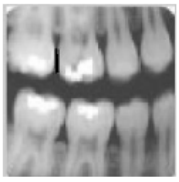
There are many applications in which Clustering is used like Statics, Engineering, Marketing etc. Data mining and Data analysis are main applications in which Clustering is applied. The algo is good when it is able to identify cluster rather than their shapes and also deals with noisy data. The dental radiograph based biometric system starts with image acquisition. Dental Image is acquired using X-Ray image Source. The x-ray image is in gray color format and needs to be binarized in order to obtain the black and white image with white as background and teeth objects as black color.

The image thresholding is done using Otsu algorithm. Otsu algorithm works on the principal of minimum within class variance. Once the threshold T is selected. The image pixels with gray color intensity less than T are made black and those greater than T are made white. This gives the binary image with some noisy pixels in the form of salt and pepper noise. The presented work is implemented in following steps:

- Image Acquisition using X-ray device or online Dental Radiographs data base
- RGB to gray scale conversion
- Gray Image enhancement using histogram equalization
- Image binarization using Otsu Algorithm
- Image Segmentation using PSO algorithm
- Extraction of Segmented area from original gray image
- Gray level c-occurrence matrix extraction of segmented gray image
- Textural and statistical analysis of segmented teeth for disease analysis
- Disease Identification using Back propagation Neural Network

IV. EXPERIMENTS AND RESULTS

The presented algorithm has been tested on number of dental radiographs. Theresults are discussed beloiw in tables:

Original Image	Processed and Segmented Image	Seg. No.	SD	Var.	Entropy	Contrast	Corr.	Energy	Homog.	Disease
		1	43.385	188.156	0.976	0.282	0.948	0.822	0.985	Normal (0.035)
		2	42.289	155.872	0.974	0.4	0.923	0.811	0.981	Normal (0.234)
		3	38.65	127.04	0.733	0.336	0.913	0.859	0.984	Normal (-0.083)
		4	8.825	1.657	0.034	0.046	0.644	0.993	0.998	Keratocyst (0.648)
		5	34.005	72.145	0.526	0.19	0.931	0.904	0.99	Normal (0.140)
		6	23.523	24.561	0.243	0.126	0.882	0.952	0.996	Ameloblastoma Cyst (0.420)
		7	9.816	1.04	0.042	0.056	0.671	0.991	0.998	Ameloblastoma Cyst (0.507)
		8	14.056	4.055	0.083	0.087	0.764	0.982	0.997	Normal (0.291)

Original Image	Processed and Segmented Image	Seg. No.	SD	Var.	Entropy	Contrast	Corr.	Energy	Homog.	Disease
		1	24.614	30.074	0.27	0.133	0.889	0.949	0.995	Ameloblastoma Cyst (0.425)
		2	16.695	9.18	0.119	0.072	0.846	0.979	0.997	Keratocyst (0.779)
		3	23.513	22.854	0.245	0.12	0.891	0.954	0.995	Keratocyst (0.637)
		4	29.152	51.098	0.381	0.156	0.916	0.929	0.993	Normal (0.179)
		5	37.392	101.778	0.605	0.21	0.94	0.892	0.989	Normal (0.093)
		6	39.096	127.417	0.684	0.257	0.934	0.875	0.987	Normal (-0.005)
		7	40.801	142.68	0.853	0.438	0.904	0.834	0.982	Normal (0.092)
		8	37.796	117.107	0.642	0.236	0.934	0.884	0.988	Normal (-0.017)
		9	12.269	7.023	0.061	0.039	0.844	0.991	0.998	Ameloblastoma Cyst (0.480)

Original Image	Processed and Segmented Image	Seg. No.	SD	Var.	Entropy	Contrast	Corr.	Energy	Homog.	Disease
		1	21.987	52.638	0.491	0.532	0.812	0.914	0.985	Normal (-0.965)
		2	16.541	10.636	0.093	0.053	0.894	0.986	0.998	Dentigerous Cyst (1.046)
		3	21.415	22.594	0.169	0.127	0.858	0.971	0.995	Dentigerous Cyst (1.037)
		4	19.605	16.417	0.14	0.068	0.905	0.978	0.997	Dentigerous Cyst (1.202)
		5	28.842	49.322	0.292	0.189	0.895	0.948	0.992	Ameloblastoma Cyst (0.423)
		6	27.075	53.564	0.202	0.165	0.889	0.962	0.995	Ameloblastoma Cyst (0.423)
		7	16.116	10.039	0.079	0.056	0.878	0.987	0.998	Keratocyst (0.885)
		8	18.829	13.882	0.113	0.104	0.845	0.98	0.996	Keratocyst (0.900)
		9	31.679	68.836	0.391	0.213	0.903	0.932	0.991	Normal (0.191)

Type of Cyst	Proposed Algo.			
	No. Of Images Considered	No. If Images Classified Correctly	No. If Images miss-Classified	Accuracy
Normal	10	10	0	100
Keratocyst	10	10	0	100
Ameloblastoma Cyst	10	10	0	100
Dentogerous Cyst	10	9	1	90

V. CONCLUSION

The presented algorithm is designed using the matlab 7.5 version and is under testing phase. Further, the dental radiograph is not readily available for use. There is a dependency of the same on availability of x-ray m/c and even the person willingness. However, the algorithm has been tested on no. of radiographs and a correlation is established between the feature vector and the person bearing the same. The feature vector set has ability to identify the person from the data base if the feature vector set is used for search purposes.

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AUTHOR'S PROFILE

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