# Neuro-Fuzzy Logic to Exploit and Classify MRI Brain Based Neoplasm and Execution of Lossless Compression

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***Abstract:*** **In the recent years classification and compression plays a vital role in digital communication and their mishmash is handy for pull out explicit data and compress the classified data. In this paper we proposed a technique for mishmash of classification and compression in MRI brain images. Here we progress a computerized tumor recognition system for MRI brain images trailed by lossless compression technique in order to reduce the usage of data storage space. A neuro-fuzzy classifier is used to exploit and catalogue MRI brain based neoplasm and we use haar wavelet compression to compress the classified images**.

***Keywords: human inspection, tumor detection, MRI images, feature extraction, ANFIS classifier, lossless compression.***

## I. INTRODUCTION

In this contemporary world Magnetic Resonance Imaging (MRI) has turned out to be an effective tool for clinical diagnoses and research. It has become a very useful medical modality for the detection of various diseases.

Human inspection is the orthodox method in medicine for MR images classification and tumor detection. Operator-assisted classification methods are impractical due to minute variations, co-resemblance between exaggerated and original biological part and also due to the large volumes of data which are also non-reproducible. Another serious problem in operator-assisted classification method is creation of noise in MR images which can lead to inaccuracy classification. The problem verves into severe predicament under brain tumor detection.

It is a puzzling assignment to progress an automated recognition system which could route on a large information of patient and afford an accurate estimation. The neuro-fuzzy logic for pixel classification of medical images uses its neural network skill to study the membership degrees and functions of fuzzy logic [1]. Mish mashing of neural network, fuzzy logic and genetic algorithm in a hybrid system for revealing and specification of abnormalities present in medical images, detects the doubtful regions which are deduced by the Fuzzy Neural Network of specification [2]. Segmentation technique evaluation for MRI brain images based on the adaptive fuzzy leader clustering algorithm [3]. A novel neuro fuzzy network [4-5] which can resourcefully motive fuzzy rules based on training data to unravel the medical diagnosis problems. This method along with feature reduction reuses a simple and interpretable fuzzy rules to support medical diagnosis.

The common segmentation problem come upon by researchers [6-8] is the noise introduced with the procurement of the image, the overlying intensities, the limited volume effect (when a pixel characterizes more than one benevolent tissue type) and also some structural (anatomical) variations from one person to another. The blood vessels might also impact and introduce the noise in the image. Researchers might undergo a lot of problems to form a precise segmentation system. Since all these techniques have their own plunders and hitches, more exploration is required in this domain and maybe some mishmash of the already prevailing methods or several new image processing techniques has to be proposed to get enhanced outcomes.

So we are going to progress an automated tumor recognition system [9] for MRI brain images and after the classification of images, we use lossless compression techniques to compress the image in order to reduce the usage of data storage space without losing the quality of data in image. Here we implement the neuro-fuzzy logic for the detection and classification of MRI brain images and we use haar wavelet compression to compress the classified images.

Decision making was performed in two stages: feature extraction and the training of ANFIS classifier. The act of the ANFIS classifier was assessed in terms of training performance and accuracy in classification. Finally, we will compress the classified image using Haar wavelet compression techniques which proves to be successful in reducing the data size without losing information about the image i.e able to recover back the original image.

This estimated result using ANFIS and lossless compression will be of great reputation for brain tumor detection and classification and also for data supervision in a hospital and for tele-radiology.

## II. METHODOLOGY

Figure.1, shows the methodology used for MR brain image classification and compression of the resultant data. The work comprises of processing the MR brain images, extracting the features of the brain, utilising appropriate neuro fuzzy classifier to classify the different MRI brain images and output data will be compressed to reduce the storage space. MRI dicom brain images is used whose textural structures are extracted using image processing techniques. Neuro fuzzy classifier utilise these extracted features for training and the performance of neuro fuzzy classifier is tested to classify different MRI brain samples.

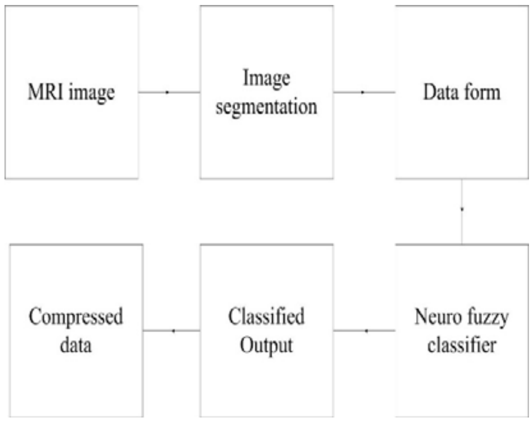


Figure.1. Flowchart of the proposed method

Segmentation is the first step in this process. Segmentation is mainly used to isolate the tumor from its background. Exploration of 3D volume using slicing is done to segment the dicom image [10]. Threshold level is selected to equalise the image in which segmentation is determined by the intensity threshold. Then morphological operation such as erosion and dilation is performed to extract the features of the image. Feature extracted images are converted into data form which can be used for training the ANFIS classifier. After training the neuro fuzzy model, the classification of the MR images starts. For the classification of normal and abnormal brain images a data set is collected from different sources. After feature extraction process the abnormal tissues in a data form are presented to ANFIS for training and to estimate membership function parameters. Each row of the training data resembles to be preferred input/output pair of the target system which is to be modelled. The data is comprised of three phase- training, checking and application. Data removal is composed of 4 phases - input, classification & FIS, ANFIS, output. After obtaining the classified output we will use lossless compression technique to reduce the storage space used by the database. Here we use haar wavelet compression techniques to compress the data.

## III. ANFIS ARCHITECTURE

An adaptive network executes a specific function on received signals in consort with ability of parameters connecting to this node. Fuzzy inference systems are the fuzzy rule based systems which comprises of a rule base, database, fuzzification interface, defuzzification interface and decision making unit. Adaptive neuro fuzzy inference system (ANFIS) [11] architecture is formed which cartels the benefits of neural networks and fuzzy logic rules.

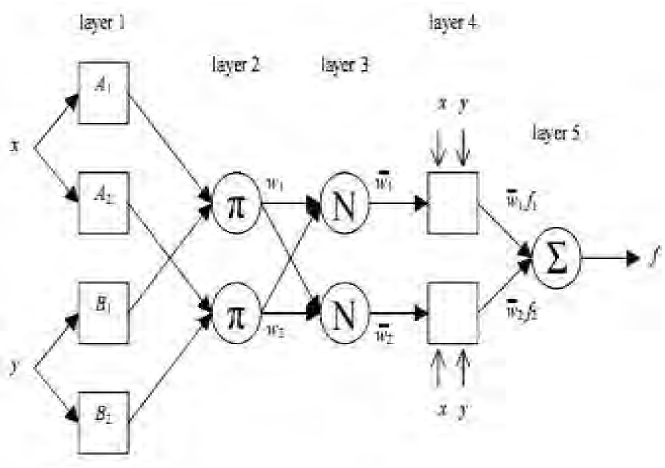


Figure.2. ANFIS Architecture

The ANFIS is a fuzzy Sugeno model that allocate the structure of adaptive systems to assist learning and adaptation. Two fuzzy if-then rules are considered based on a first order Sugeno model.

**Rule 1:** If(x is A1) and (y is B1)

Then (f1 =p1x + q1y + r1)

**Rule 2:** If (x is A2) and (y is B2)

Then (f2 = p2x + q2y + r2)

where x and y are the inputs, Ai and Bi are the fuzzy sets, fi are the outputs within the fuzzy region specified by the fuzzy rule, pi, qi and ri are the design parameters that are determined during the training process.

Figure.2, shows the implementation of two fuzzy rules using ANFIZ architecture. The appropriate selection of the number, the type and the parameter of the fuzzy membership functions and rules plays a vital role in achieving the desired performance but in most circumstances, it is problematic. Sometimes these parameters are chosen on the basis of trial and error method which enlighten the importance of tuning the fuzzy system. The main objective of training the ANFIS system is to govern the optimal premise and resultant parameters.

ANFIS Classifiers uses Gradient descent and Backpropagation algorithms to alter the parameters of membership functions and the weights of defuzzification for fuzzy neural networks. ANFIS relates two techniques in updating parameters. A parameterized model structure (relating inputs, their membership functions, rules, corresponding outputs their membership functions, and so on) is postulated and input/output data is composed which will be used by ANFIS for training. ANFIS can be used to train the FIS model by modifying the membership function parameters based on error chosen criterion to cope with the training data. The FIS model having parameters related with the least checking data model error is selected, when ANFIS contains the checking data and training data

## IV. EXPERIMENTAL RESULTS

Region of interest is selected by considering the normal brain and abnormal brain. Figure.3a, 3b shows the abnormal brain and color mapped image and figure.4a, 4b shows the sliced image and segmented image. Figure.5 shows the region of interest. By considering the classification accuracy, the amount of training and testing sets were determined and several experiments were performed. ANFIS is trained using the training data sets and their precision, efficacy is verified using testing data sets. Analysis of initial and final membership functions point out that there are significant changes in the final membership functions but the minute variation due to minimum the number of data training. The initial and final membership function before training and after training is shown in the figure. 6a and 6b. In the meantime the ANFIS classifier chains the qualities of both the neural network and the fuzzy classifier which yields greater results than any other classifiers. The compression technique used here also proves to be fruitful which can able to reproduce the original image without loss of an information.

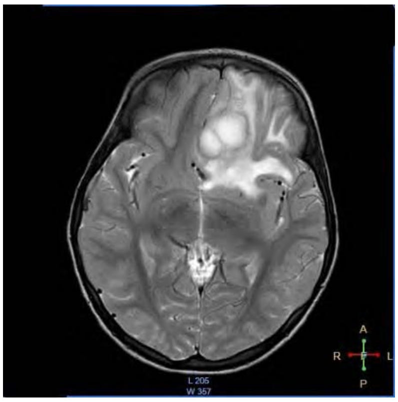


Figure.3a. Abnormal brain

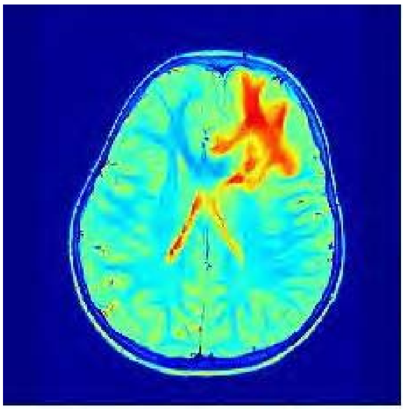

Figure.3b. Color mapped image

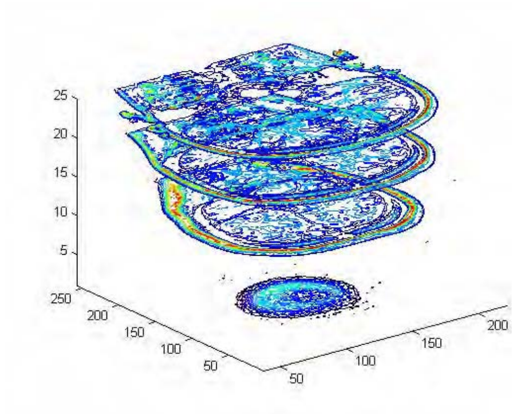


Figure.4a Sliced image

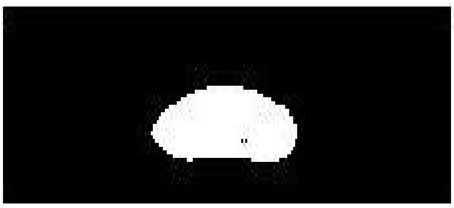

Figure.4b segmented image in data form

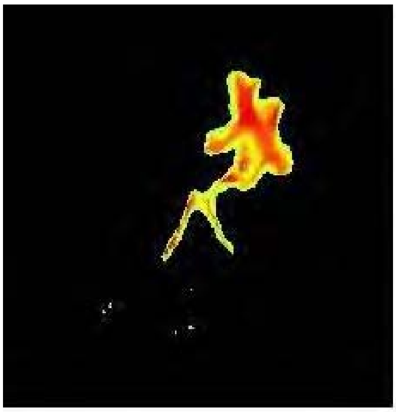

Figure.5 Region of interest

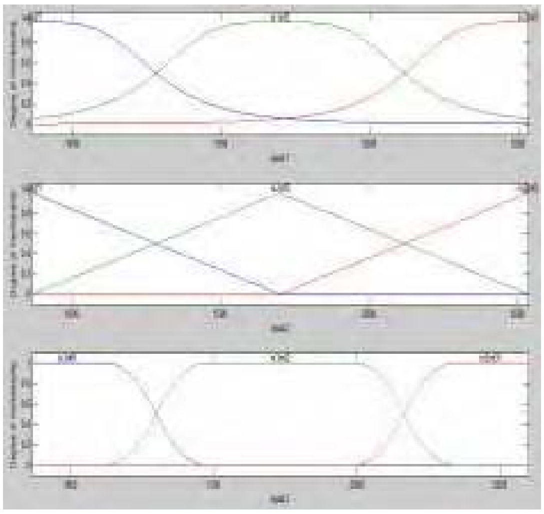

Figure.6a Membership function before training

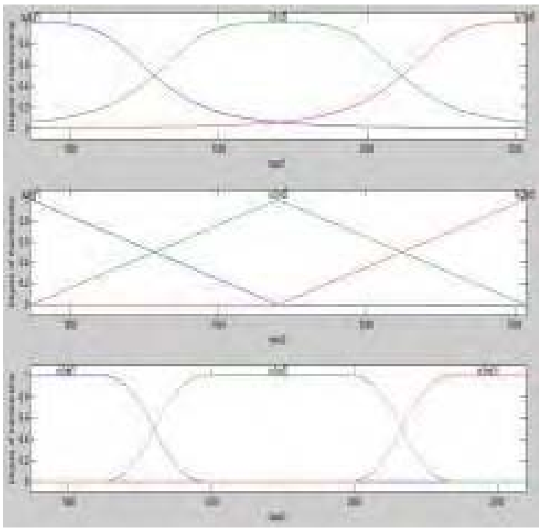

Figure.6b Membership function after training

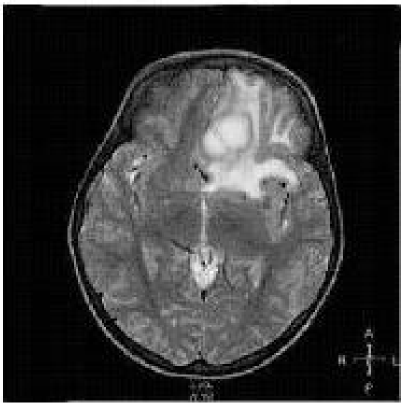

Figure.7 Compressed image

## V. CONCLUSION

This paper boons a computerised recognition system for the MRI image using the neuro fuzzy logic and compress the resultant data which is reproducible. Tentative result designates that the technique is effective with greater accuracy. This technique is firm in execution, effective in classification and compression and tranquil in implementation. This estimated result using ANFIS and lossless compression will be of great reputation for brain tumor detection and classification and also for data supervision in a hospital and for tele-radiology.

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