Automated Classification of Brain Tumor Images Employing DWT and Deep Neural Networks

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Abstract - Brain tumour classification using conventional techniques involving human intervention is prone to errors. Errors in feature extraction and/or classification may turn out to be fatal. Hence focus has shifted on automated techniques for the feature extraction and classification of brain tumour images. In the present work, a mechanism for the same has been proposed involving Artificial Neural Networks (ANN). Three categories have been incorporated in the present work, viz. normal brain, brain with benign tumour and brain with malignant tumour. In the present case, MRI images of the brain have been used to train an Artificial Neural Network which subsequently predicts the category of some new MRI data. The key challenge in designing such a system is attaining high accuracy of classification. This can be achieved by accurate feature extraction mechanism and then designing an appropriate Neural Network for training and testing. At the outset, segmentation has been employed to separate the region of the tumour (if any). Later the Discrete Wavelet Transform (DWT) is used as a preprocessing tool. The DWT helps in removing the non linearities of the image signal and smoothen it out. Since images exhibit abrupt changes in pixel values, conventional Fourier methods like the Fourier Transform prove to be unfit for image analysis. Subsequently, features like contrast, correlation, energy, homogeneity, mean, standard deviation, entropy, RMS value, variance, smoothness, kurtosis and skewness have been evaluated. Prior to training the Neural Network using the feature values, Principal Component Analysis (PCA) has been employed to find trends in the feature values. A Probabilistic Neural Network (PNN) has been designed and it has been trained using the feature values. I has been found that brain tumour MRI image are classified into normal, benign and malignant category using PNN classifier with an accuracy of 97% for the used data set which can be attributed to the efficacy of the proposed method.

***Key Words*:** Brain Tumor Classification, Machine Learning, Feature Extraction, Neural Networks, Confusion Matrix, Classification Accuracy.

1.INTRODUCTION

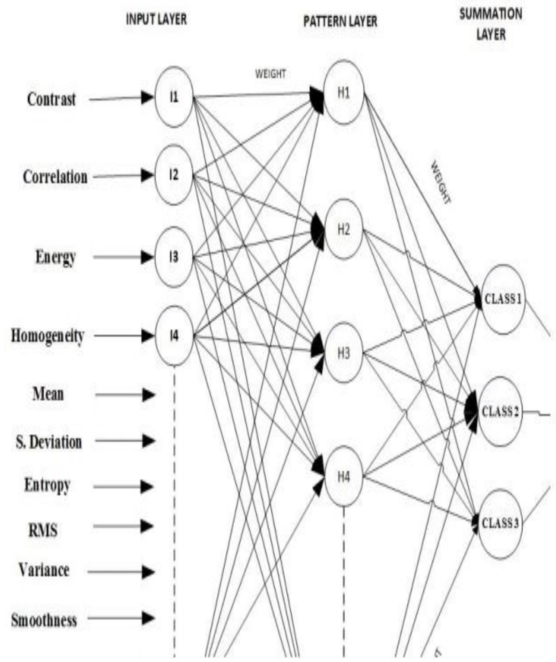
Probabilistic Neural network (PNN) with photo and records processing techniques may be hired to implement an automated brain tumor class. The traditional technique for clinical Resonance (MR) brain pictures classification and tumors detection is with the aid of human inspection .Operator-assisted class techniques are impractical for large quantities of records and are also non-reproducible. Medical Resonance (MR) images incorporate a noise due to operator performance that could lead to inaccuracies in class. The use of synthetic intelligent techniques like neural networks, and fuzzy common sense has proven tremendous potential on this field. Traditional strategies of monitoring and diagnosing the illnesses rely on detecting the presence of particular capabilities by means of a human observer.

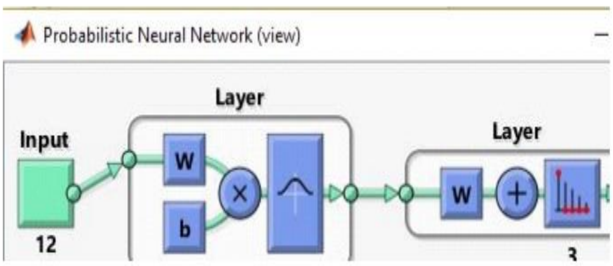
2. Body of Paper

We have created an effective and efficient computer aided determination method for brain tumor classification implemented trying using the DWT for processing in advance the image as an extraction tool, Principal component analysis (PCA) as dimensionality reduction tool along with PNN as a Probability based classification paradigm or tool.. PNN are mathematical analogous to biological neuron device. They're made from parallel interconnected machine of nodes called neurons. Mixture of PNN with one-of-a-kind forms of gaining knowledge of schemes outcomes in a diffusion of PNN structures. The entire PNN systems do not yield a fine bring about all of the sensible applications. Relying on the precise requirement, PNN system is to be designed. The proposed paintings describe using PCA and PNN in automatic class of the mind tumors. PCA is a mathematical technique this

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 09 | September - 2023 SJIF Rating: 8.176 ISSN: 2582-3930

is used to lessen the big dimensionality of the facts after which PNN may be used for category of the tumors





After following the steps mentioned in the proposed methodology, one reaches at the results obtained. The process entailed in reaching acquired outputs is given below: • One image is loaded at a time to the MATLAB workspace. • RGB to Grayscale Conversion and Binary Thresholding for conversion of the Binary Image have been employed as a preprocessing tool. • Segmentation has been used to remove the area of probable tumor (if any). • Subsequently Discrete Wavelet Transform (DWT) has been implemented smoothen out the non-linearity inside the image to facilitate feature extraction. • Principal Component Analysis (PCA) has been made use of to find regular patterns or trends in the DWT coefficients computed above. • Twelve feature values are computed for the image under consideration. • The above process is employed to the entire range of training data samples in the information set. • The feature values obtained for the complete set of training values that are needed to make the PNN learn • The PNN is then put to the final feature test using the remaining images of the data set. • Sensitivity and Accuracy have been evaluated for the Proposed System Design. The results obtained through the above mentioned steps have been shown below.

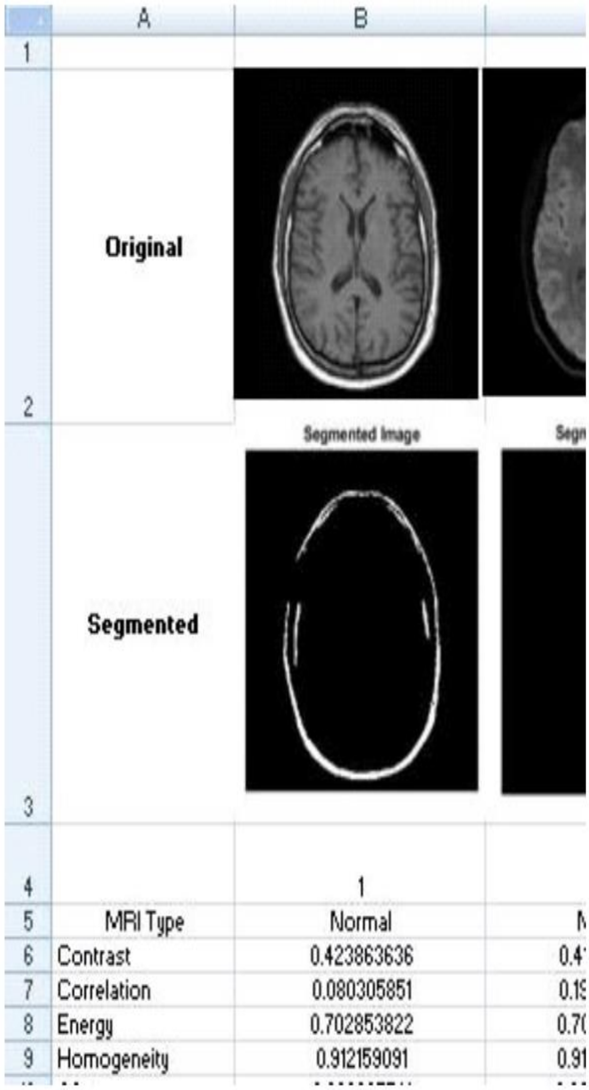


Fig 5.1: Shows the Parameters Calculated For Brain MRI Images

Table 5.1: This table is generated by fig 5.1

	MRI type	Normal	Normal
1	Contrast	0.423863636	0.417613636
2	Correlation	0.080305851	0.193570981
3	Energy	0.702853822	0.709520919
4	Homogeneity	0.912159091	0.914299242
5	Mean	0.003935541	0.007328694
6	Standard Deviation	0.106556652	0.106376924
7	Entropy	2.743369367	2.575002567
8	RMS	0.106600358	0.106600358
9	Variance	0.011361868	0.011315766
10	Smoothness	0.879123104	0.931240417
11	Kurtosis	6.961505164	8.09675679
12	Skewness	0.711892665	0.861298531

3. CONCLUSIONS

Concluding remarks about the proposed study of work can be outlined as: • The presented work of study puts forth a novel yet comprehensive approach in brain tumor classification. The work focuses on two vital aspects of classification problems viz. pre-processing of data that is raw using the networks. Since the MRI images can contain disturbances and degradations in noise form and random fluctuations, henceforth it becomes mandatory to remove them with some suitable tool. • In this case the tool used is Discrete Wavelet Transform. DWT smoothens up the image by removing the non-linearity. Also being a sampled form of the Continuous Wavelet Transform, DWT also helps in removing spatial redundancy. Sectoring of the sector containing suspected tumors is implemented using pixel thresholding. This process helps in clearly identifying the area of possible tumor. • Overall twelve features have been evaluated for training of the neural networks designed. It must be marked that the more the number of images, greater is the possibility of accurate classification and detection of brain tumors. Subsequently to follow a particular trend for the extracted feature values, principal component analysis (PCA) has been employed. • Finally values adhering to feature so obtained are used to train the designed neural network. here a Probabilistic Neural network (PNN) has been used to categorize the new data sets. PNN works on the basis of the Baye's theorem considering the feature values of classified data as true and then predicting the class of any new image based on it. The feature values of the twelve enlisted features serve as the training data of the neural network. Following a convention, 70% data has been used for training and 30% data has been used for testing. It has been observed that our proposed work technique shows no false positives or false negatives for the used data set thereby achieving an accuracy of 97%.

REFERENCES

[1] N Ghassemi, A Shoeibi, M Rouhani (2020), Deep neural network with generative adversarial networks pre-training for brain tumor classification based on MR images", Biomedical Signal Processing and Control, Elsevier 2020, Volume 57, pp. 101678.

[2] J Amin, M Sharif, M Raza, T Saba, MA Anjum, (2019) Brain tumor detection using statistical and machine learning method, Computer Methods and Programs in Biomedicine, Elsevier 2019, Volume 177, pp. 69-79.

[3] G. Manogaran, P. M. Shakeel, A. S. Hassanein, P. Malarvizhi Kumar and G. Chandra Babu, (2018) "Machine Learning Approach-Based Gamma Distribution for Brain Tumor Detection and Data Sample Imbalance Analysis," in IEEE Access, vol. 7, pp. 12-19.

[4] L. Chato and S. Latifi, "Machine Learning and Deep Learning Techniques to Predict Overall Survival of Brain Tumor Patients using MRI Images," 2017 IEEE 17th International Conference on Bioinformatics and Bioengineering (BIBE), 2017, pp. 9-14.

[5] Hasan A., Dr.Jumaa D.&Dr.Bashk S.(2016) "Brain image classification based on discrete wavelet transform and probabilistic neural network" International Journal of Scientific & Engineering Research, Volume 7, Issue 5