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An Approach for Brain Tumor classification using Artificial Neural Network

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Abstract: Brain Tumor is detected by using automatic support intelligent system through the neural network system. Automatic support intelligent system helps in the diagnostic and assistance in the treatment of the brain tumor. To find the brain tumor is a very difficult problem because of the complexity of the cells in the brain. In this paper we are presenting an analytical method that improves the detection of brain tumor cells in its initial stages by investigating anatomical constructions for training and classification of the samples in neural network system. The back propagation neural network will be used for classification purpose of brain tumor whether it is benign or malignant. In this paper, the MRI images of brain have been taken into consideration.

Keywords: Magnetic Resonance Image, Segmentation, Back Propagation Network, Image processing, Brain tumor.

I. INTRODUCTION

Brain and spinal cord are the most vibrant parts of our body. Neurons (nerve cells) and Glial cells (supporting cells) are combined together and make these parts. Message passing is done through nerves that control all the parts of body. Bulk of abnormal tissues is called a tumor. Some brain tissues are multiplied in anomalous manner and make tumors. Tumors are not contained in a specific part of brain. They can rise from any part of spinal cord, nerves or brain. Most common and fatal disease in the world is brain tumor. So detection of it in the initial stage is important for cure. Brain tumors are of different types that creates the difficulty in treatment.

So to classify whether a patient is suffering there is a need of classification. A good classification technique is very important for the treatment of brain tumor. Brain tumor segmentation is one of the crucial procedures in surgical and treatment planning. However, at present, brain tumor segmentation in brain tumor images is mostly performed manually in clinical practice. Apart from being time consuming, manual brain tumor delineation is difficult and depends on the individual operator. Currently, multimodal MRI images are used simultaneously by radiologists in segmenting brain tumor images because multimodal MRI images can provide various data on tumors. In brain structure analysis, the tissues which are WM and GM are extracted. There are two stages in decision making-first stage is feature extraction using GLCM (Gray Level Co-occurrence matrix) and the second is classification using neural network Technique. Back propagation neural network has been used in this study for classification. The segmentation is performed by Watershed segmentation and its result would be used as a further processing to detect the brain tumor which would increases the odds of endurance for the patient. After segmentation the size of the tumor is also calculated. The results obtained by both back propagation and feed forward are compared on the basis of performance, accuracy and efficiency of the systems. The results which are calculated from simulation show better accuracy than previous methodologies. Brain tumor is of two types-

(1) Benign Tumor- Benign is a tumor which does not expand in abrupt way. Neighboring healthy tissues are not affected by benign. It grows slowly and does not expand to nonadjacent tissues. As it grows there is a chance that it pressurizes the normal brain and affects the cerebral and human functions. The common example of benign tumor is holes.
(2) Malignant Tumor- Malignant is a type of tumor that grows rapidly with the time and ultimately leads to death of the person. Basically malignant defines the severe processing of disease. This tumor is cancerous. Malignant tumor can spread to the other part of brain or spine.

Back Propagation Neural Network is used for classification of tumor. As, there is an important need for the doctors to judge whether the tumor is curable or not and it is performed only when the detection and classification is done efficiently.

II. REVIEW OF LITERATURE

Kohir and Karaddi[1] developed a system to classify the brain tumor whether it is benign or malignant or normal image. They used OTSU threshold method for segmentation and GLCM method for the feature extraction. On these features they applied artificial neural network techniques to compare the results of them. Back propagation and probabilistic neural network techniques are used to classify. Back propagation gives 80% accuracy in this case while PNN gives better than back propagation.

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Selkarand & Thakare [2] developed a system to detect the brain tumor whether it is benign or malignant. They used two methods of segmentation. First one is watershed segmentation followed by thresholding and another is threshold segmentation. Watershed segmentation gives the better results as compared to threshold segmentation. P. Sangeetha [3] developed a system for classifying the brain tumor whether it is benign or malignant. PNN-RBFN is used for training and classification purpose and wavelet based co-occurrence feature extraction is also used.
Singhai and Ladhake [4] developed a system which is used to detect the tumor based on marker based watershed segmentation to detect the tumor. In this area of the tumor is also calculated on the basis of connected component analysis in pixel.
Madhusudhanareddy and Prabha[5] developed a novel approach to classify the brain tumor in benign and malignant. They used two layer feed forward neural network with sigmoid to classify the tumor. They worked on the set of 36 images. Morphological operation such as dilation is used for filling the gaps so that the proper shape of the tumor will detect.
Binoy et al [6] conducted a comparison study between various techniques of features extraction separately combined with artificial neural network. They used DCT (Discrete cosine transform), DWT (Discrete wavelet transform) and PCA (Principal component analysis) for feature extraction and Probabilistic neural network for classification. As a result PCA with PNN gave better results than other two combinations.
Oo and Khaing [7] developed a system to detect whether given brain slice is having tumor or not. They used watershed segmentation to segment the image morphological operators to get proper shape of the tumor. In this erosion is used as a morphological operator to fill the gaps at the boundaries. They also calculated the area of the tumor in terms of square inches.
Jain and Mishra [8] developed a system to classify whether a given image is having tumor or not. They calculated texture based seven features and extracted them by using GLCM. Two approaches were used to classify the brain tumor. One is back propagation neural network and other one is probabilistic neural network.
Sindhu et al [9] developed a system to extract the features of an MRI image. These features can be used for the purpose of classification. They use k means clustering to extract the features. Image segmentation plays a critical role in all advanced image analysis applications, a key purpose of segmentation is to divide image into regions and objects that correspond to real world objects or areas, and the extent of subdivision depends on requirements of specific application. Complete segmentation of an image scene, where objects correlate with real world objects, cannot be usually achieved without inputs from the user or specific knowledge of the problem domain. Image feature selection is a significant prerequisite for most image processing algorithms, depending on these features the segmentation methods can be classified into three categories namely thresholding, edge-based, region-based segmentation. As clear from the literature, that there are discrepancies in the results obtained using different segmentation and classification methods, there is a scope of improvement. Next section discusses the proposed method for brain tumor classification.

III. PROPOSED METHOD

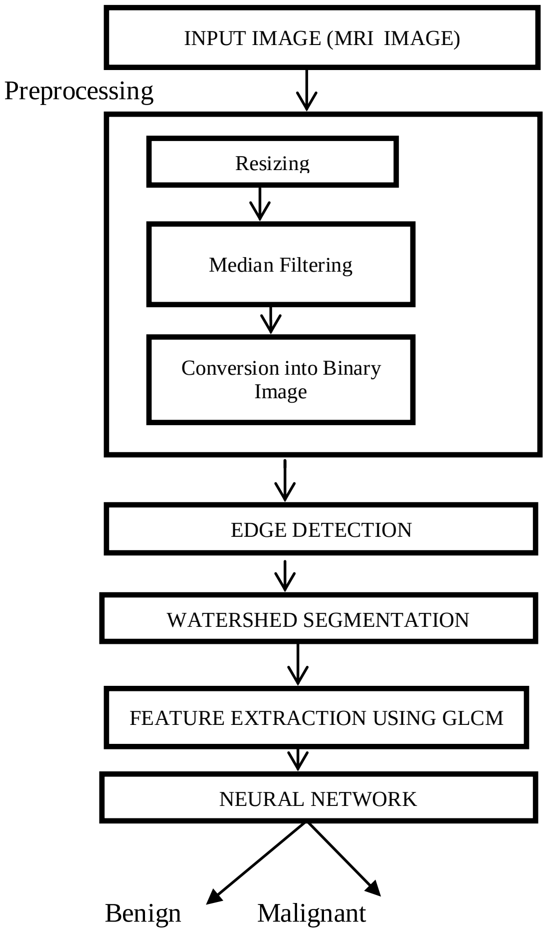

Fig 1: Proposed Methodology

A. Preprocessing
There is a huge variance in “contrast, brightness and luminosity “inside the brain images, which make it composite and extort brain features. Therefore, image pre-processing is fundamentally required to eliminate the occurrence of noise in the image and equalization of the unbalanced illumination present inside the brain images. The image pre-processing includes the following steps:

B. Resizing the image
Original image is a rectangular matrix of pixels. For the convenient and simplicity purpose these rectangular images need to resize. In most cases further processing is done on the square images i.e. square matrix of pixels. In this paper we are also using the square matrix of pixels and gray scale images. Gray images can take any values between 0-255. The images are converted in 200*200 square images in this study for further processing.

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C. Noise Removal

After resizing the image, next step is removal of the noise. 'fespecial' has been used in this study to remove the noise available in the images. This filter approximates the motion of the image. This removes the noise in the image at an extent. But there are some other outliers available in the image. To remove these outliers the addition operation of the images are performed. After applying the filter, the resized image and the output image are added and then median filtering is applied to remove outliers and enhanced the image.

D. Median Filtering

Median filtering is the best technique for suppressing the secluded noise without distorting sharp edges. It modifies the pixel by the degree of median of all pixels in the surrounding of small sliding window. Median filter helps in eradicating the salt and pepper noise and horizontal perusing artifacts. During the image pre-processing, the salt and pepper noise is added to the intensity band and then it is strained by using median filtering of 3*3 sizes. Median filter removes the noises as well as preserves the edges. Since there is a need to extract and calculate the area of tumor , median filtering has been used here.

E. Grey to Binary Conversion

After median filtering, the resultant image is converted into binary image. To convert the gray image which is having 256 values into binary image of 2 values, there is a need to set up a threshold. Binary image can take 2 values i.e. 0 or 1. Binary images are useful in segmentation part because tumor part should be represented by foreground and remaining part should be background. To distinguish image into foreground and background there is a need of converting the gray image into binary image. After conversion the segmentation is done to extract the part of tumor. OTSU global threshold method is used to set the threshold for conversion into binary image.

F. OTSU Global Threshold Method

We have used OTSU global threshold method because in the brain MRI image salt and pepper noise is generally found. The working of OTSU is very simple: First of all, threshold is calculated such that the weighted within-class variance should be minimized. This gives the same result that comes when between-class variance is maximized. It operates on gray level histogram. Certain assumptions which should be considered are –

(1) Histogram (also the image) must be bimodal.
(2) Spatial coherence and other object structure are of no use here.
(3) The assumptions are stationary but it can be adaptive by modifying it.
(4) Another assumption is uniformity in illumination.

Within-Class Variance (Weighted) can be calculated as:

$\sigma_w{}^2(t) = q_1(t)\,\sigma_1{}^2(t) + q_2(t)\,\sigma_2{}^2(t)$

Where the Class Probabilities are estimated as-

$q_1(t) = \sum_{i=1}^{t} P(i)$

$q_2(t) = \sum_{i=t+1}^{I} P(i)$

And the class means are given as-

$\mu_1(t) = \sum_{i=1}^{t} \frac{iP(i)}{q_{1(t)}}$

$\mu_2(t) = \sum_{i=t+1}^{t} \frac{iP(i)}{q_{2(t)}}$

Finally the individual class variances can be written as:

$\sigma_1{}^2(t) = \sum_{i=1}^{t} [i - \mu_1(t)]^2 \frac{P(i)}{q_{1(t)}}$

$\sigma_2{}^2(t) = \sum_{i=t+1}^{t} [i - \mu_2(t)]^2 \frac{P(i)}{q_{2(t)}}$

From the full range of gray values, we pick the value that minimizes $\sigma_w{}^2(t)$.

Between/within and total variance

The basic idea for total variance is that, it is not dependent on threshold. For any given threshold, the total variance is the sum of the weighted within-class variances and the between class variances, which is the sum of weighted squared distances between the class means and the grand mean.

Now after performing some algebra the total variance can be expressed as-

$\sigma^2 = \sigma_w{}^2(t) + q_1(t)\,[1-q_1(t)][\mu_1(t) - \mu_2(t)]^2$

The first part is within-class variance and second part is between-class variance.

Since total is constant and independent of the value t, to change the threshold two terms contributed more. The good thing about this is that it can compute the quantities in $\sigma_B^2(t)$ again and again through the values of t.

Finally, Initialization takes place as-

$q_1(1) = P(1), \quad \mu_1(0) = 0$

Recursion is done as-

$q_1(t+1) = q_1(t) + P(t+1)$

$\mu_1(t+1) = \frac{q_1(t)\mu_1(t)+(t+1)P(t+1)}{q_{1(t+1)}}$

$$\mu_2(t+1) = \frac{\mu - q_1(t+1)\mu_1(t+1)}{1 - q_1(t+1)}$$

IV. BACK-PROPAGATION NEURAL NETWORK

Back propagation neural network is neural network is different from feed forward neural network in a way that it has the feedback. Since feed forward network does not have feedback so the training of the samples are not as effective as in back propagation. For getting the better results the back propagation neural network has been used here. The learning of back propagation is done by examples. Firstly the algorithm needs the examples that what system wants from it to do and it changes the weight of network so that when training is finished it will give the output which is needed. Once the network is trained it gives the desired output for any of the input pattern.

In a multilayer net, the information coming to the input nodes could be recoded into an **internal representation** and the outputs would be generated by the internal representation rather than by the original pattern. Input

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patterns can always be encoded, if there are enough hidden units, in a form so that the appropriate output pattern can be generated from any input pattern.

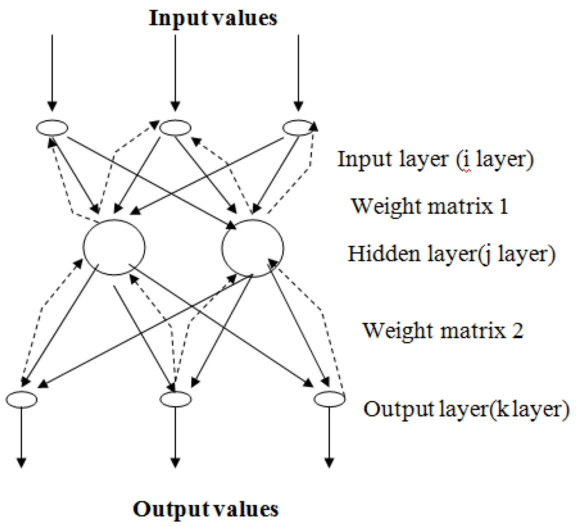

Fig 2: Back Propagation Neural Network

V. RESULT & ANALYSIS

This section describes the results after applying the steps mentioned above in section III.
Sample Image results:
The Area of image = 3341 pixels
Now the values of features after applying feature extraction:
Contrast = 2.4317
Homogeneity = 0.9566

Table 1: Feature matrix of images

Image	Area	Contrast	Homogeneity	Energy	Correlation	Entropy
1	3627	3.10	0.94	0.73	0.69	0.5260
2	3462	1.82	0.96	0.78	0.79	0.4738
3	4467	2.17	0.96	0.73	0.80	0.5591
4	3341	2.43	0.95	0.76	0.73	0.4858
5	4160	2.21	0.96	0.73	0.79	0.5483
6	3849	2.29	0.95	0.74	0.77	0.5295

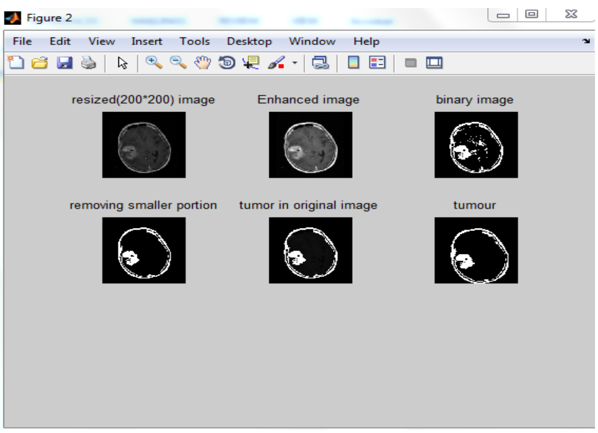

Fig 3: Results after applying various steps.

After detection of the tumor, classification has been done to know the category of the tumor i.e. whether it is a benign or malignant tumor. We have selected the MRI image from our dataset and after applying the preprocessing and other steps described in Fig 1, we came to know that it is a malignant type of tumor.

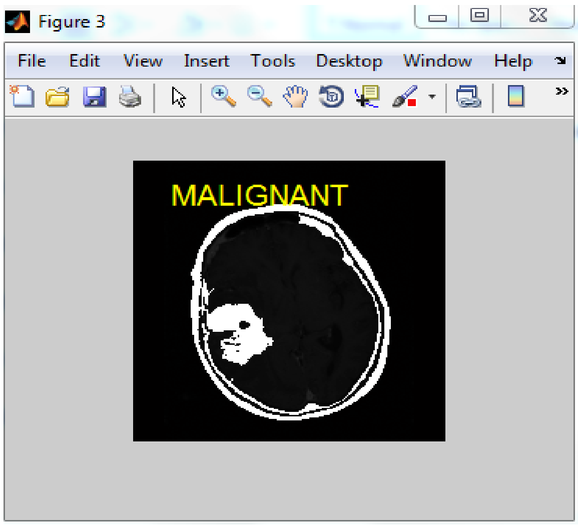

Fig4: Final Classification

VI. CONCLUSIONS

This paper focuses on an automated brain tumor detection and classification system. First, tumor has been detected and then classified it in the benign or malignant categories. This system can be used for the early detection of the brain tumor. The MRI image of brain is taken for the processing. First step is the pre-processing of image in which three steps are performed. Watershed segmentation has been used for segmentation purpose. After that morphological operators are used to fill in the gaps at the boundaries of the tumor. After applying these steps the tumor is extracted and the area of the tumor is calculated in the form of pixels. The feature extraction is done with the help of GLCM. Total six features are calculated. From these features, some features are given to the neural network modal which gives the classification of the tumor. Back propagation neural network is used. The performance of this system is good as tested on many images. From the above results it is clear that the tumor has been detected efficiently. The proposed system also successful in classification of the tumor whether its a benign or malignant. This method can be applied for detection and classification of brain cancer.

REFERENCES

[1] V.V. Kohir and S.H. karaddi, “Detection of brain tumor using back propagation and probabilistic neural network”, 19th IRF International Conference Chennai, pp.74-80, 2015
[2] R.G. Selkar and M.N. Thakre,” Brain tumor detection and segmentation by using thresholding and watershed algorithm,” International journal of advanced informational and communication technology (IJAICT), , pp.321-324, 2014.

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[3] P. Sangeetha, "Brain tumor classification using PNN and clustering", International journal of innovative research in science, Engineering and Technology, pp.396-803, 2014
[4] P.P. Singhai and S.A. Ladhake," Brain tumor detection using marker based watershed segmentation from digital MR images", International journal of innovative technology and exploring engineering, pp.201-204, 2013.
[5] P. Madhusudhanareddy and I.S. Prabha," Noval approach in brain tumor using artificial neural network," International journal of engineering research and applications , pp.2378-2381, 2013.
[6] B.K. Binoy, D. Shetty, J.A. Mathew," International journal of electronic and electrical engineering," pp.31-36, 2014.
[7] S.Z Oo, and A.S. Khaing ,"Brain tumor detection and segmentation using watershed segmentation and morphological operators", International journal of research in engineering and technology, pp.367-374, 2014
[8] S. Jain and S. Mishra, " ANN approach based on back propagation network and probabilistic neural network to classify brain tumor," International journal of innovative technology and exploring engineering pp.101-105, 2013.
[9] S.S. Siva, Sindhu, M. Sangeetha, R. Shenbaga, A.R.," Feature extraction of brain tumor using MRI," International journal of innovative research in science, Engineering and Technology, pp.10281-10286, 2014.
[10] D.Y. Lin Huang, T.W. Hu, W.C. ,"Automatic multilevel thresholding based on two level OTSU'S method with cluster determination by valley estimation," International journal of innovative computing, information and control, pp.5631-5644, 2011.
[11] D. Shevad, "Multiple object segmentation and tracking in image sequence," Lamar University -Beaumont, April 2005.
[12] B.Sudha, P.Gopikannan, A.Shenbagarajan, C.Balasubramanian," Classification of Brain Tumor Grades using Neural Network ," Proceedings of the World Congress on Engineering ,Vol I, WCE 2014, July 2 - 4, 2014, London, U.K.
[13] Simon Haykin, "Neural Network designs". I Edition, Vikas Publishing House, New Delhi, India, 2004.
[14] Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing," Pearson Education, New Delhi, India, 2004.
[15] M. Ozkan, B.M. Dawant, R.J. Maciunas, "Neural-network based segmentation of multi-modal medical images: a comparative and prospective study," Medical Imaging, IEEE Transactions on, vol.12, no.3, pp.534-544, Sep 1993.