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RESEARCH ARTICLE

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IMPLEMENTATION OF NON LINEAR NEURAL WITH IMPROVED FEATURE EXTRACTION TECHNIQUE FOR DETECTION AND CLASSIFICATION OF BRAIN TUMOUR

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ABSTRACT
This paper presents distinguished methodology for analysis, detection and classification of tumour cells from the MRI images of the brain. Many methodologies are involved and proven their success in detecting, analysing and classification of tumour cells from MRI images of brain, but each proposed methodologies has its own challenges in its detection, accuracy computational complexity and performance. These methods failed to develop an automated system or assisted system for physicians to analyse, detect and classify tumor cells. This paper presents advanced feature extraction techniques to represent the characteristics of the various tumours and also helps to distinguish tumour cells to non tumour cells, there by applying feed forward back propagation neural network technique to classify benign and malignant tumours. The experimental results show the classification accuracy is more promising. Here, the performance characteristics such as confusion matrix, error histogram are plotted to know the extent of the success of the proposed methodology.
Keywords: MRI, neural networks ,confusion matrix

I. INTRODUCTION

The uncontrolled growth of cells in any part of the human body is called tumour. This type of uncontrolled growth in the body can occur in many parts of body like brain, liver etc. These are always threat to life for human, hence proper diagnosis and treatment has to be done to save the life of a person. Number of equipments are available to capture the tumours such as MRI,CT-scan, x-ray etc and once the images are obtained from these equipments, they are analysed manually by physicians in which case, they may not be analysed properly. Hence, to prevent the errors during diagnostics of tumour,[1]In this work, we propose a novel method to detect tumours of brain obtained through MRI technique by the help of image processing techniques and supervised learning algorithms. In the following sections, we discuss methodology used, the model of neural network used and the performance measurements obtained through experimental results.

II. METHODLOGY

Basically, the method consists of two phases, training phase and testing phase as shown in figure 1. In the Training phase, a model of classifier is built based on the classification algorithm employed. In this work, the Levenberg-Marquardt algorithm is employed. The input to the classification algorithm is the huge set of image database, in our case, the data base is the noisy MRI images of human brain .The training phase involves number of procedures such as image pre-processing such as reducing noises, segmentation, features extraction and from the procedures, the algorithm develops a model which can be suitably used in testing phase. In the testing phase, the user information is fed to the developed model. Upon all required procedures performed on the given input image, it is fed to the classifier model developed during training phase .The Classifier model compares the test data with the stored data base and tries to fit the data at its best. Upon completion, the Classifier model labels given input images as Normal or a tumour attacked brain[2].

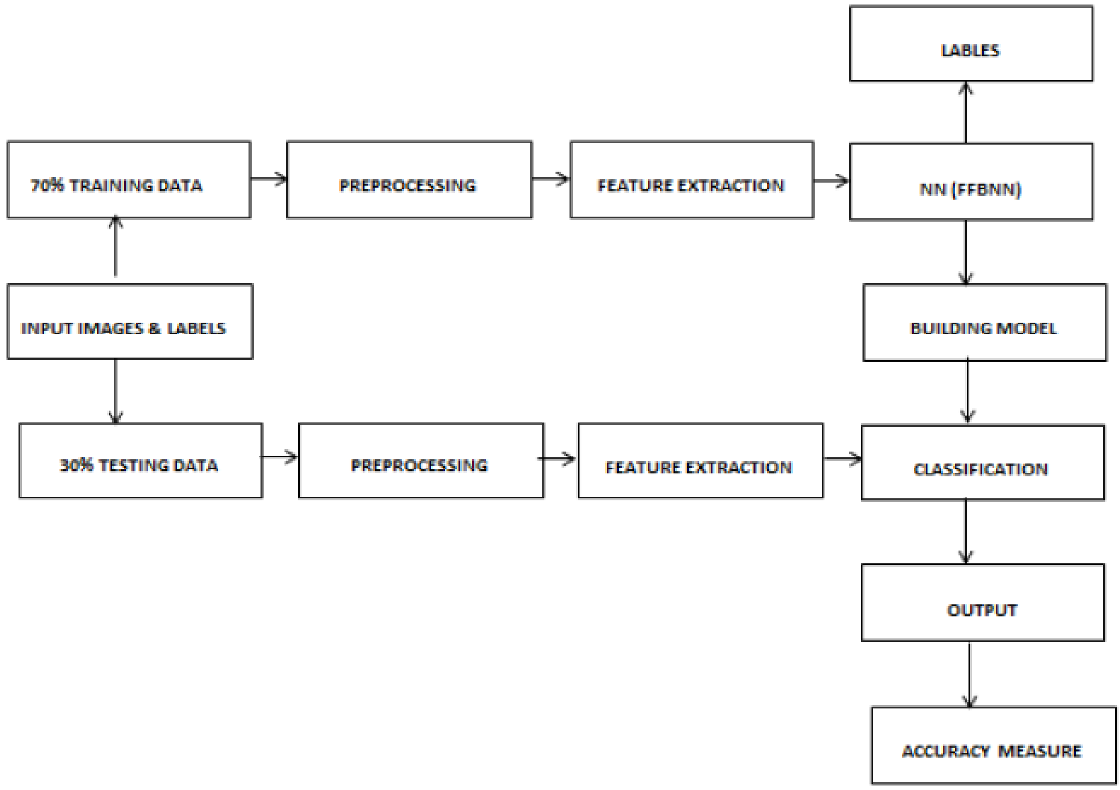

Figure 1. Methodology

III. Neural Network Model

Till today, various models have been proposed on the development of model for a single neuron structure. It was Mucculloch and pits in 1973 gave the model of "Integrate and Fire "model which is as shown in figure 2

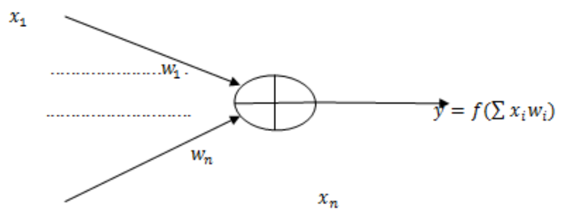

Figure 2.

In the figure, x_i, …. ,x_n denotes input to the developed model, W_1, …. ,W_n denotes the weight on the x_i, …. ,x_n input respectively which are multiplied to the input giving weighed sum output. The function f ($\sum$xi,W_i) is generally termed as Activation function and the activation function can be linear, sigmoid, step function etc.

In the development of artificial neural networks, training of model plays an important role and also an important too. Number of algorithms has been developed for training purposes and it solely depends on the size of the problem defined. But the goal of the algorithm is to provide a numerical solution which minimizes the given non-linear function.

There are many methods developed for neural network training [3].In this work, Levenberg – marquardt algorithm is employed and detailed explanation follows on the same. The Levenberg – marquardt algorithm was developed as an improvement to existing methods such as EBP algorithm. It was developed by Kenneth Levenberg and Donald marquardt to provide fast and stable convergence. Let 'P' denotes the number of patterns, „M „ denotes the number of outputs, „N" denotes the number of weights and let p, m, i, j, k denote the index of patterns, outputs, weights and iterations respectively. Evaluation vector, Sum Square Error (SSE) for input vector „x" and weight vector „w" can be defined as

$$E(x,w) = 1/2 \sum_{p=1}^{P} \sum_{m=1}^{M} e_{p,m}^{2} \qquad (1)$$

Where $e_{p,m}$ is the error obtained during training between actual output vector and desired output vector.

From the previous developed algorithms, it is clear that Hessian matrix H, gives the proper evaluation on change of gradient vector and inverted Hessian matrix gives well matched step size.

To approximate Hessian matrix,

$$H \cong J^T J + \mu I \qquad (2)$$

Where μ is called combination co-efficient and it is always positive. I is the identity matrix. Since the elements on the main diagonal approximated matrix will be larger than zero, it is clear that H is always invertible. Update rule is given by

$$w_{k+1} = w_k - (J_k^T J_k + \mu I)^{-1} J_k e_k \qquad (3)$$

If μ=0, it turns out to be gauss newton algorithm, and if μ is very large, the method turns out to be steep descent method. Finally, this method can be regarded as the combination of steepest descent methods and newton's method

IV.REULTS & DISCUSSIONS

Let us consider a sample MRI brain image attacked with tumour shown in figure 3 as an input which has tumour part marked with green circle. Since the input data is corrupted by noise, median filtering, a non-linear filtering technique, is performed on input images and RGB to gray scale conversions are also performed. On the filtered input image, only the part of the image which exhibits tumour are selected, shown in figure 3 and Image segmentation is done to get the features of interest. Since, median filtering preserves edges, filtering operation does not affect in extracting the boundaries of defected part of the brain.

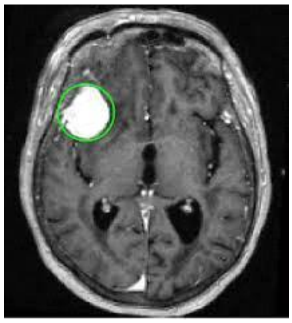

Figure 3. MRI brain Image with tumour

For the figure 3, the values for the features extracted are as below.

ECCENTRICITY:0.6544
CENTROIDS:[66.703,78.9109]
ENTROPY:0.6468
ECCENTRICITY:0.6544
EULER NUMBER:1
LENGTH OF MAJOR AXIS:2.391
LENGTH OF MINOR AXIS:7.809
MEAN INTENSITY:42.1522
ORIENTATION:-75.3126
PERIMETER:7.4731
SOLIDITY:0.26785
STANDARD DEVIATION:94.7207
UNIFORMITY:.7240

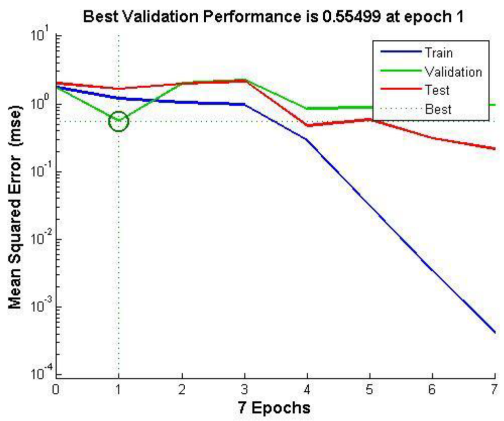

Figure 4. Performance plot

The above figure 4 depicts the performance measurement against the epochs where a gradual decrease in the mean square error is observed with increase in the number of epoch's .Epochs basically mean that number of the times that the training data is used only once to build a model. Here, the value of epoch is 8.From the figure, it is clear that during validation, the MSE is above 0.01 and the best validation performance achieved is at epoch 2 with MSE value of 0.041485.

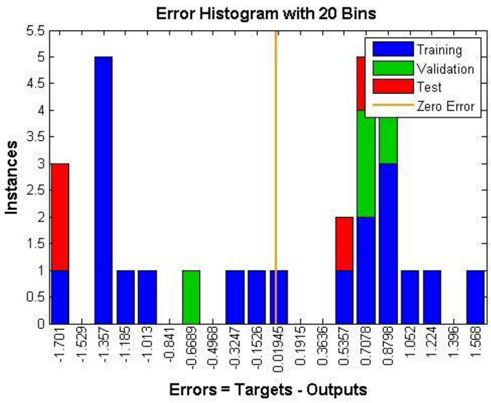

Figure 5 Error Histogram

From the above figure 5,we observe that error value lies in between -2 to +2.In learning or training the algorithm, there are chances that the result predicted to be true can be true or may be false. Also, the result predicted to be false could be true or false too giving us to generate confusion matrix with matrix elements as true positive(TP),true negative(TN),false positive(FP), false negative(FN) .From the experimental results, 87.9% of test inputs were properly recognized as malignant tumours and 12.1% was improperly recognized as malignant tumours.

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