Medical Images Verification using Statistical Features and Back Propagation Neural Network

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Abstract

In the present paper, Medical Image Verification using statistical factors and back propagation Neural Network is proposed. Database consists of 200 images (100 image for satisfactory skin cancer, 100 image for unsatisfactory skin), types for image .jpg , .png and .bmp image formats. Database prepared in our conditions. Indeed the images obtained (50 image for satisfactory skin cancer, 50 image for unsatisfactory skin), other images obtained from internet (50 image for satisfactory skin cancer, 50 image for unsatisfactory skin). Testing stage consists of 80 images (20 image for satisfactory skin cancer, 20 image for unsatisfactory skin cancer) from in Al-Seder Hospital and (20 image for satisfactory skin cancer, 20 image for unsatisfactory skin cancer) from internet. The experiment results confirm the effectiveness of the proposed algorithm.

Keyword Back propagation Neural Network, statistical parameters

1. Introduction

A simple and effective recognition scheme is to represent and match images on the basis of color histograms as proposed by Swain and Ballard [2].

An Artificial Neural Network (ANN) is an information processing paradigm that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. It is composed of a large number of highly interconnected processing elements (neurons) working in unison to solve specific problems. ANNs, like people, learn by example. An ANN is configured for a specific application, such as pattern recognition or data classification, through a learning process. Learning in biological systems involves adjustments to the synaptic connections that exist between the neurons. This is true of ANNs as well [3].

The applications of ANNs in medical image processing have to be analyzed individually, although many successful models have been reported in the literature. ANN has been applied to medical images to deal with the issues that cannot be addressed by traditional image processing algorithms or by other classification techniques. By introducing artificial neural networks, algorithms developed for medical image processing and analysis often become more intelligent than conventional techniques [4].

For updated related works, Andrius Ušinskas etal described a new method to segment ischemic stroke region on computed tomography images by utilizing joint features from mean, standard deviation, histogram, and gray level co-occurrence matrix methods. Presented unsupervised segmentation technique shows ability to segment ischemic stroke region [11]. Researcher FEI GAO has a master thesis about a survey of image segmentation methods and their possible applications to identify Cervical Intraepithelial Neoplasia (CIN) [12]. Huajun Ying *et al.* proposed an algorithm to detect the optical disk location in retinal images depends on the fractional dimension [13]. Dr. J. Abdul Jaleel *et al* .presented a paper about the early detection of skin cancer using Back-Propagation Neural Network. It classifies the given data set into cancerous or non-cancerous [14].Ahmed Sami introduced A master thesis about bone cancer and it has been classified into groups based on a variety of different features of statistical and neural network with the deployment of reverse discrimination images represent different samples of bone disease [20].

2. The Segmentation of Image

The autonomous machine perception task is achieved by a number of steps. The initial step is the segmentation of the image into a meaningful region or object. When analyzing a region or object in an image it is vital that we distinguish between the object of interest and the background. From this division, the object can be identified by its shape or from other features. The segmentation task usually starts with the extraction of the limits of the object. These limits are commonly called "edges". Moreover, an object contour, which may be constructed from the compacted information provided by these edges, can facilitate the measurements on the object [1].

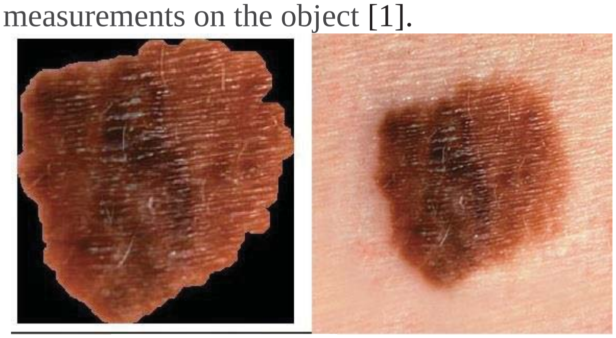

Figure 1: segmentation of the image(the right is the original image while the left is the segmented image using Otsu's method)

3. Feature extraction and Back propagation neural network

Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy [3]. There are different types of features such as global, grid, texture, and local feature. Global features provide information about specific cases concerning the structure of the signature. Many object recognition systems use global features that describe an entire image. Most shape and texture descriptors fall into this category. Such features are attractive because they produce very compact representations of images, where each image corresponds to a point in a high dimensional feature space. As a result, any standard classifier can be used[4]. There are many Global features such as in Table(1) [5.6].

4. The Structure of Neural Network

We used a feed forward backpropagation neural network with adaptable learning rate. The NN have 3 layer; an input layer (10 neuron), a hidden layer (50 neuron) , and output layer (2 neuron), We have put a desired output 1 for Sick skin images and 0 for Intact skin images. The activation function used is the tan sigmoid function, for both the hidden and the output layer. The input to the neural network is the feature vector containing 10 components, the neural network classifier structure consists of Input layer, Hidden layer and Output layer. The hidden and output layer adjusts weights value based on the error output in classification. The output of the network is compared with desired output. If both do not match, then an error signal is generated. This error is propagated backwards and weights are adjusted so as to reduce the error. The modification of the weights is according to the gradient of the error curve, which points in the direction to the local minimum. In BPN, weights are initialized

Table (1): Statistical Features Equations

Statistical	Mathematical Formula
Mean	$m=\sum_{i=0}^{K-1} r_i g(r_i)$
Stander Deviation	$\mu_n(r)=\sum_{k=0}^{K-1}(r_i-m)^n g(r_i)$
Perimeter	$T=\sum_{i=1}^{L} d_i=\sum_{j=1}^{L}\lvert X_i-X_{i+1}\rvert$
Area	$M_{KL}=\sum_{i=1}^{K}\sum_{j=1}^{L} i^k j^l A(i,j)$
Centroid	$j_c=\frac{\sum_i\sum_j j\times A_{i,j}}{\sum_i\sum_j A_{i,j}}$ $i_c=\frac{\sum_i\sum_j j\times A_{i,j}}{\sum_i\sum_j A_{i,j}}$
Equiv.diameter	$D=max_{X_k,X_l\in R}\, d(X_k,X_l)$
Euler	$E=C-H$
Roundness	$\lvert k(t)\rvert^2 \triangleq \left(\frac{d^2x}{dt^2}\right)+\left(\frac{d^2y}{dt^2}\right)^2$
B Box	$y\ max$ $xmax$ $ymin$ $x\ min$
Entropy	$E=\sum_{i=0}^{L-1} r(i)\log g(r_i)$

randomly at the beginning of training. There will be a desired output, for which the training is done. Supervisory learning is used here. The aim of this network is to train the net to achieve a balance between the ability to respond correctly to the input patterns that are used for training [10]. During forward pass of the signal, according to the initial weights and activation function used, the network gives an output. That output is compared with desired output. If both are not same, an error occurs.

Error = Desired Output - Actual Output

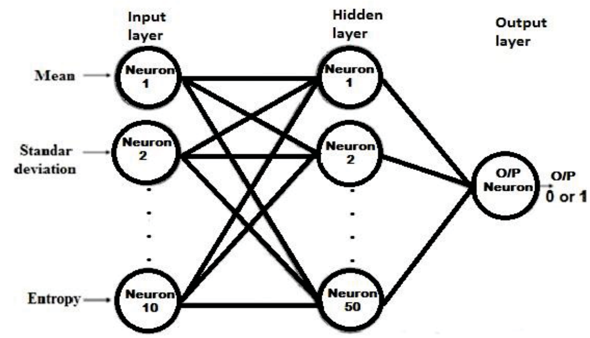

Figure 2: The Neural Network Structure.

5. Results and Experiments

In this section a detailed experimental skin image Recognition has been presented. We have used Data base contain (50 image for satisfactory skin cancer, 50 image for unsatisfactory skin), other images obtained from internet (50 image for satisfactory skin cancer, 50 image for unsatisfactory skin).

Testing stage consists of 80 images (20 image for satisfactory skin cancer, 20 image for unsatisfactory skin cancer) from in Al-Seder Hospital and (20 image for satisfactory skin cancer, 20 image for unsatisfactory skin cancer) from internet.

Figure (2) show the sample of Sick skin images while figure (3) show the sample of intact skin images testing for one person in this paper.

The next stage is feature extraction concerns finding for images. To be able to recognize Sick skin images or intact skin images testing for one person in automatically. In feature extraction, we generally seek invariance properties so that the extraction process does not vary according to chosen (or specified) conditions. Features are sensitive to clutter and occlusion. As a result it is either assumed that an image only contains a single object, or that a good segmentation of the object from the background is available[4].

Table 2: Statistical features for image 1, image 2 and image 3 in sick skin images and intact skin images.

no.	Statistical	Image -1-		Image -2-		Image -3-	
		Intact	Sick	Intact	Sick	Intact	**Sick**
1	Mean	145.205	134.332	130.310	133.478	149.894	**130.116**
2	Stander Deviation	21.675	19.999	20.3604	39.486	17.728	**31.328**
3	Perimeter	0	4	0	0	6	**6.828**
4	Area	1	4	1	1	6	**5**
5	Centroid	8 164	12.500 125.500	90 19	10 102	62.000 30.500	**1.200** **41.400**
6	Equiv.diameter	1.128	2.256	1.1284	1.1284	2.764	**2.523**
7	Euler	1	1	1	1	1	**1**
8	Roundness	Inf	3.1416	Inf	inf	2.0944	**1.3475**
9	B Box	7.500 163.500 1.000 1.000	11.500 124.500 2.000 2.000	89.5000 18.5000 1.0000 1.0000	9.500 101.500 1.000 1.000	60.500 29.500 3.000 2.000	**0.500** **39.500** **2.000** **4.000**
10	Entropy	6.451	6.191	6.0238	7.149	5.9954	**6.926**

Table 3: Statistical features for image 4, image 5 and image 6 in sick skin images and intact skin images.

no.	Statistical	Image **-4-**		Image **-5-**		Image **-6-**	
		Intact	Sick	Intact	Sick	Intact	Sick
1	Mean	151.507	134.852	144.851	144.379	156.216	138.080
2	Stander Deviation	56.4351	44.8704	21.391	37.924	25.748	34.923
3	Perimeter	4	95.1127	2	0	4	13.656
4	Area	4	453	2	1	3	19
5	Centroid	127.500 38.5000	90.4680 9.8631	40.500 133.000	44 40	198 174	63.210 44.947
6	Equiv.diameter	2.2568	24.0162	1.595	1.128	1.954	4.918
7	Euler	1	1	1	1	1	1
8	Roundness	3.1416	0.6293	6.283	Inf	2.356	1.280
9	B Box	126.500 37.5000 2.0000 2.0000	73.5000 0.5000 30.0000 25.0000	39.500 132.500 2.000 1.000	43.500 39.500 1.000 1.000	196.500 173.5003.0 00 1.000	60.500 42.500 5.000 5.000
10	Entropy	7.0156	7.3504	6.4235	6.8462	6.5226	6.9203

Figure (3) : sample of Sick skin images

In this research was used back propagation neural network and that the results of accurate and efficient in image verification and distinctiveness . Based network in its work on the values of the Statistical features of the image. Where the network receives mono a matrix include 10 values are the results of the Statistical features of the image . To the output for neural network verification image if Sick skin images or Intact skin image.

Figure (4): sample of intact skin images

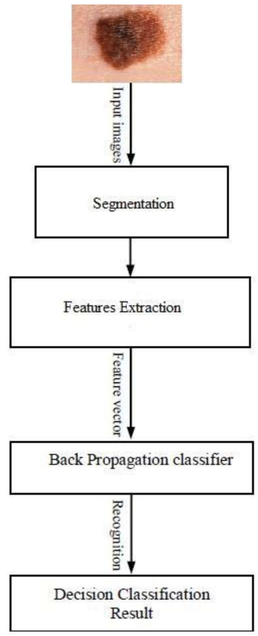

Figure (5) :Diagram for our method

Mean square error performance function (MSE) and Mean absolute error performance function (MAE) to find out the amount of divergence in between them using Elman neural network and which is defined as discrimination and signature and identify the person concerned.

phase begins training the network where they are taking the values of the results of the features of the input of the network where the network is trained on error rate (0.001) and the number of cycles of (1000) cycle to reach the desired goal concept of used Mean square error performance function (MSE) and Mean absolute error performance function(MAE) to find out the amount of divergence in between them using neural network and which is defined as discrimination and image and identify the person concerned.

Table 4 MSE and MAE for Intact skin images

No. of image	MSE	MAE
1	2.2589e-021	1.9670e-011
2	3.5296e-021	2.4648e-011
3	6.9190e-021	3.4949e-011

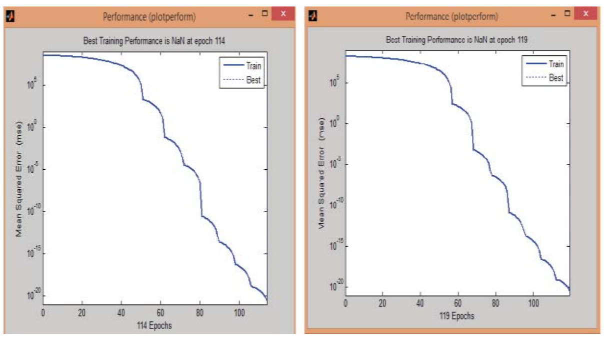

Figure 6 performance NN effects for Intact skin image(1 and 2).

Table 5 MSE and MAE for Sick skin images

No. of image	MSE	MAE
1	2.8594e-021	2.2389e-011
2	1.9650e-022	1.1833e-011
3	1.7299e-021	1.7512e-011

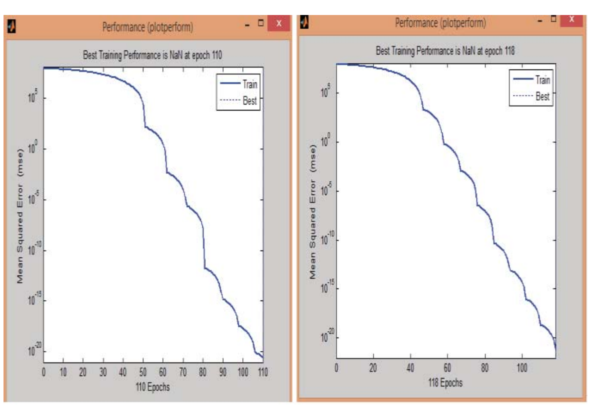

Figure 7: performance Neural Network effects for sick skin image(image 1 and image 2).

Some of the suggestions of artificial neural network used in MATLAB:-

net.trainFcn = 'trainlm'; for training function
net.trainParam.epochs = 1000; for max number of iterations
net.trainParam.lr = 0.05; for the learning rate
net.performFcn1 = 'mse'; Mean square error performance function(MSE) net.performFcn2 = 'mae'; Mean absolute error performance function (MAE)
net.divideFcn = 'dividerand'; how to divide data

[net,tr] = train(net, input, target); for training

5. Conclusion

When the technique of neural network was applied on Data base contain sick skin images and Intact skin images, the fowling remarks can be considered in this paper:

1 - We applied ten statistical parameters as input of ANN. After training, five of them distinguishes the type of test image(sick or intact).

2- In sick skin image Mean square error performance function(MSE) and Mean absolute error performance function(MAE) are Convergent values while in Intact skin image are spaced.

3-Tabel 6 showed the final results for greater and smaller Statistical features in sick skin images and Intact skin images.

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Table 6: Statistical Criteria results in paper

No.	Statistical Criteria	Sick Image
1	Mean	Greater
2	Stander Deviation	Greater
3	Perimeter	Variable
4	Area	Less
5	Centroid	Variable
6	Equivalent diameter	Greater
7	Euler	No change
8	Roundness	Variable
9	B Box	Variable
10	Entropy	Greater

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