Constructive Neural Network Algorithm for Breast Cancer Detection

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ABSTRACT

The traditional neural network methods are mainly concerned about the problem of choosing proper network architecture using test and error method. But this method leads to many other problems like under fitting or over fitting. To overcome these problems and to detect cancer effectively, the constructive neural network method has been proposed. The proposed methomainly used to construct the topology by adding neurons during the training segment and to extract texture and color features. These extracted features are used for simulation to detect breast cancer cells effectively.

Keywords: *Artificial neural network, Constructive neural network, Breast Cancer.*

1. INTRODUCTION

Artificial neural networks (ANNs) remain the accurate model enthused in the performance of the brain that can be subjugated in ordering and federation problems and these can be used in the numerous fields ,efficiently with pattern appreciation, control tasks stock market calculation. Generally the ANN is inspired by the way bio-logical nervous systems, for instance brain.,etc.[1]-[2] .The novel structure of the information processing system is the important element of this model. To solve certain problems the novel structure of the information has more number of highly organized processing elements(neurons) working in unity. An artificial neuron is a piece of equipment with one output and many inputs. The neuron consists two modes of operation, the using mode the training mode. In the training mode, For a certain input patterns the neuron can be trained to fire (or not) in the train mode. The associated output turn into the current output when a taught input pattern is perceived at the input, In the using mode. The firing rule will decide whether to fire or not with respect to the threshold value. If the input pattern does not belong in the taught list of input patterns.

Feed-forward ANNs allow signals to travel one way in the network from input to output. There is no feedback (loops) i.e. the output of any layer does not affect that same layer. Feed-forward ANNs have a habit of to be straight forward[14]-[6]networks that associate inputs with outputs. They are broadly used for the purpose of pattern recognition. This type of organization is also referred to as bottom-up or top-down.

Feedback networks can have signals travelling in both directions from input to output and vice versa by introducing loops in the network. Feedback networks are very powerful and can get enormously complicated. Feedback networks are dynamic. Till they reach an equilibrium point the state of the feed forward network will change continuously. They remain at the equilibrium point until the input changes and a new equilibrium needs to be found. Organizations

2. RELATED WORKS

The topological structure describes the architecture of an ANN. The topological structure is nothing but the transfer function of each node in the network and overall connectivity of the network.

2.1 Radial Basis function network (RBF)

By using a supervised training algorithm the Radial Basis Function is nothing but a feed forward network. The Radial Basis Function network architecture is designated from a class of function. These are named as basis function which are arranged with the a single hidden layer of the elements. The Radial Basis Function networks have several advantages more than that of Back propagation due to the fast propagation training and due to the performance of the Radial Basis Function hidden units. These are less vulnerable to problems along with non-stationary inputs.

2.2 Self-organizing map

The Self-Organizing Map comes under the classifier of competitive learning network. It is one of the most standard neural network models. During the learning the SOM no need to have human intercession because it is depends on the unsupervised learning, and it should have to be known about the input data characteristics. The SOM affords a topology preserving mapping from the high dimensional space to map units. The two-dimensional lattice and thus the mapping is a mapping from high dimensional lattice will for by a neurons array map units or by a map units. These mapping will be from high-dimensional space to a map units. The meaning of the property of the topology is that the mapping preserves the relative distance among the points. The points are mapped to near by map units in the SOM which are closer each other in the input space. The SOM can assist as a cluster analyzing unit of the high-dimensional data also it has the ability to generalize. The Generalization capability means that the network can recognize or describes the inputs it has not ever come across before.

2.3 Multi-layer Perceptron Network (MLP)

It consists of a feed-forward linked network with an input layer of neurons, and a output layer. Between the input and output layer it consist number of hidden layers. So it is called as multi-layer [3] feed forward network. Through the activation functions which are classified in the hidden layer will reveal the output and the actual value.

3. PROPOSED METHODOLOGY

C-Mantec[5](Competitive Majority Network Training Error Correcting) is a new neural network and it comes under the constructive neural network algorithm .This algorithm makes race among neurons to build the compressed architectures [12] and cooperation between neurons [7] to achieve the output of the network by using the modified perceptron learning rule . The C-Mantec network consists of one hidden layer between the input and output layer. The hidden layer passes the information to an output neuron which contain majority role that will provide the output network . The majority used as a output function the network because it will provide the good computational capabilities compared to the set of linearly separable functions. The majority neuron can be implemented by setting all the synaptic weights to 1 and the umbra value to $M/2$ .where M is the number of neurons in the hidden layer . The constructive neural network algorithm produces very compressed neural architectures with the good generalization capability.

Thermal Perceptron Rule:

The C-Mantec algorithm uses the thermal perceptron rule [19]at the single neuron level. While the neurons contest for new incoming information and the information rises it guarantees constancy of the assimilated knowledge .After adding the new units to the network the Competition makes it possible.

Deliberate a neuron, demonstrated as a bias value, contains two response states: TRUE=1 =Cancer present and FALSE=0=Absence of cancer, getting input from N incoming continuous signals. The input signal is multiplied with the weight if the value is greater than the bias value the neuron will fire the output.

S= 1 (ON) presence of cancer

0 (OFF) Absence of cancer; (3.1)

where φ is the potential of the neuron defined as

$$\Phi = w_i - b_i \quad (3.2)$$

Where Φ is the value of the input and t is the target value of the input and which is linked to the output by the weight w_i. The variation between the thermal perceptron rule and the original perceptron learning rule and is that , the

thermal perceptron learning rule joins the temperature factor, T_{fac} which is indicated by,

$$\Delta wi = (t - S)\ \psi i Tfac\ , \qquad (3.3)$$

where,ψ is the value of input unit *i* which is connected to the output by weight *wi* and *t* is the target value of the existing input. The variation between the thermal perceptron rule and the original perceptron learning rule and is that, the thermal perceptron learning rule joins the temperature factor, T_{fac}.It is same like a simulated annealing procedure.

$$Tfac=(\ T/T0)\exp\{-|\varphi|/T\} \qquad (3.4)$$

Where *T* is theactual temperature, and *T*0 is the initial temperature value set at the beginning of the learning process, and φ is the synaptic potential .According to the value of parameter m the temperature will reduced gradually from lower iterations to the high iteration(*Imax).*As following the linear equation the temperature will reduced gradually.

$$T=T0-mI \qquad (3.5)$$

The values of *T*0, *m* and *Imax* will depends on the progression of the *T*. This algorithm was not much effected in order to decrease the space of the parameter. The *m* value was assumed as to decrease from *T* to 0 at the completion of the permitted number ofiterations, i.e., when *I = Imax*. Additionaly, we declared that it was not required to use dissimilar values of *T*0 when the input measurement was fixed and the*T*0 value equals to the number of input variables, *N*.

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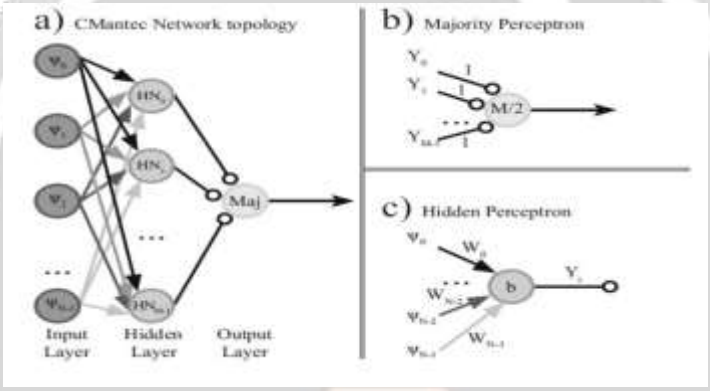

Fig -1 C-Mantec Architecture

3.1 FEATURE EXTRACTION

Feature extraction [6] is used to reduce the amount of resources required to define a large set of data. Investigating with great number of variables commonly requires a huge amount of memory. Texture feature [17] gives us the information about spatial arrangements of color or intensities in an image. MATLAB tool is used to extract the features from the input(breast cancer)image. These Extracted values are converted into hexadecimal value and these values are loaded into the xilinx software to train the algorithm to detect the normal and abnormal images. The Texture features extracted are contrast, correlation and etc, The Color features extracted are Mea, Standard deviation, Entropy.

Table 1.1 Feature Extraction Results

FEATURES	NORMAL	ABNORMAL
Contrast	0.3212	0.5425
Correlation	0.7918	0.9527
Homogeneity	0.8201	0.9310
Energy	0.1857	0.1342
Entropy	167	215
Mean	4.1741e+04	8.8184e+04

4. EXPERIMENTAL RESULTS

The network is trained and now a new input image is being given, for example if the network is trained with a abnormal breast cancer image then if the new image given is normal image then the output will be displayed as No Cancer Cell Detected otherwise it will be Cancer Cell Detected.

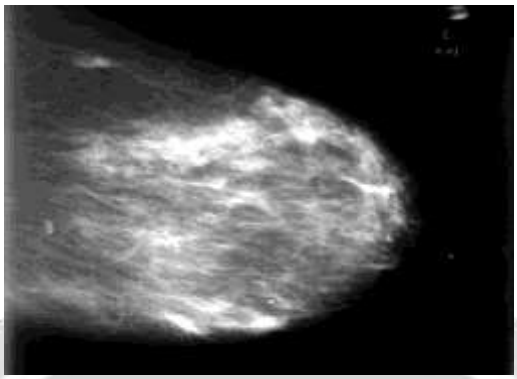

Fig -2 Normal image

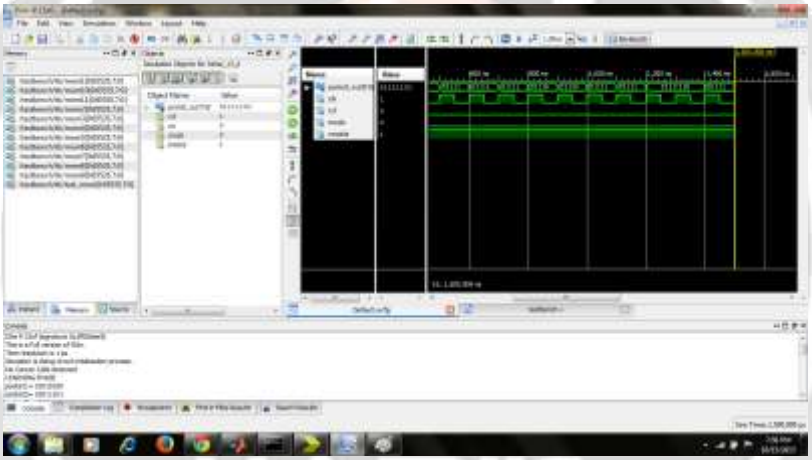

Fig -3 Absence of Cancer

As the network was trained with abnormal image when a new image is given which is also a abnormal image then the network is classified as cancer cell detected and if the new image is a normal then the network will be classified as no cancer cell detected.

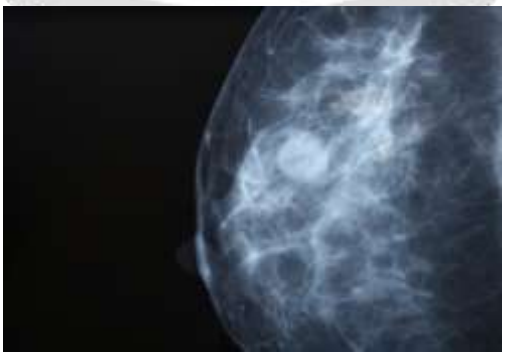

Fig -4 Abnormal Image

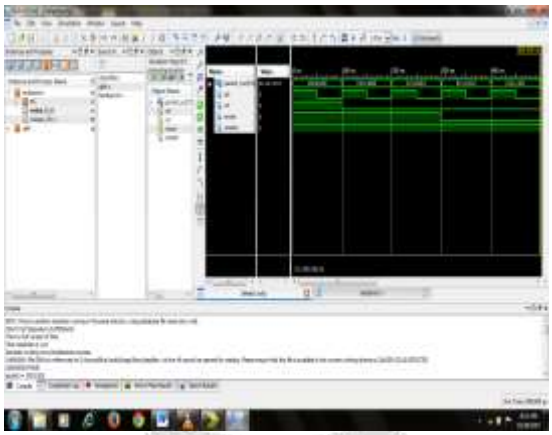

Fig -5 Detection of Presence of Cancer

5. CONCLUSION

In this paper, the C-Mantec neural network constructive algorithm has been used for the purpose of choosing proper and compact architecture and for the classification purpose. It is mainly used to reduce the size of network architecture, So that cancer cells have been detected and classified effectively. Since the algorithm can able to classify the normal and abnormal cancer cells depending on the datasets, breast cancer image have been used and features such as texture and colors are extracted and classified using virology simulator. The simulation results show that the proposed algorithm detecting the cancer cells effectively while comparing traditional classification methods.

6. REFERENCES

[1] I. Gómez, L. Franco, and J. Jerez, "Neural Network Architecture Selection: Can Function Complexity Help?," Neural Process Letter. Vol. 30, pp. 71–87, 2009.

[2] D. Hunter, Y. Hao, M. Pukish, J. Kolbusz, and B. Wilamowski, "Selection of proper Neural Network Sizes and Architectures—A comparative study," IEEE Transaction. Industrial. Application., Vol. 8, no. 2, pp. 228–240, May 2012.

[3] Liang Lu, Camilo Ordonez, Emmanuel G. Collins, Jr. and Edmond "Application of Artificial Neural Networks for the Analysis of Microarray Cancer Data", Springer,2010

[4] AhmetMert, NiyaziKilic, Ayd_n Akan, "Breast Cancer Classification by Using Support Vector Machines with Reduced Dimension"- IEEE Transaction on Neural Network (2010)

[5] N. Z. Supardi, M. Y.. Mashor,N. H. Harun,F. A.Bakri, R. Hassan "Classification of Blasts in Acute Leukemia Blood Samples Using K-Nearest Neighbor"- (2010)

[6] Luque-Baena1, Daniel Urda, Jose Luis Subirats, Leonardo Franco Jose "Applications of Genetic Algorithms and Constructive Neural Networks for the Analysis of Microarray Cancer Data "(2013) Science Direct

[7] J. Subirats, L. Franco, and J. Jerez, "C-Mantec: A Novel Constructive Neural Network Algorithm Incorporating Competition between Neurons," Neural Network., Vol. 26, pp. 130–140, 2012.

[8] Lovely Professional University, Phagwara, India,"Cancer Detection Using Adaptive Neural Network" International Journal of Advancements in Research & Technology, Vol1, No. 4, September-2012.

, [9] Francisco Ortega Zamorano, José M. Jerez, and Leonardo Franco, Senior Member, IEEE "Fpga Implementation of the C-Mantec Neural Network Constructive Algorithm"

[10] "Constructive Neural Networks to Predict Breast Cancer Outcome by Using GeneExpressionProfiles"DanielUrda, Jos´e Luis Subirats, Leo Franco, and Jos´e Manuel Jerez, Springer 2012.