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An Intelligent System for Lung Cancer Diagnosis Using Fusion of Support Vector Machines and Back Propagation Neural Network

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Abstract: ***Cancer is the most important cause of death for both men and women. The early detection of cancer can be helpful in curing the disease completely. So the requirement of techniques to detect the occurrence of cancer nodule in early stage is increasing. A disease that is commonly misdiagnosed is lung cancer. Neural Networks (NNs) play a vital role in the medical field in solving various health problems like acute diseases and even other mild diseases. Earlier diagnosis of Lung Cancer saves enormous lives, failing which may lead to other severe problems causing sudden fatal end. Its cure rate and prognosis depends mainly on the early detection and diagnosis of the disease. This thesis provides a Neural Network and SVM model for early detection of lung cancer. The model consists of an input layer, a hidden layer and an output layer. The network is trained with one hidden layer and one output layer by giving twelve inputs. One of the most common forms of medical malpractices globally is an error in diagnosis. By using the fusion of SVM and BPNN we achieved the accuracy of 98%.The performance simulation is taken place in MATLAB 7.10 environment. The MATLAB has inbuilt Neural Network toolbox and SVM has been implemented using two steps training and testing phases.***

Keywords: SVM, Neural Network, Lung Cancer, Survival Rate

1. Introduction

Lung cancer is the leading cause of cancer deaths in both women and men. It is estimated that 1.2 million people are diagnosed with this disease every year (12.3% of the total number of cancer diagnosed), and about 1.1 million people are dying of this disease yearly (17.8% of the total cancer death) [1]. The survival rate is higher if the cancer is detected at early stages. The early detection of lung cancer is not an easy task. About 80% patients are diagnosed correctly at the middle or advanced stage of cancer [2]. Computer-aided diagnosis sys-tem is very helpful for radiologist in detection and diagnosing abnormalities earlier and faster [3]. The computer aided diagnosis is a second opinion for radiologists before suggesting a biopsy test finally compare this with individual SVM and BPNN to show the improvement in proposed work. [4]. In recent research literature, it is observed that principles of neural networks have been widely used for the detection of lung cancer in medical images [5].For classification of lung cancer, few methods based on neural network have been reported in the literature. Abdulla et al. [6] proposed a computer aided diagnosis based on artificial neural networks for classification of lung cancer. The features used for the mode of the area of the new pre classification are area, perimeter and shape. The maximum classification accuracy obtained is 90%.Camarlinghi et al. [7] proposed a computer-aided detection algorithm for automatic lung nodule identification. The sensitivity obtained is 80% with 3 FP/scan. Al-Kadi et al. [8] proposed classification method based on fractal texture features. The classification accuracy obtained is 83.3%. van Ginneken et al.[9] compared and combined six computer aided detection algorithms for pulmonary nodules. The combination of six algorithms is able to detect 80% of all nodules at the expense of only two false positive detections per scan and 65% of all nodules with only 0.5 false positives. Cascio et al. [10] proposed computer-aided detection (CAD) system for the selection of lung nodules in computer tomography (CT) images. The detection rate of the system is 88.5% with 6.6 FPs/CT on 15 CT scans. A reduction to 2.47 FPs/CT is achieved at 80% efficiency. But in proposed work, we will show the efficiency of the proposed work by hybridization of SVM and BPNN. Then finally compare this with individual SVM and BPNN to show the improvement in proposed work.

2. Proposed Methodology

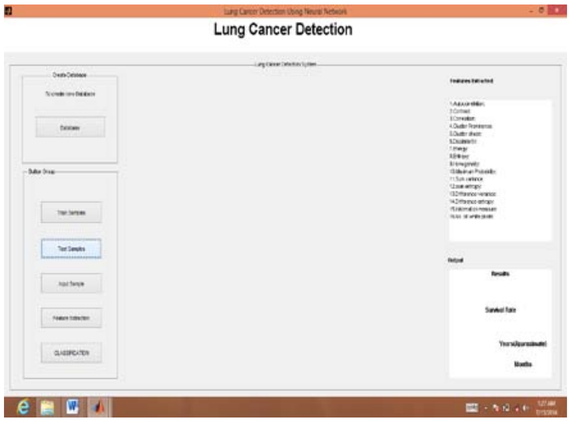

Figure 1: Lung Cancer Detection

Above **Figure 1** shows the main working of the project of the lung cancer detection using the neural network. The project contains two section , the first section is called the training section and the another section is called the testing section .In the training section , the system is trained on the basis of affected diacom images taken from the medical institutes [11]. The first process of the training is the feature extraction. To extract the features, the system requires the training folder which can be uploaded using a button provided at the GUI. In the same manner the user will have to specify that through which folder he has to confirm the images.

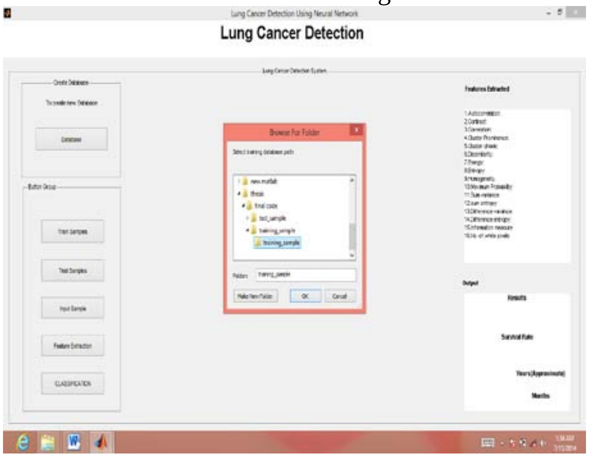

Figure 2: Training Section

Above **Figure 2** shows the training section of project. The project contain two section, the first section is called training section. Training is done by using Neural network as well as SVM method. Both of the classifiers are used for traning and the section of testing. Traning section is uploaded the tested diacom images that has been tested by both of the classifier. To extract the features, the system requires the training folder which can be uploaded using a button provided at the GUI.

Figure 3: Training System uploaded

Above **Figure 3 shows** that the system is trained on the basis of diacom images taken from the medical institute.

Figure 4: Input Image

Above **Figure 4** shows the input image that has been taken for the training of the image.

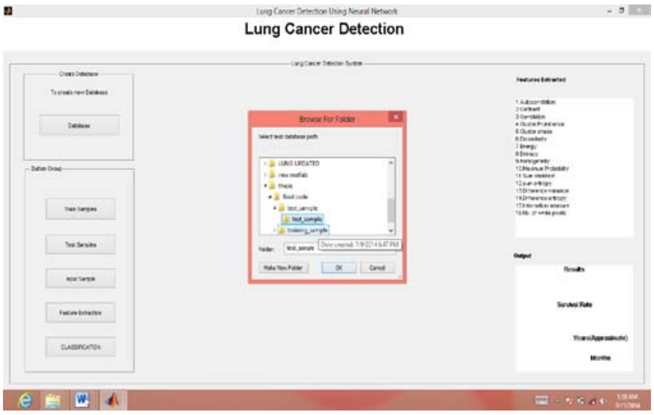

Figure 5: Testing section

Second section is shown by **Figure 5** that is called testing section, that include affected or not affected..testing section defines the original output of the diacom images.

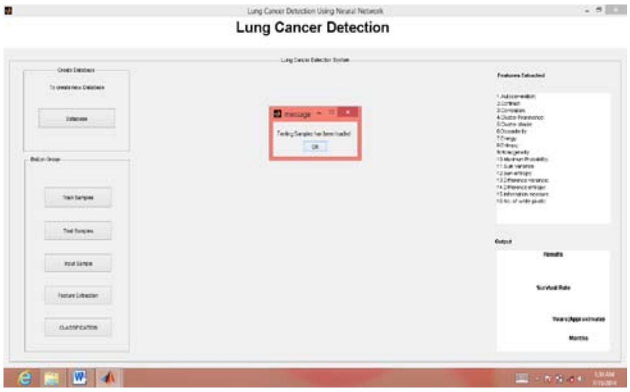

Figure 6: Testing is done

Above **Figure 6** shows that testing is done on the image that has been inputted to the system.

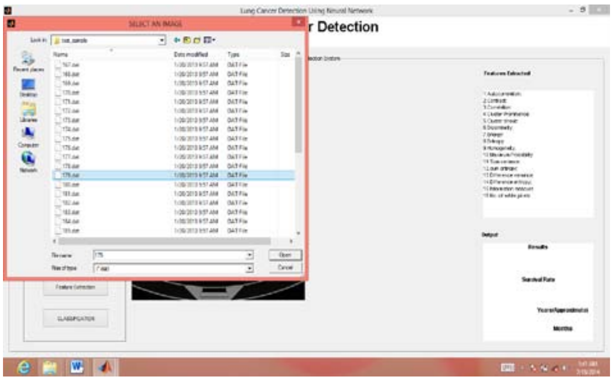

Figure 7: Select image for feature extraction

Above **Figure 7** shows the window for the extraction of features of the inputted image.

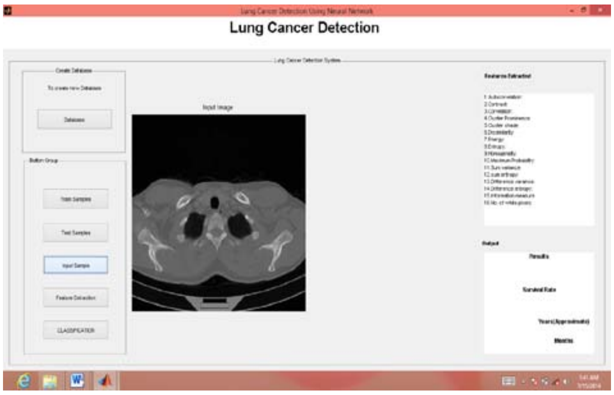

Figure 8: Feature Extraction Process

First process of the training is feature extraction feature extraction describes the different types of symptom's that's bring in a logical way feature extraction is done by Principle Component Analysis.

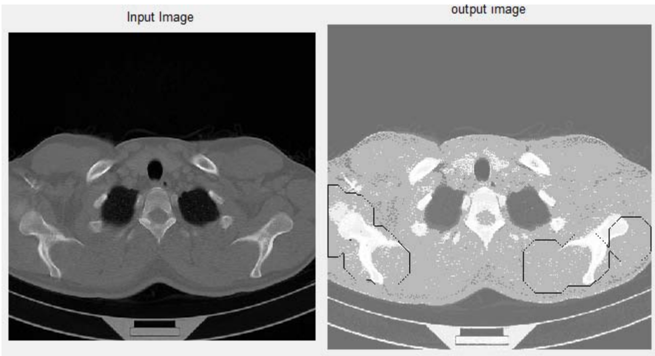

Figure 9: Feature extractions done

Above **Figure 9** shows that after the feature extraction classification is done of the lung cancer detection.

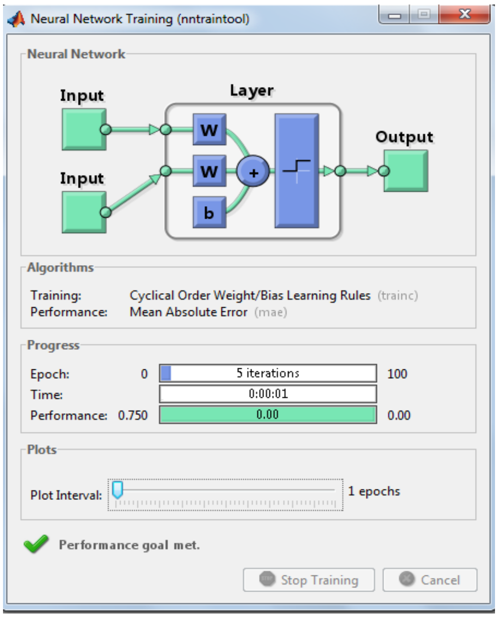

Figure 10: Neural network toolbox

Above **Figure 10** shows that for classification neural network has been used, It has 5 iterations that has been used. In proposed neural network 2 input layers, 3 hidden layers and 1 output layer has been used.

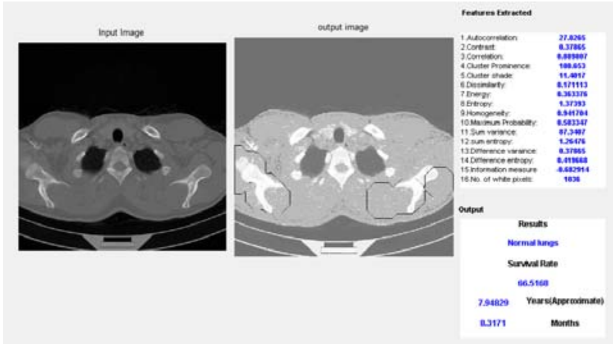

Figure 11: Classification done

Above Figure 11 Shows that classification is done after applying SVM [12] and neural network only or in hybridisation.

3. Pseudo Code of Implementation

do
for (Neural Network)
tmp = sigmoid(I)
for I = 1 to element_second_layer
if tmp is greater than θi
yi =tmp
flag = check_with_expected()
if flag is equal to false
adjust_weight()
return false
else
yi = 0
I □weighted sum of y
tmp = sigmoid(I)
if tmp > θi
flag = check_with_expected()
if flag is equal to false
adjust_weight()
return false
else
return confirm
else
return negative
do
for (SVM)
initialize radial basis kernel function for training

- Operator$_1$: substitute one existing input feature with one unselected variable.
- Operator$_2$: add one input feature
- Step 1: do for each Operator$_k$, k=1,2
- Step 2: do for each variable i=1, … ,93 ($i \neq$ the variable selected as input features)

1. Trial new SVM: SVM*=Operator$_k$ (SVM)
2. ROC evaluation;
3. If k=2, i=93, and SVM is not replaced, stop construction.

- parameter C and σ are selected for testing
- matching : if yes = stop
- if no= go ahead

4. Results and Discussion

In result and discussion figure of performance measurement shows the accuracy of SVM is 89% and accuracy of BPNN is 98%.But the result of both SVM+BPNN is eual to 99%.That accurate the result of the given.

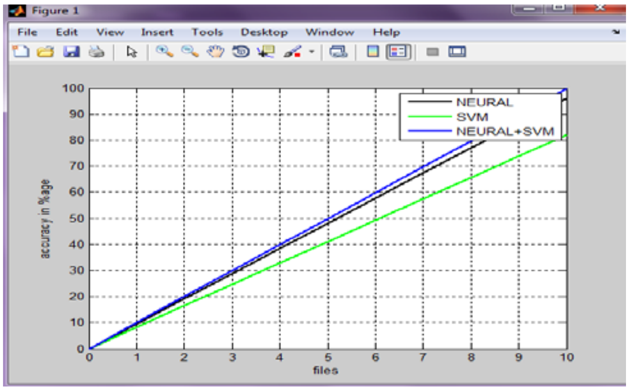

Figure 12: Performance measurement

Above figure shows that the accuracy of detecting cancer using SVM and Neural Network. It has been concluded that neural accuracy rate is 98% while SVM accuracy rate is 89 %. Initially the best optimized ANN is obtained by varying various parameters of network like hidden nodes, training percentage for training ANN, number of epochs. After the successful network have been developed it is then ready for classification process. The following Table shows the result obtained from classification process using SVM and Neural Network.

Table 1: SVM, NN versus NN&SVM

Classifier	Accuracy
SVM	89 %
Neural network	98 %
SVM +Neural Network	99%

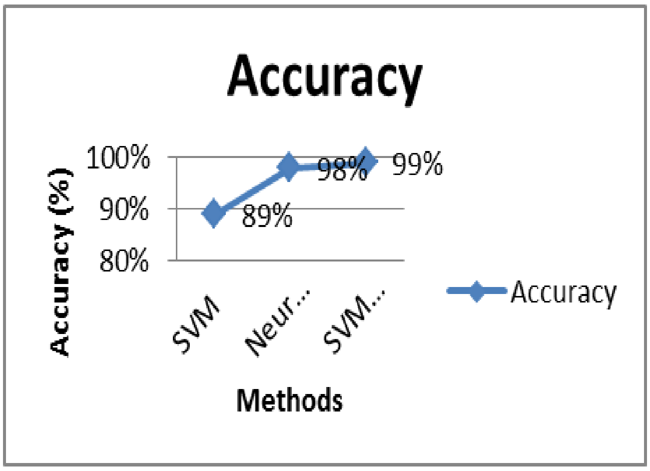

Figure 13: Accuracy Performance

5. Conclusion and Future Scope

Cancer is the most important cause of death for both men and women. The early detection of cancer can be helpful in curing the disease completely. So the requirement of techniques to detect the occurrence of cancer nodule in early stage is increasing. A disease that is commonly misdiagnosed is lung cancer. Neural Networks (BPNNs) [13] play a vital role in the medical field in solving various health problems like acute diseases and even other mild diseases. Earlier diagnosis of Lung Cancer saves enormous lives, failing which may lead to other severe problems causing sudden fatal end. Its cure rate and prognosis depends mainly on the early detection and diagnosis of the disease .This model prevents the cases of wrong diagnosis and in turn delay in proper diagnosis, this feature enhances its usability given that lung cancer is kind of disease which can only be cured if an early diagnosis is available to patient. Prognosis of early diagnosis of Lung cancer with BPNN models has the best performance in large data sets and for more accuracy after that result has been passed through SVM classifier, but the hybridization leads to more enhancements [14, 15]. We get the accuracy of this proposed method i.e fusion of SVM and NN is 99%, 98% by using neural and by using SVM it is 89 %

Future Scope lies in the technique where we can use BFO, Bacterial foraging optimization algorithm (BFOA) has been widely accepted as a global optimization algorithm of current interest for distributed optimization and control. BFOA is inspired by the social foraging behavior of *Escherichia coli*. BFOA has already drawn the attention of researchers because of its efficiency in solving real-world optimization problems arising in several application domains. The underlying biology behind the foraging strategy of *E.coli* is emulated in an extraordinary manner and used as a simple optimization algorithm. This chapter starts with a lucid outline of the classical BFOA. It then analyses the dynamics of the simulated chemotaxis step in BFOA with the help of a simple mathematical model. Taking a cue from the analysis, it presents a new adaptive variant of BFOA, where the chemotactic step size is adjusted on the run according to the current fitness of a virtual bacterium.

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