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**Research Article**

# BRAIN TUMOR IDENTIFICATION AND ANALYSIS USING FEED FORWARD NEURAL NETWORK METHOD IN MAGNETIC RESONANCE BRAIN IMAGES

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## ABSTRACT

Considered the automatic classification of medical images critically and high-resolution analysis and high accurate in the diagnosis of disease and medical interpretation, we proposed in this paper feed forward neural network (supervised method) using segmentation in magnetic resonance brain images in order to identify the region of the tumor and analysis the performance of the method. The advantages of this method give excellent performance and excellent results in terms of accuracy detection, Sensitivity, mean square error (MSE), error histogram, dice overlap index (DOI), specificity, this is confirmed trough the results obtained in this paper.

**Keywords:** MRI, Brain tumor identification, Feed forward neural network, Parameters.

## INTRODUCTION

A brain has very complex structure and known as a kernel part through the body and it is a soft, spongy mass of tissue. It is paid by the bones in the skull, three thin layers of tissue (meninges) and watery fluid (cerebrospinal fluid) that flows through spaces involving the meninges and thru spaces (ventricles) inside the brain (https://www.cancer.gov/publications).

Magnetic resonance imaging (MRI) is a type of scan which utilizes strong magnetic fields and radio waves to create detailed images of within of the body, the results of an MRI scan can be used to help diagnose conditions, plan treatment sand assess how effective's previous treatment has been (http://www.nhs.uk/conditions/MRIscan/Pages/Introduction.aspx).

A plentiful of researchers has been proposed by researchers for the brain tumor identification analysis using neural networks in MR brain images. A brief review of some of the recent researches is presented here. Shweta Jain and Shubha Mishra, they proposed a presents the artificial neural network approach namely (PNN) to classify brain cancer (Bhattacharyya,*et al.*,2011).

V.P. Gladis Pushpa Rathi and Dr.S.Palani proposed a novel method to classification brain tumor using linear Discriminant Analysis which includes this steps, image collection, normalization, intensity, shape and texture feature extraction, feature selection and classification (Rathi, *et al.*, 2012).

R. J. Deshmukh and R.S Khule, they proposed Neuro-fuzzy systems use the combined power of two methods, fuzzy logic and artificial neural network (ANN) using to detect the brain tumor, the work carried out involves processing of MRI images of brain cancer affected patients for detection and classification on different types of brain tumors (Deshmukh, et al., 2014).

P.B.Nikam and V.D. Shinde proposed brain image classification and detection using distance method, this these presents a system for automatic classification of healthy or affected person using region growing segmentation by watershed algorithm, Euclidean distance classifier for fast computation, accompanied with pre-processing and post-processing method apply on database consisting both normal and tumorous samples of MRI images (Nikan, *et al.*, 2013).

Damodharan*et al*., 2015 presented a segmentation method for brain tumor based on Neural Network. The Quality Rate (QR) is used to calculate the abnormal MRI images of the brain. Demirhan, *et al*., 2015 discussed a segmentation method that segments brain into a tumor, edema, GM, WM, and CSF. Zhao *et al*., 2016 proposed a segmentation technique for Chinese visible human (CVH) brain dataset. The proposed method is based on supervised learning and also used multilayer stacked auto encoder (SAE) for feature representation. In this work, we proposed we were able to improved method feed forward neural network (supervised method) and we were able to through the results, which we'll show the diagnosis and identify the region of the tumor in 4 MR brain images (2 images MR brain FLAIR and 2 images T1-weighted brain images). Performance analysis of feed forward neural network method has given the excellent results comparison with another method, as distinguish high detection and analysis the images and short duration time. Also, good results in other parameters (MSE, DOI, sensitivity, error histogram, and specificity).

## METHODOLOGY

In this paper, brain tumor analysis is mainly based on feed forward neural network using 4 MR brain images. The methodology consists of the following phases:

**Stage1**: Input MR Brain image

**Stage2**: pre-processing using Trilateral Filter : this using to calculate ( input MR brain image variance, filtered image variance, improvement factor, standard deviation, filter standard, improvement).

**Stage3**: Filter

**Stage4**: EM-GM Segmentation

**Stage5**: Segmentation using ANN

**Stage6**: detected and analysis and performance of the method.

To understand the methodology more show the figure1.

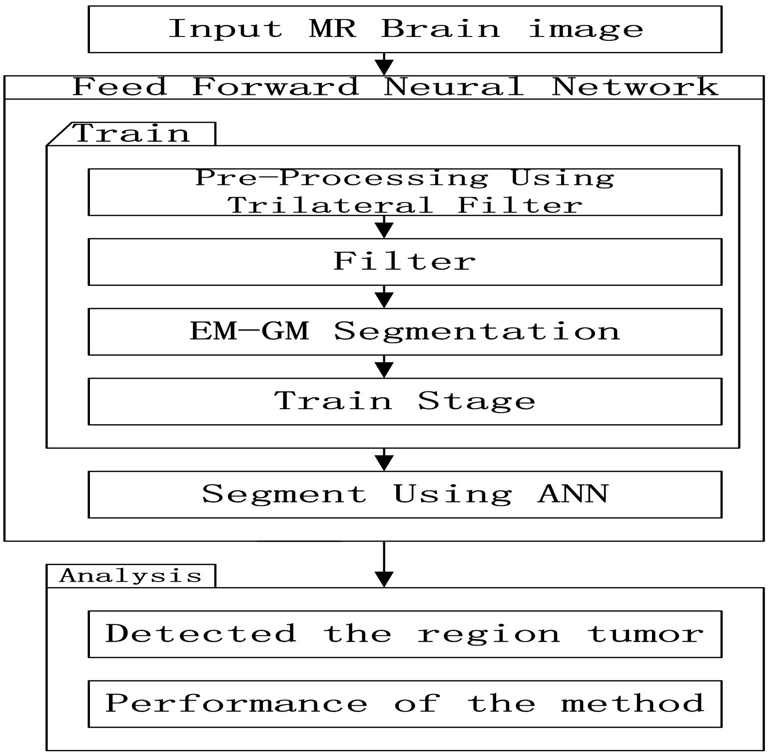
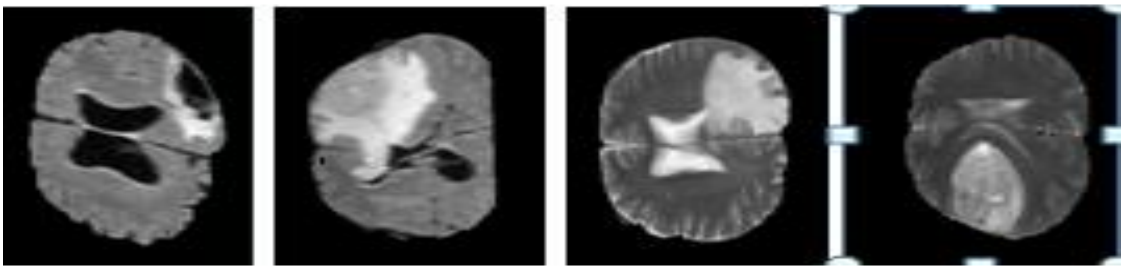



**Figure 1:** Schematic of the Feed Forward Neural Network methodology.

## Materials

In our work we used 4 Magnetic resonance images, 2 MR brain FLAIR images, and 2 MR brain T2-weighted images obtained from Florida University brain repository. As (a) and (b) MR brain FLAIR images, (c) and (d) MR brain T2-weighted images.



a b c d

**Figure 2:** MR brain FLAIR and T2-weighted images database.

## Pre-processing Using Trilateral Filter

Sharp ridges and gutters are commonly present in medical images, including nested vessels in digital subtraction angiography (DSA) and 3D angiography, and folded gray and white matters in brain MR images, therefore, a narrow spatial window, say, 3 pixels in every dimension, must be used in order to avoid over-smoothing structure of sizes much like an image resolutions. This can lead to involving performing more iteration inside the filtering process. The trilateral filtering is expressed as follows:

$$\vec{I}^{(t+1)}(\vec{x}) = \frac{1}{k(\vec{x})} \sum_{\vec{\xi} \in N} \vec{I}^{(t)}(\vec{\xi}).\omega(\vec{\xi}, \vec{x}, t) \qquad [1]$$

## EM-GM Segmentation

After pre- processing using Trilateral Filter process, the next step is segmentation using EM-WM present in the brain MR image. Here, the input to the process is the skull stripped image. The major steps that are followed to segment the EM-WM are explained below:

$$\nabla f(x,y) = \frac{\partial f}{\partial x}\hat{i} + \frac{\partial f}{\partial y}\hat{j} \qquad [2]$$

## Feed Forward Neural Network

The neurons are arranged in layers and they've unidirectional connections between them. They produce only one set of output values. They are referred to as static network because within this the output values are designed only depending on current input. The output values will not be determined by previous input values. Fortunately, they are referred to as memory less network.

## Accuracy Detection

Accuracy, reliability also referred segmentation used to look effectiveness in the segmentation algorithm evaluation variables. The truth is denoted in [3].

$$Accuracy = \left( \frac{k}{m \times n} \right) \times 100 \qquad [3]$$

Here $'k'$ Is the total number of pixels present in the segmented output image, $'m'$ and $'n'$ are the rows and columns presents in the input image.

### Mean Square Error (MSE)

Defines the entire process of squaring the differentiated quantities. It's expressed as of the average of the squares with the errors obtained by subtracting the input and output values. MSE maybe the cumulative squared error value relating to the input image $A(i, j)$ as well as the segmented image $B(i, j)$.

$$MSE = \frac{1}{mn} \sum_{i=0}^{m-1} \sum_{j=0}^{n-1} [A(i, j) - B(i, j)]^2 \qquad [4]$$

### Dice Overlap Index (DOI)

DOI value is expressed with Jaccard Index DOI defines the overlapping objective of the image (A) and segmented output image (B).

$$D(A, B) = 2 \times \frac{J(A, B)}{1 + J(A, B)} \qquad [5]$$

### Sensitivity

Sensitivity value means the input image appropriate division or classification, defined error rate success in accurately identify tumors area. This is explained as:

$$OF = \frac{TP}{TP + FN} \qquad [6]$$

### Specificity

Specificity defines specific word or algorithms to classify segments of ordinary tissue are mixed together within a region within a region within the input image capability. Specificity is assumed using Eq (7):

$$Specificit\,y(\sigma) = \frac{TN}{TN + FP} \qquad [7]$$

## RESULTS

This paper results in concerns about tumor identification analysis based on Feed Forward Neural Network (FFNN) method Using 4 MR brain images. We will divide the results into two parts:

## Tumor identification using (FFNN) in 4 MR brain images

In this particular diagnosis and identification of the tumor region, we'll show the results of the four MR brain images as (a) original MR brain image, (b) white matter image, (c) Gray matter image, (d) detected tumor region using (FFNN).

(a) (b) (c) (d)

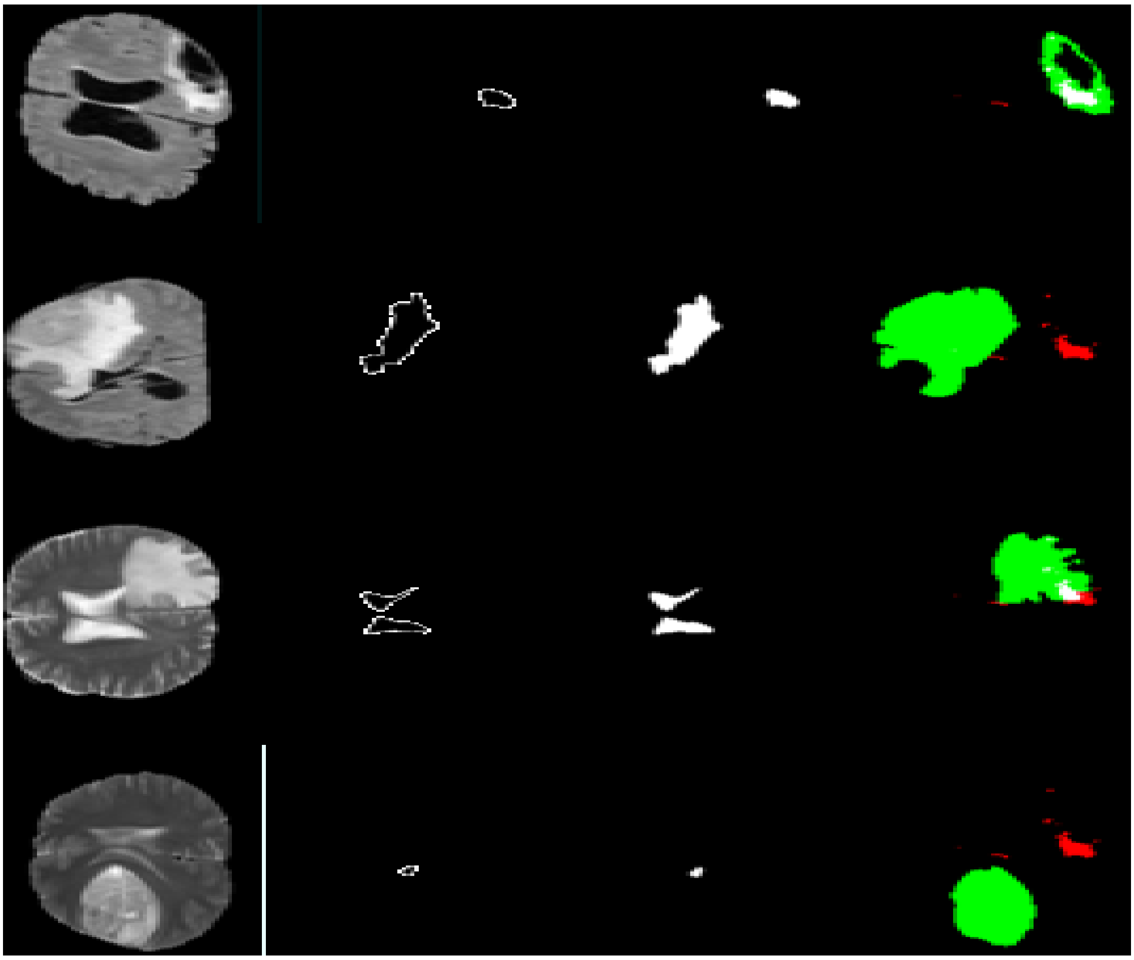


**Figure 3:** Tumor Identification Process for 4 MR brain images based on (FFNN) method.

## Analysis and Performance of the (FFNN) Method

**Table 1:** Performance Using Pre-Processing Trilateral Filter in 4 MR brain images.

| 1. Analysis Using Pre-Processing Trilateral Filter | | | | | | |
|---|---|---|---|---|---|---|
| **Images** | **Actual variance** | **Filtered variance** | **Improvement factor** | **Standard deviation** | **Filtered standard deviation** | **improvement** |
| FLAIR1 | 3297844,71 | 3310126,79 | 0,003724 | 6,08,929 | 6,12,943 | 0,006593 |

| | | | | | | |
|---|---|---|---|---|---|---|
| FLAIR2 | 72298752,49 | 8231411,33 | 0,127783 | 7,19,212 | 7,39,413 | 0,02808 |
| T2-W1 | 1722850,31 | 2062650,34 | 0,197231 | 4,74,855 | 4,99,235 | 0,00513 |
| T2-W2 | 4858893,98 | 4779595,61 | 0,016523 | 6,64,621 | 6,60,700 | 0,00588 |

## Evaluation Performance of the (FFNN) Method

**Table 2**: Evaluation Performance Using (FFNN) Method in 4 MR brain images.

| **Images** | **Accuracy%** | **DOI** | **Sensitivity** | **Specificity** | **Per-segment** |
|---|---|---|---|---|---|
| **FLAIR1** | 99,94 | 0,34066 | 0,9589 | 0,9588 | 1,3546e-07 |
| **FLAIR2** | 99,12 | 0,00061 | 0,4320 | 0,4319 | 9,5730e-07 |
| **W2-T1** | 98,77 | 0,02954 | 0,6975 | 0,6974 | 3,0139e-04 |
| **W2-T2** | 98,98 | 0,00100 | 0,4634 | 0,4633 | 5,6047e-06 |

## Evaluation Performance of Means Squared Error (MSE)

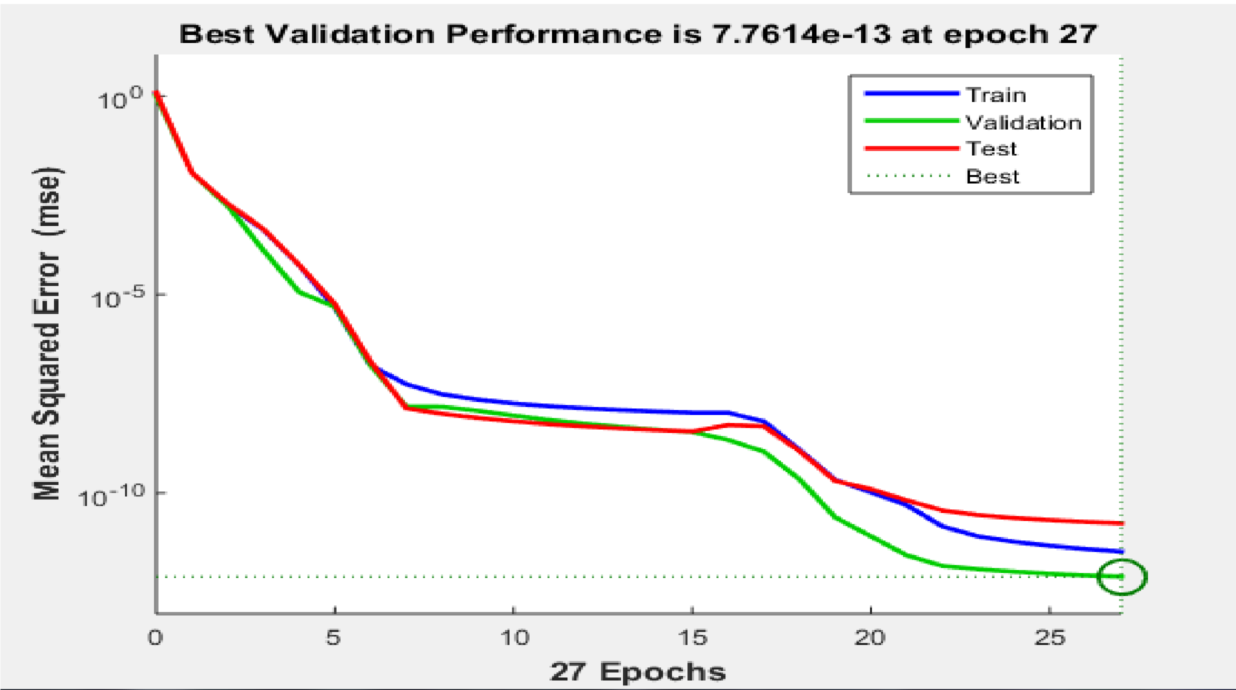



**Figure 4:** 12 plot performance of best ten features using FFNN method.

### Evaluation Performance of Training State

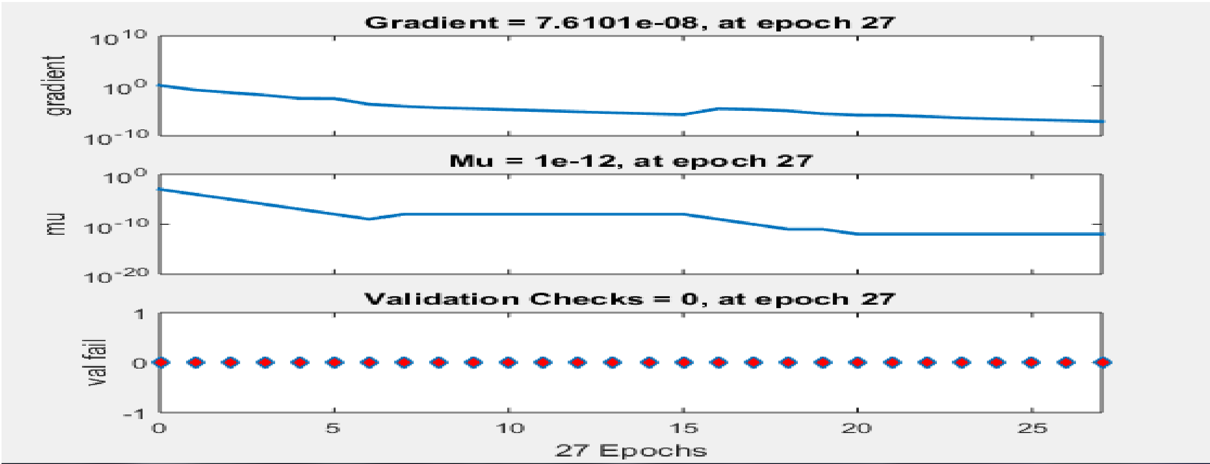



**Figure 5**: Plot Training State Of the best feature using FFNN method.

### Evaluation Performance of Error Histogram

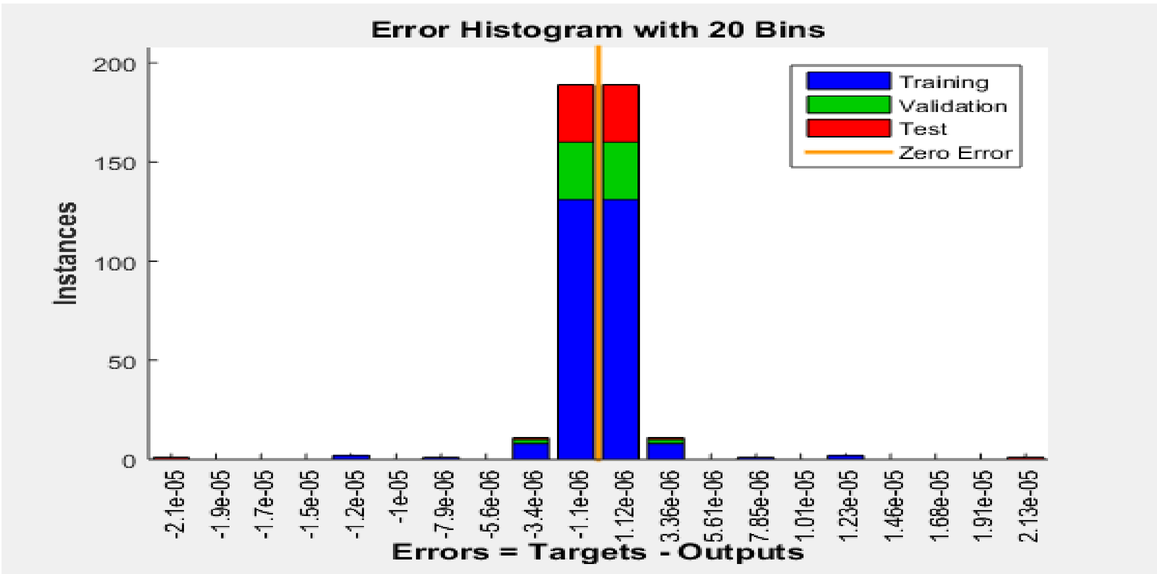



**Figure 6**: Plot Histogram Error with 20 Bins using FFNN method.

## DISCUSSIONS

In this work, we will discuss the results obtained are as follows: the results of 4 MR brain images processing stages described in the "Figure 3" which describes the region of the tumor in 4 MR brain images that have been processed Using (FFNN) method, it gave an excellent result. Results of (FFNN) training which includes results of the pre-processing

Trilateral Filter which includes the results in the "table 1" which gives information and values about 4 MR brain images used. Results evaluation performance of the (FFNN) method that illustrates the accuracy and results of the parameters described in the "Table 2" Results performance of (MSE) in the "Figure 4" which gives a very small percentage error.

Performance of training state that explains gradient and MU and validation check as described in the "Figure 5". The Performance of error histogram that explains the percentage of the error Histogram as described in the "Figure 6".

The limitation of this study it's a good and unlimited according of the results and the the disadvantage of FNN Method is cannot segment clearly T1-weighted MR images.

## CONCLUSION

In this paper, we used Feed Forward Neural Network to identification analysis brain tumor and we have obtained excellent results, so was the method accuracy between 99, 94% and 98, 77% and the results of parameters (DOI, sensitivity, specificity, performance segments, MSE, training state, error histogram and trilateral filter). With excellent performance for (FFNN) method can be proposed to help the doctors for diagnosing a patient in the short period of time with very high effectiveness.

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