Human Tumor Detection in Brain using Wavelet Optimization Classification Algorithm

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***Abstract*—**This Brain is the organ present in the human body. It consists of nerve cells and tissue cells known as glial tissue and meninges. Brain tumor is a major disease which contains cancer cells. The basic tumor starts its disease from the brain tissues. The braintumor produced in abnormal cells that acquired the errors in the DNA. Brain tumor divided into two categories such as primary brain tumor and secondary tumors. An effectof primarytumors are more as compared to secondary tumors. This tumor originated by the glimas, meningiomas, acoustic neuromas tissues present in the brain. There are some symptoms seen from the beginning of tumor as, changed headache patterns, vommitings, problems in speech , alterations in the personality and behivour. To get rid of this disease, Discrete wavelet transform (DWT) used which filtered the extracted features of tumorimage and originate the normalized features. After that the genetic algorithm is an optimization methods preferred to minimize the features and classify the tumor detection with the help of Multi-layer perceptron neural network (MLPNN).In the proposed research work, information acquired from various algorithms particularly for the image segmentation in the brain tumor disease. The working of DWT enhanced the features collection done in addition of genetic algorithm. MLPNN applied to search tumor area in brain cells. All the performance parameters are improved. Accuracy is the pivotal requirement which is enhanced and the error rates are expelled.

Keywords*—*DWT (Discrete wavelet transform); GA (Genetic Algorithm); MLPNN(Multi-layer perceptron neural network); MRI(Magnetic Resonance Image);

I. INTRODUCTION

A brain tumor is defined as the growth of abnormal cells in the tissues of the brain (National Cancer Institute, http://www.cancer.gov/ , accessed on June 27, 2009). Brain tumors can be benign (noncancerous) or malignant (cancerous). In contrast to normal cells, cancer cells result from uncontrolled cell growth and can grow into adjacent tissue. Although benign tumors can become large and press on healthy organs and tissue, which can potentially affect their functioning, they rarely invade other tissue. Primary brain tumors start from the brain itself, while secondary brain tumors (metastatic tumors) originate from other parts in the body.

Magnetic Resonance (MR) image enhancement are mainly used for reconstruction of missing or corrupted parts of MR images, image de-noising and image resolution enhancement. While using Magnetic Resonance (MR) images resolution enhancement face many problems like Resolution enhancement of MR images (512 x 512 pixels 2 times more),conservation of sharp edges in the image and conservation and highlighting of details [1]. The MR signals are generated with the help of water molecule protons. The variations are arrived due to the density and the longitudinal and relaxation time of protons. To calculate the relaxation time of protons involves few concentrations of the paramagnetic material. The nonhemeironhaveoly 2 things such as ferritin and hemosiderin which have capability to effect the MR contrast in the brain cells. In the previous researches there, biochemical analysis describes the one third of nonheme iron was in the form of ferritin in the human brain. The human brain contains many other paramagnetic ions like copper and magnese [2].

Image segmentation is a low-level image processing task that aims at partitioning an image into homogeneous regions. How region homogeneity is defined depends on the application. Several techniques for segmentation are available in to divide images as per to various criteria such as grey level, color, or texture. Several automated methods have been developed to process the acquired images and identify features of interest, including intensity-based methods, region-growing methods and deformable contour models. Intensity-based methods identify local features such as edges and texture in order to extract regions of interest. Region-growing methods start from a seed-point on the image and perform the segmentation task by clustering neighborhood pixels using a similarity criterion [3]. The main two parts of the image segmentation which is decomposition and the representation that mainly done in sequence. Firstly, in the decomposition the essential pixels are extracted and in the representation there is analysis done to enhance the quality of images. The images that extract the colors from the images when that images portioned .the colors that are captured called color image segmentation [4].

A. *Image Aquisation :*We collect the dataset from the UCI machine learning site. Initialize, the first image is uploading from the dataset. It convert the image to reduce the dimenisons in the original image.

B. *Pre-processing :*In pre-processing stage, we convert the original image to grey scale image. We check the interference and remove the interference in grey scale image. We perform the segmentations approach to detect the regions in the original image. In region based algorithm is either rejected by a stage or it proceeds to the next stage. Initial stages are simpler than subsequent ones and focus in rejecting non-positive regions based, i.e. areas where there is a low chance of detecting a brain tumor. As such areas represent larger portions of the images; the overall detection speed is increased. When a stage approves a edge, this region is passed on to the next stage. If the region is approved by every stage, then this region is classified as a brain tumor image.

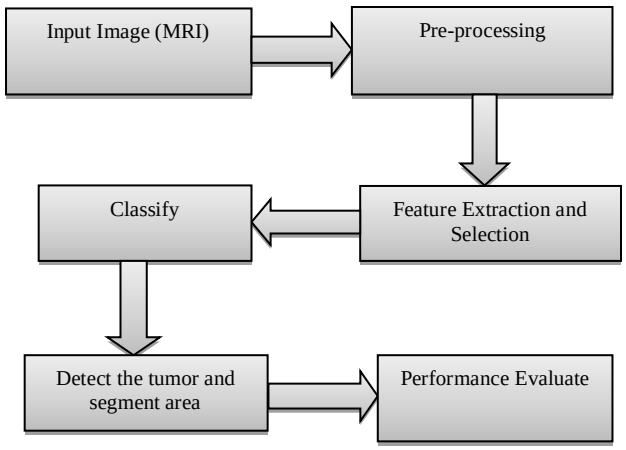

Fig. 1 Flow Chart to Detect Tumor

A. Feature Extraction: Extracted feature seeks out unique properties in a picture that are modally distinct, invariant to picturing situations and stable under geo-metric transformations. Some authors developed a technique for extracting features from the image that could be used to evaluate reliable matching between dissimilar views of an object. Unique Identities in the form of feature could be used for feature extraction form fingerprint images. The extraction features are invariant to image scaling and partially invariant to modify in illumination and rotation.

B. Optimized Classification: In this method implemented has selected features base on optimization methods (genetic algorithm) . It fetch the features based on the genetic operators i.e Selection, Crossover and Mutation. In selection phase, to initialize the features.The crossover operator to divide the fetaure in two groups according to the range.Mutation operator, to modify the features in the brain tumor.The classification method to train and test the tumor image.A single brain tumor used for authentication is more when compared to the accuracy of the system which uses three tumor for authentication. We identify and classify using the machine learning classification algorithm the brain tumor using feature to feature comparison and scoring of the brain tumor features which is extract by FeatureTransformation algorithm.

The proposed research introduced DWT for feature extraction, genetic algorithm for selection of features on the basis of fitness value and detailed description of MLPNN given mainly to focus on the classification of tumor area's with their different types. Furthermore, the result shows with parameters that enhanced the accuracy.

II. RELATED WORK

G. Rajesh Chandra, et al., (2016) [5] concentrated on the methods which utilize picture division to recognize brain tumor. Location of braintumor is exceptionally basic casualty in current situation of human services society. Picture division is utilized to separate the unusual tumor partition in mind. Braintumor is an unusual mass of tissue in which cells develop and increase wildly, evidently unregulated by instruments that control cells. A few strategies have been produced for identification of tumor in cerebrum. Tumor arrangement and division from cerebrum registered tomography picture information is an essential however tedious undertaking performed by therapeutic specialists.

Nelly Gordillo, et al., (2013) [6] reviewed various important cerebrum tumor division strategies, directed after the procurement of the picture. Mindtumor division comprises of isolating the distinctive tumor tissues (strong or dynamic tumor, edema, and putrefaction) from typical cerebrum tissues: dim issue (GM), white issue (WM), and cerebrospinal liquid (CSF). In braintumor examines, the presence of anomalous tissues might be effortlessly distinguishable more often than not. In any case, exact and reproducible division and portrayal of anomalies are not clear. Before, numerous specialists in the field of medicinal imaging and delicate figuring have made critical review in the field of cerebrum tumor division. Both self-loader and completely programmed techniques have been proposed. Clinical acknowledgment of division procedures has relied upon the straightforwardness of the division, and the level of client supervision. Intelligent or self-loader strategies are probably going to stay prevailing by and by for quite a while, particularly in these applications where wrong understandings are unsatisfactory. Given the benefits of attractive reverberation imaging over other symptomatic imaging, this overview is centered on MRI cerebrum tumor division. Self-loader and completely programmed procedures are stressed.

Adriano Pinto, et al., (2015) [7] proposed a discriminative and completely programmed strategy for the division of gliomas, utilizing appearance-and setting based highlights to nourish an Extremely Randomized Forest (Extra-Trees). Gliomas are among the most widely recognized and forceful

mind tumors. Division of these tumors is vital for surgery and treatment arranging, yet additionally for follow-up assessments. Notwithstanding, it is a troublesome undertaking, given that its size and areas are variable, and the outline of all tumor tissue isn't minor, even with all the distinctive modalities of the Magnetic Resonance Imaging (MRI). Some of these highlights are figured over a non-direct change of the picture. The proposed strategy was assessed utilizing the openly accessible The outcomes are focused, when contrasted with different outcomes announced utilizing a similar database.

Mohammad Havaei, et al., (2017) [8] exhibited a novel CNN design which varies from those generally utilized as a part of PC vision.CNN misuses both neighborhoods includes and more worldwide logical highlights at the same time. Additionally, unique in relation to most conventional employments of CNNs, our systems utilize a last layer that is a convolution execution of a completely associated layer which permits a 40 crease accelerates. Furthermore they depicted a 2-stage preparing system that enables us to handle troubles identified with the awkwardness of tumor marks. Lastly, they investigated a course design in which the yield of an essential CNN is dealt with as an extra wellspring of data for a resulting CNN. Results wrote about the 2013 BRATS test informational index uncover that our engineering enhances over the right now distributed best in class while being more than 30 times quicker. The proposed systems are custom made to glioblastomas (both low and high review) envisioned in MR pictures. By their extremely nature, these tumors can show up anyplace in the mind and have any sort of shape, size, and complexity. These reasons propel our investigation of a machine learning arrangement that adventures an adaptable, high limit DNN while being greatly effective.

III. METHODS FOR IMAGE SEGMENTATION

Image segmentation uses three main methods for segmentation that are as below-

A. Edge based segmentation: A region is a set of pixels with same properties and features. Gray values are in use to create the regions for the region segmentation. All the objects are differentiated by the edges or the grayscalediscontnuties and it needs the gray level gradients for detection of edges[9]. As same as the color images.these are determined for the binary classification problem at the pixel's levels. The pixels must be edge on or edge off. In this method boundries not necessary and the computation is fully based on the differences of pixels [10].

B. *Region based segmentation*: In this method the image is segmented into the regions and a threshold value is chosen for achieving the goal of this method.. The primary focus is on the boundries of regions which are gray scale or coloured. The pixels are extracted while segmentation are from the boundaries at the edges of the image. These pixels communicates at first instance with the closer pixels or neighbour pixels These techniques directly extracts the pixels from the different regions. This method used into two ways such as Thresholding method which consists of threshold parameters and P-tile method which have objects of P% and then Thresholding.Thresholding is further divided into histograms, clustering methods. These are based onthe closest boundries and due to the use of this method the multispectral images are improved and the calculations of the results based on the similarity between pixels.

C. *Hybrid Methods:* This type of methods are collaction of other methods such as edge based methods, clustering method, Thresholding methods and the region based methods. The outcomes ofc these methods are better rather than otherseparated methods [10].

IV. PROPOSED METHODS

A deep description of proposed research work is as follow-

A. Discrete Wavelet Transformation (DWT)

An advancement of wavelet theory has taken the interest of researchers in its application to image enhancement which is done by noise removing and edge enhancement. Wavelet basis function enables DWT based filtering procedures to adapt to spatial variations. Wavelets are functions generated from one single function Ψ by dilations and translations. The basic idea of the wavelet transform is to represent any arbitrary function as a superposition of wavelets. Any superposition breaks down the given capacity into various scale levels where each level is additionally decayed with a determination adjusted to that level [11]. In the medical field, DWT became a essential part. This is highly recommended in the image compression. The transformation is not individual in this but also by the group of transformation. There are two basic functions of DWT such as HAAR function and the DAUBRECHIES function. Haar function invented by the Alfred haar and it is a step based function and mainly used to the orthonormal systems. The implementation of this function is easy and fast. In another function the wavelets are transformed. In orthonormal wavelets these functions are obtained these are written through dbbN. The working sequence and implementation is similar as to the Haar function and only difference is of scale signals [12].

1) *Characteristics of Discrete Wavelet Transformation:* DWT have various kinds of characteristics that are given below:

a) These are spatial localized and easy to understand.

b) It reduces the computational time while transforming the signals.

c) This method is recommended for the sub band coding also.

d) It can identify the relevancy of data.

e) More accuracy in the outcomes.

f) Input data is required and at the end of transformation the contrast of images are brighten.

*g)*The wavelets are more efficient than the pixels [13] [14].

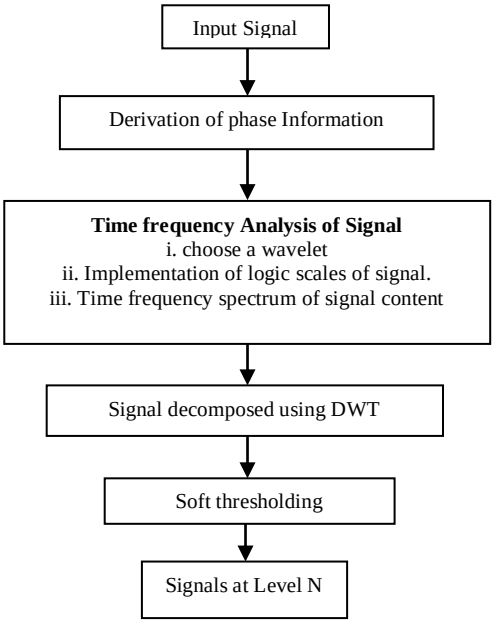

Fig. 2. Discrete Wavelet Transform [15].

In this Fig.2. firstly a signal is selected and extract the relative information from the derivation of phases and there is a time analysis of signals are performed which have a wavelet and a logic scale on the signal content. There is then soft Thresholding performed at the end there is De noised signals are generated at the level-N.

2) Pseudo Code for DWT

DWT

```
Public void For (double [] data)
{
dble [ ] temp= new dbl [data. Length];
Int r= data. Length>>1;
For (int p = 0; p <  r;  p++)
        {
                int g= (p << 1);
                temp[p]=  data[k]  *r0  +
data [g+1] * s1;
                temp[p+r] = data [g] * x0
+data [g+1] *y1;
        }

        For ( int p = 0; p< data. length;
p++)
                Data [p] = temp[p];
    }
```

B. Genetic Algorithm

GA discover the optimal value by simulating the evolution of apopulation until survival of best fitted individuals. The survivors are individuals obtained by crossing-over, mutationand selection of individuals from the previous generation. We think that GA is a good candidate to find out theoptimal combination of segmentation results for two main reasons. First one is due to the fact that an evaluationcriterion is not very easy to differentiate. GA is an optimization method that does not necessitate to differentiate thefitness function but only to evaluate it. Secondly, if the population is important enough considering the size of thesearch space we have good guarantees that we will reach the optimal value of fitness [16].Genetic operators- genetic operators have three primary operators as selection, crossover and mutation. In the selection operator the basic chromosomes are chosed from whole population .in the crossover operator the selected chromosomes are further dividing into the binary genes for the better results. If there is any changes are required in the algorithm then mutation operator is selected for this purpose [17].

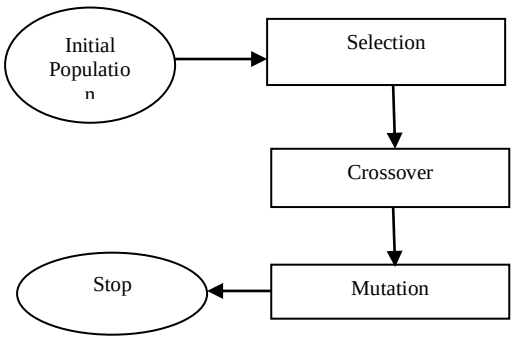

Fig. 3. GA Operators

In Fig.3. The chromosomes are chosen from the initial population after collecting all the initial population the three operators are performed which are selection, crossover and the mutation. After all these operations, the final fitness value is collected [18].

1) Pseudo Code Genetic Algorithm

Genetic Algorithm

```
Funct. Gene Algo ( )
{
Initial Pln;
Cal fitness  funct;
While ( fitness val = final val)
{
Selection; // three genetic operators
Cross Over;
Mutation;
Cal fitness Funct;
} }
```

In this pseudo code the funct term is used for function and gene algo refers to the genetic algorithm. First of all the intial population Pln are selected for the operations on the three methods as selection , crossover and mutation. Eventually the fitness function value are selected as the final value. And call the fitness function.

C. Multi Layer Perceptron Neural Networks

Multi layer perceptron neural network discovered in 1958 by Frank Rosenblatt. The whole process is based on the Mc-Culloch and Pitts with the error corrections rules. These rules contain some primary features of the Artificial intelligence systems. The first model of Perceptron neural networks is developed in the medical field such as in the human eye research. So named s perceptron Zerpa in year 2001[19]. The regulated learning issue of the MLP can be tackled with the back-proliferation calculation. The calculation comprises of two stages. In the forward pass, the anticipated yields relating to the given sources of info are assessed. In the backward pass, halfway subsidiaries of the cost work as for the distinctive parameters are engendered back through the system. The chain administers of separation gives fundamentally the same as computational tenets for the regressive go as the ones in the forward pass. The system weights would then be able to be adjusted utilizing any angle based advancement calculation. The entire procedure is iterated until the point that the weights have met. The MLP system can likewise be utilized for unsupervised learning by utilizing the supposed auto-acquainted structure. This is finished by setting similar esteems for both the sources of info and the yields of the system. The extricated sources rise up out of the estimations of the concealed neurons. This approach is computationally rather concentrated. The MLP arrange needs to have no less than three shrouded layers for any sensible portrayal and preparing such a system is a tedious procedure [20].

1) MLPNN Pseudo Code

Pseudo Code for MLPNN

```
Nrn =W.size()
For i=0
If
{
j<nrn; j++ do
w[i]= rand (-1,1)
end j<nrn: j++ do
bias =0.5// obtained output
input = read intput( )
output = read output( )
size= input.size ()
for j =0; j<size; j++
 do
sum of size =0;
for k=0; k<nrn; k++ do
sum= sum W[k]* inputs [j][k]/// ANN output
end
OP = Hardlims (sum + bias)
If output = output[j]
Then
ERR= otput[j[]
For k =0; k<nrn; k++ do
W[k]= w[k]= input[j][k]
End
Bias=0.5+ ERR
End
End
```

In the pseudo code of MLPNN there is nrm is taken as the neurons or layers and OP as the final output, W assigned to the weights that are loaded to the samples and rand as the random variables. In the processing of MLPNN for and do loops are used to compare the inputs of the sample in the neural network [21].

V. RESULT DISCUSSION

In this section, the description of results and simulation tools are described.

MATLAB is a high appearance, language for technological computing. It incorporates calculation, apparition, and programmed environment. In addition, MATLAB is modern programming language surroundings: it has complex data structures, contains built-in editing and debugs tools, and supports object oriented programming. These factors make MATLAB a commendable tool for teaching and research. To collect the dataset from the UCI machine learning site. We download the two states like benign and Malignant. We segment the tumor images and classify the tumor area and evaluate the performance parameter like an accuracy. The upload the brain tumor image from the dataset. We identify the tumor cases such as benign and malignant.

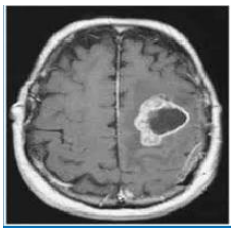

Fig. 4.Upload Image

In Fig. m the stored data ba

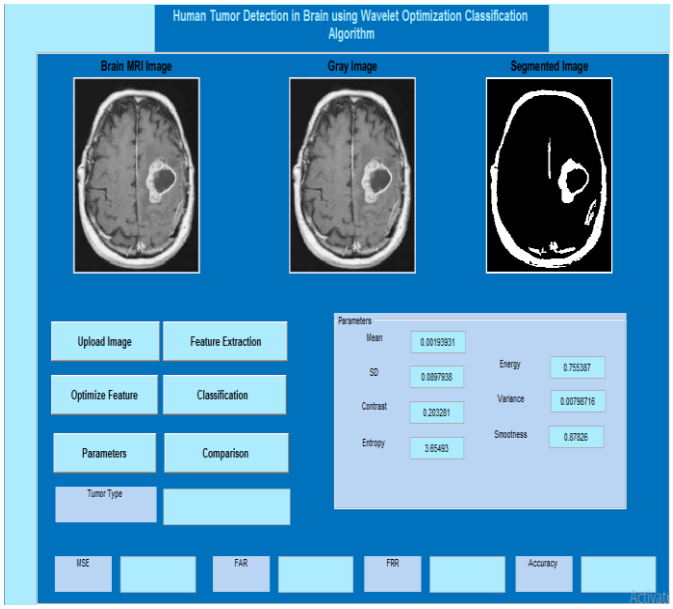

Fig. 5. Wavelet Transform

The above Fig 5 shows that apply the segmentation approach using DWT approach. In this DWT algorithm described that the divide the data using LL,HL, LH and HH. DWT for enhancement the image detect the area of the cancer image. In DWT algorithm, we identify the cancer area through the particular area. DWT based filtering procedures to adapt to spatial variations. Wavelets are functions generated from one single function Ψ by dilations and translations. The basic idea of the wavelet transform is to represent any arbitrary function as a super position of wavelets. Any such superposition decomposes the given function into different scale levels where each level is further decomposed with a resolution adapted to that level. It evaluates the features i.e., mean, standard deviation, variance , entropy, smoothness , contrast and energy etc.

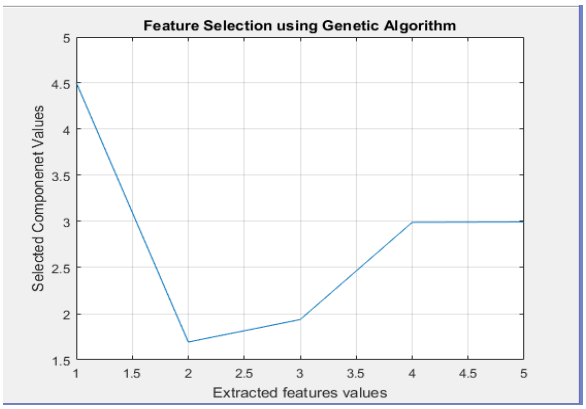

Fig. 6 Feature Selection Using Genetic Algorithm

Fig s of image uploaded from the dataset. This algorithm based on three main operators such as(i) Selection: this operator operates to select the initial population from the collected all data , After that (ii) crossover operator applied to divide the data in relevant and non relevant segments. If any end time modification required in the process of GA then, (iii) mutation operator used to make the changes in the new data. The extracted data based on the Fitness value calculations. The fitness value depends on the true false conditions. If the condition true, then the brain tumor data selected otherwise, selection process failed.

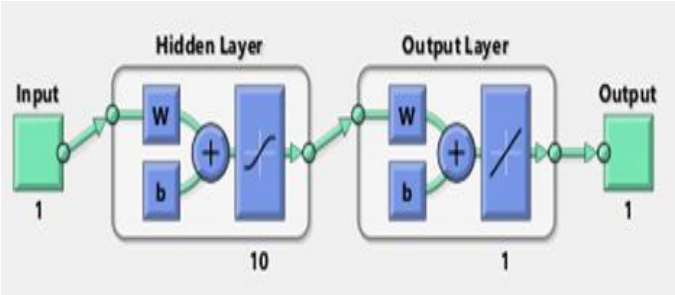

Fig. 7. MLPNN Architecture

Fig.7. This figure described the architecture of multi layer propagation neural network. MLPNN network consists of basic three layers as input layer which referred to collect and extract te data from the multiple sources. Second layer is hidden layer which divided into two parts as hidden part layer and output layer. Last layer is output layer which preferred for obtaining output from the data extracted from the hidden layer. The process of MLPN based on three phases as performance, training state and regression. The performance is

dependent on the data generated through Epoch which worked on three iterations. Training state is the place in the network which used for the knowledge base. Third phase is regression that is the sum of other states. In this way, MLPNN worked.

Performance Evaluation

Fig. 8. below defined that the brain tumor detection using Genetic algorithm .Excessive features increase computation times and storage memory. Furthermore, they sometimes make classification more complicated, which is called the curse of dimensionality. It is required to reduce the number of features. However, it is still too large for calculation.

Thus, Feature Extraction is used to further reduce the dimensions of features to a higher degree. The above figure shows that the performance parameters like accuracy value is 89%.

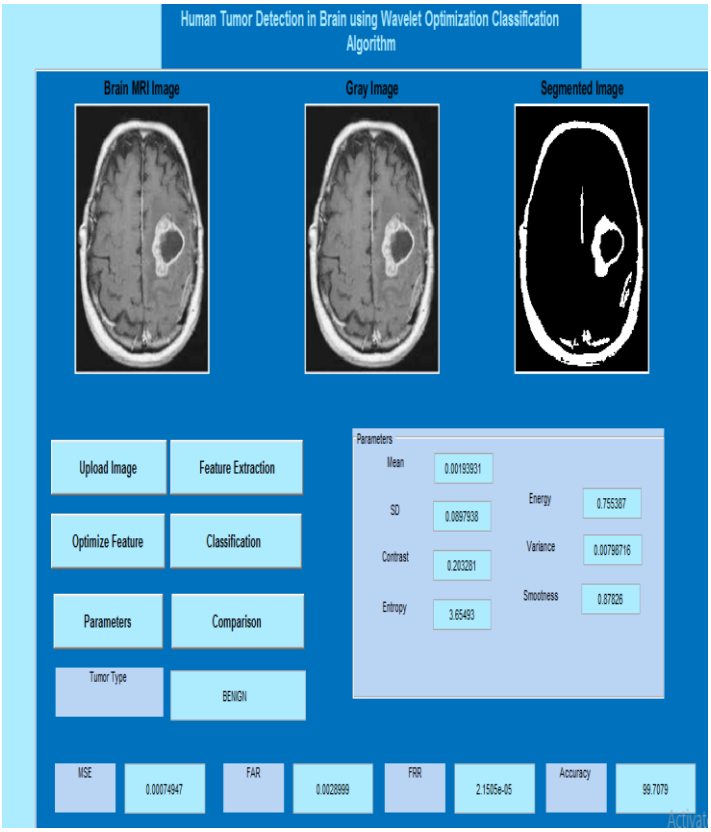

Fig. 8. Testing Window

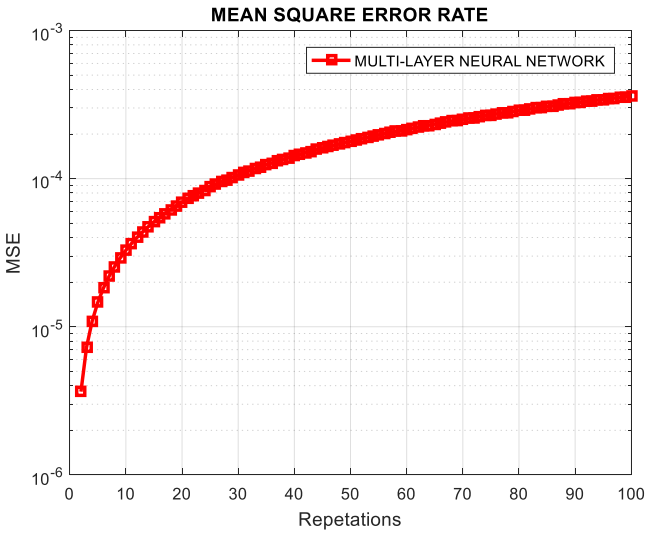

Fig.9. Mean Square Rate Error (MSE)

Fig. 9. shows the errors generated from both training state and from test .the sum of those errors obtained the mean square error rate.

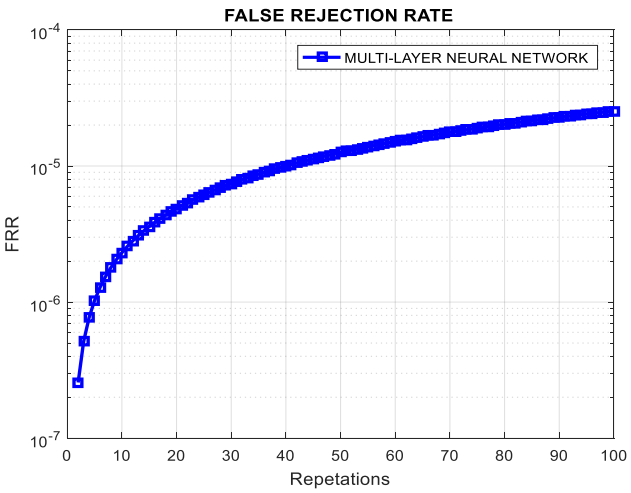

Fig. 10. False Rejection Rate (FRR)

Fig.10. Depicts the errors known as false rejection errors .in this part , the errors are expelled to increase the performance and to make the data more reliable.

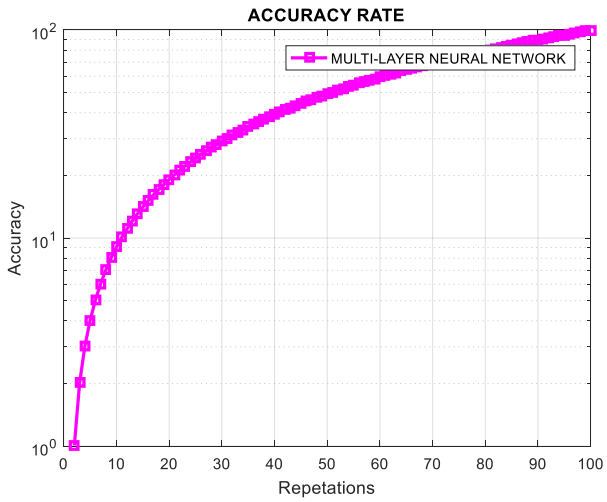

Fig. 11 Accuracy Rate

This figure represents the more accuracy when there is no errors in the system. It reduces the error rates to increment the accuracy of data.

TABLE 1. PROPOSED WORK

Parameters	Proposed Values
Accuracy	99
False Positive Rate	0.0029
False Negative Rate	2.150
Mean Square Error Rate	7.494

In table 1. defined that the proposed performance parameters are FAR value is 0.0029, FNR value is 2.1 , MSE value is 7.4 and Accuracy value is 99.

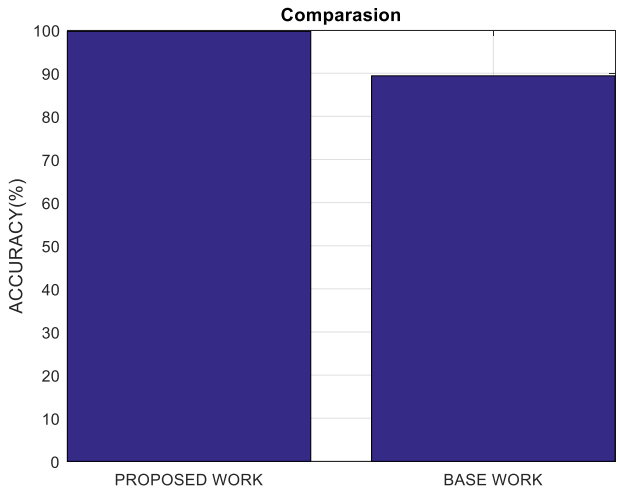

Fig. 12. Accuracy Comparison

Figure no 12 describes the accuracy obtained from the proposed work is better rather than the existing work. It shows the overall accuracy in the system.

TABLE 2. COMPARISON (BASE AND PROPOSED WORK)

Performance Metrics	Proposed Work (DWT+GA+MLPNN)	Existing Work (GA +DWT)
Accuracy Rate (%)	99	89.4

Table 2 described that the comparison existing and proposed work in the brain tumor detection. In research work algorithm improved the accuracy rate and existing work to reduce the accuracy rate. We enhanced the performance using multi layer perceptron neural network.

VI. CONCLUSION AND FUTURE SCOPE

Now a days, image segmentation play vital role in medical image segmentations. The segmentation of brain tumor from magnetic resonance images is an important task. Manual segmentation is one of the techniques for finding tumor from the MRI. This method is time consuming but also generates errors. Segmentation by experts are variable . Manually segmentation takes at least three hours to complete. So, several automated technique have been developed. In this paper several existing brain tumor segmentation and detection methodology has been discussed for MRI of brain image. After segmentation the next step is feature extraction. The feature extraction is extracting the group which shows the predicted tumor at the output. The extracted cluster is given to the thresholding process. It applies binary mask over the entire image. It makes the dark pixel become darker and white become brighter. In threshold coding, each transform coefficient is compared with a threshold. In this work, an algorithm is implemented to extract and calculate the area of the tumor region for four MR images based on morphological operation. This algorithm has failed to distinguish between a mass in brain or tumor. In this work only area is calculated but many features like height, width, perimeter and volume are needed to properly analysis the MR images and also need to implement accurate algorithm for calculating patient's life expectancy based on the growth of Brain Tumors. In the proposed work, the algorithms are improved with better performance parameters in terms of Accuracy , Mean Square error rate, False positive rate and False rejection rate. Overall, performance is greater as compared to the existing work.

In future we incorporate the preprocessing step to improve the contrast of tumor regions with background which helps to improve the performance of algorithm. It will implement the brain tumor detection and classification together with appropriate segmentation approach. Along with this comparison between K- means and fuzzy C-Means Clustering, GA and PSO has also being drafted.

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