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Brain Tumor Extraction using Genetic Algorithm

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Abstract: A Brain Cancer is very serious disease causing deaths of many individuals. The detection and classification system must be available so that it can be diagnosed at early stages. Cancer classification has been one of the most challenging tasks in clinical diagnosis. At present cancer classification is done mainly by looking through the cells' morphological differences, which do not always give a clear distinction of cancer subtypes. Unfortunately, this may have a significant impact on the final outcome of whether a patient could be cured effectively or not. We have proposed a methodology to segment and classify the brain MRI image using k-means clustering algorithm and Genetic algorithm.

Keywords: k-means, Genetic classification

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Introduction

Automated classification and detection of tumors indifferent medical images is motivated by the necessity of high accuracy when dealing with a human life. Also, the computer assistance is demanded in medical institutions due to the fact that it could improve the results of humans in such a domain where the false negative cases must be at a very low rate. It has been proven that double reading of medical images could lead to better tumor detection. Conventional methods of monitoring and diagnosing the diseases rely on detecting the presence of particular features by a human observer. Due to large number of patients in intensive care units and the need for continuous observation of such conditions, several techniques for automated diagnostic systems have been developed in recent years to attempt to solve this problem. Such techniques work by transforming the mostly qualitative diagnostic criteria into a more objective quantitative feature classification problem. In this project the automated classification of brain magnetic resonance images by using some prior knowledge like pixel intensity and some anatomical features is proposed. Currently there are no methods widely accepted therefore automatic and reliable methods for tumor detection are of great need and interest. The application of PNN in the classification of data for MR images problems are not fully utilized yet. These included the clustering and classification techniques especially for MR images problems with huge scale of data and consuming times and energy if done manually. Thus, fully understanding the recognition, classification or clustering techniques is essential to the developments of Neural Network systems particularly in medicine problems.

Segmentation of brain tissues in gray matter, white matter and tumor on medical images is not only of high interest in serial treatment monitoring of "disease burden" in oncologic imaging, but also gaining popularity with the advance of image guided surgical approaches. Outlining the brain tumor contour is a major step in planning spatially localized radiotherapy (e.g., Cyber knife, iMRT) which is usually done manually on contrast enhanced T1-weighted magnetic resonance images (MRI) in current clinical practice. On T1 MR Images acquired after administration of a contrast agent (gadolinium), blood vessels and parts of the tumor, where the contrast can pass the blood–brain barrier are observed as hyper intense areas. There are various attempts for brain tumor segmentation in the literature which use a single modality, combine multi modalities and use priors obtained from population atlases.

Literature Review

Parveen, Amritpal singh suggested that method uses Gray Level Run Length Matrix (GLRLM) to extract features.The reduced GLRLM features are deferred to support vector machine for training and testing.The brain MRI images were classified using SVM techniques which are widely used for data analyzing and pattern recognizing[1].

Arashdeep Kaur suggested that method used an approach to detect brain tumor using four different methods namely Otsu, K-means, Fuzzy-c-Means and thresholding. The main objective of this paper is to develop a fully automated brain tumor detection system that can detect and extract tumor from MR Image of brain. This paper also gives the comparison between the algorithms presented [2].

Aniket A. kathalkar suggested that deals with such a system which uses computer based procedures to detect tumor blocks and classify the type of tumor using Artificial

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Neural Network Algorithm for MRI images of different patients. Different image processing techniques such as histogram equalization, image segmentation, image enhancement, morphological operations and featureextraction are used for detection of the brain tumor in the MRI images of the cancer affected patients[3]

Aqhsa Q. Syed1,K.Narayanan introduced one automatic brain tumor detection method to increase the accuracy and yield and decrease the diagnosis time. Here, it is tried to give clear description from brain tissues using Multi-Layer Perception Network, energy, entropy, contrast and some other statistic features such as mean, median, variance and correlation. It is used from a feature selection method to reduce the feature space too. This method uses from neural network to do this classification.[4]

S. N. Deepa and B. Aruna Devi introduced a survey has been made on the applications of intelligent computing techniques for diagnostic sciences in biomedical image classification. This study gathers representative works that exhibit how AI is applied to the solution of very different problems related to different diagnostic science analysis. It also detects the methods of artificial intelligence that are used frequently together to solve the special problems of medicine. SVM neural network issued in almost all imaging modalities of medical image classification. Similarly fuzzy C means and improvements to it are important tool in segmentation of brain images. Various diagnostic studies like mammogram analysis, MRI brain analysis, bone and retinal analysis etc., using neural network approach result in use of back propagation network, probabilistic neural network, and extreme learning machine recurrently. Hybrid approach of GA and PSO are also commonly used for feature extraction and feature selection [5]

J. selvakumar, A. Lakshmi,T.Arivoli suggested that a noise free image is given as a input to the k-means and tumour is extracted from the MRI image. And then segmentation using Fuzzy C means for accurate tumour shape extraction of malignant tumour and thresholding of output in feature extraction. Finally approximate reasoning for calculating tumour shape and position calculation. The experimental results are compared with other algorithms.[6]

Eltaher Mohamed Hussein 1 suggested an automated recognition system for MR imaging using ANNs. It was observed that when Elman network was used during the recognition process, the duration time and the accuracy level were high, compared with other ANNs systems.[7]

Kamal Kant Hiran reviewed the techniques of the MRI image enhancement in terms of tumor pixels detected. They studied several digital image processing methods and discussed its requirements and properties in brain tumor detection .This paper gives enhanced information about brain tumor detection and segmentation. The marked area is segmented and the assessment of this tool from the radiologist, whom the project is concerned with, is positive and this tool helps them in diagnosis, the treatment procedure and state of the tumor monitoring.[8]

R. J. Deshmukh, R.S. Khule presents a automated recognition system for the MRI image using the neuro fuzzy logic. Features are extracted from raw images which are then fed to ANFIS (Artificial neural fuzzy inference system).ANFIS being neuro-fuzzy system harness power of both hence it proves to be a sophisticated framework for multi object classification. A comprehensive feature set and fuzzy rules are selected to classify an abnormal image to the corresponding tumor type.[9]

The system develoved in this study classifies and identifies pathological tissues in a noninvasive and automated fashion. The designed brain tumor detection and classification system uses conceptually simple classification method using the neural network. Textures features are used in the training of the ANN. Co-occurrence matrices at different directions are calculated and GLCM features and Gabor features are extracted from the matrices.[10]

Proposed System Architecture

The method include brain tumor segmentation using optimized k-means and genetic algorithm.
Optimized k-means algorithm will be used for clustering. Genetic algorithm will be used for classification. At the end of process the tumor is extracted from the MRI image and also its exact position and shape are determined in grayscale
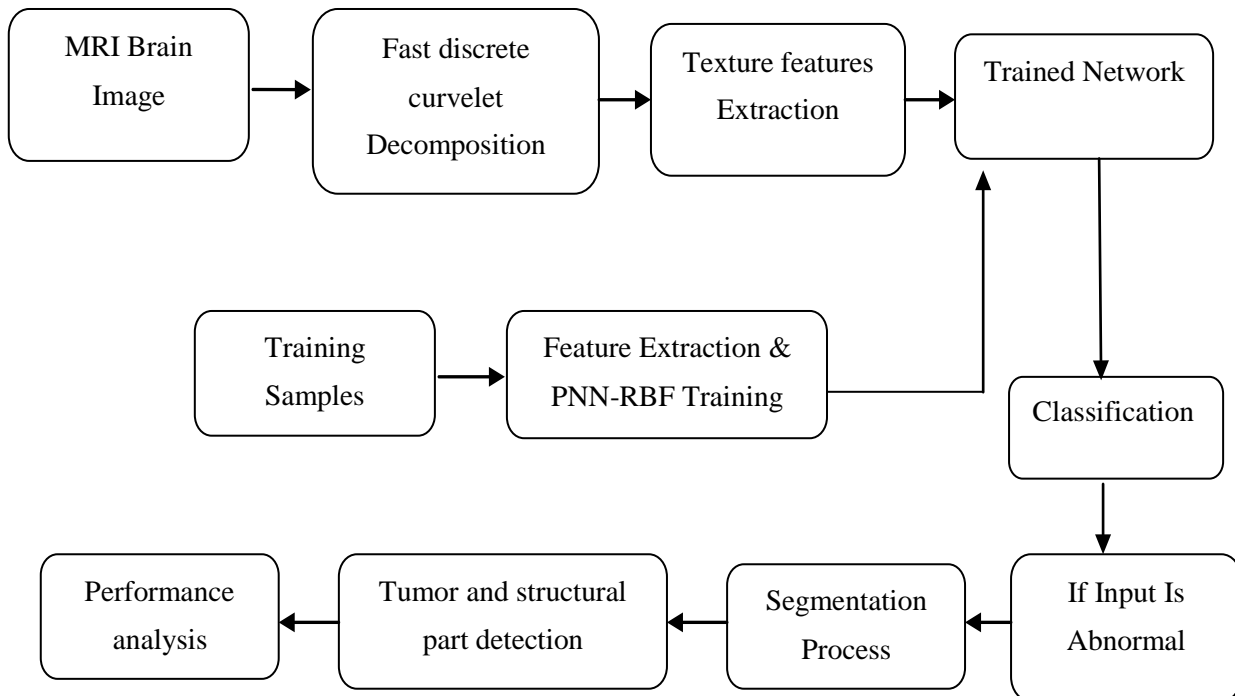
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Fig: System Architecture

For optimum classification purposes, what concern us are the statistical techniques of characterization… This is because it is these techniques that result in computing texture properties… The most popular statistical representations of texture are:

(1) Co-occurrence Matrix

(2) Tamura Texture

(3) Wavelet Transform

Co-Occurrence Matrix

Originally proposed by R.M. Haralick, the co-occurrence matrix representation of texture features explores the grey level spatial dependence of texture. A mathematical definition of the co-occurrence matrix is as follows:

- Given a position operator *P(i,j)*,

- let *A* be an n x n matrix

- Whose element *A[i][j]* is the number of times that points with grey level (intensity) *g[i]* occur, in the position specified by *P*, relative to points with grey level *g[j]*.

- Let *C* be the *n* x *n* matrix that is produced by dividing *A* with the total number of point pairs

that satisfy *P*. *C[i][j]* is a measure of the joint probability that a pair of points satisfying *P* will have values *g[i]*, *g[j]*.

- *C* is called a co-occurrence matrix defined by *P*.

Examples for the operator *P* are: "*i* above *j*", or "*i* one position to the right and two below *j*", etc.

This can also be illustrated as follows… Let *t* be a translation, then a co-occurrence matrix C_t of a region is defined for every grey-level *(a, b)* by [1]:

$$C_t(a,b) \quad card\{(s,s \qquad t) \underline{\quad} \qquad R^2 | A[s] \quad a, A[\underline{s \quad t}] \quad b\}$$

Here, $C_t(a, b)$ is the number of site-couples, denoted by *(s, s + t)* that are separated by a translation vector *t*, with *a* being the grey-level of *s*, and *b* being the grey-level of *s + t*.

For example; with an 8 grey-level image representation and a vector *t* that considers only one neighbor, we would find [1]:

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1   2   1   3   4
2   3   1   2   4
3   3   2   1   1
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Classical Co-Occurrence Matrix

At first the co-occurrence matrix is constructed, based on the orientation and distance between image pixels. Then meaningful statistics are extracted from the matrix as the texture representation. Haralick proposed the following texture features:

(1) Energy

(2) Contrast

(3) Correlation

(4) Homogeneity

Hence, for each Haralick texture feature, we obtain a co-occurrence matrix. These co-occurrence matrices represent the spatial distribution and the dependence of the grey levels within a local area. Each *(i,j)* th entry in the matrices, represents the probability of going from one pixel with a grey level of '*i*' to another with a grey level of '*j*' under a predefined distance and angle. From these matrices, sets of statistical measures are computed, called feature vectors.

Figure: Final Output of the System

Above image shows the tumor segmentation and classification. It shows type of tumor and its

parameters.Above image shows four accuracy that can be calculated .

Result Analysis

Performance Measurement

The performance of the given system measured by using the following table that given various condition for outputs. They give the multiple images of brain MRI that are detected by the system. The first condition if we provide one brain MRI image from the dataset and system detected it as tumor is present then we consider the true positive. If we provide another image from the dataset and system detected is tumor is absent then we consider the false negative. For calculating a precision, we required a relevant dataset and for the recall we take the overall dataset of the given system. For the result analysis we provide the number of tumor present and tumor absent and find the precision and recall by the following formula.

Precision = Relevant instance / Retrieve instance

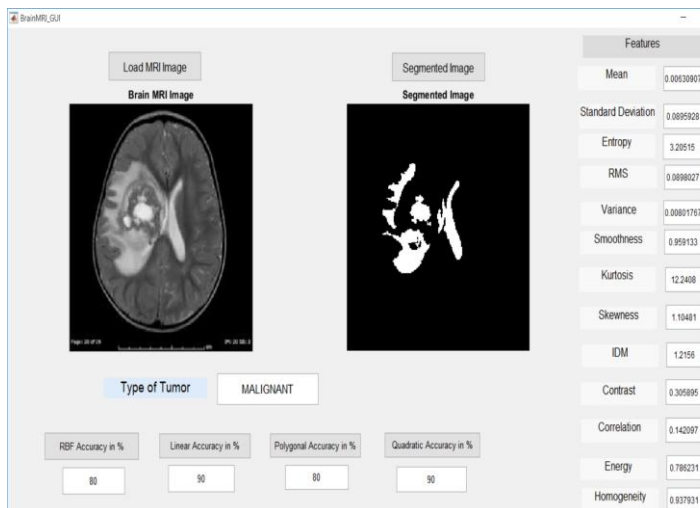Recall = Relevant instance that have been retrieve / Total amount of instance

Function	Accuracy	Precision	Recall
Linear	91.66%	100%	83.33%
Quadractic	83.33%	100%	66.66%
Polygonal	87.50%	100%	75.00%

Table : Performance Evolution for Existing System

Function	Accuracy	Precision	Recall
Linear	93%	100%	93%
Quadractic	87%	100%	91%
Polygonal	89%	100%	92.5%

Table : Performance Evolution for proposed System

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Evaluation Result

The graph shows 6.1 the result of precision and recall of the brain MRI image of the current system as well as existing system according to the accuracy from the 23 images which are taken from the dataset.
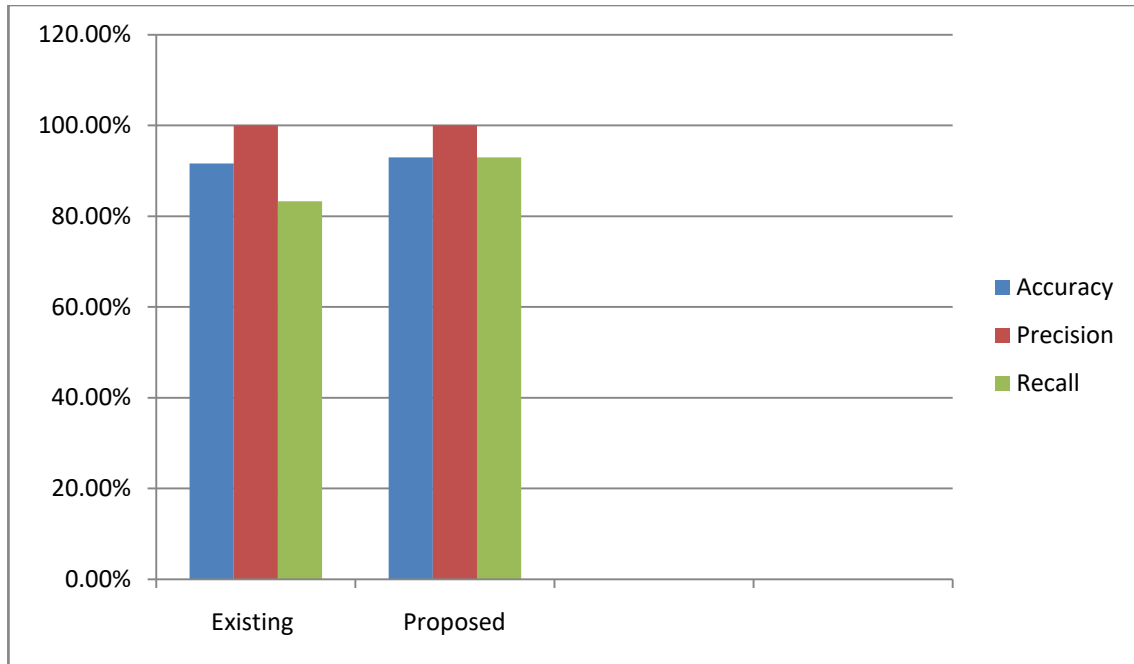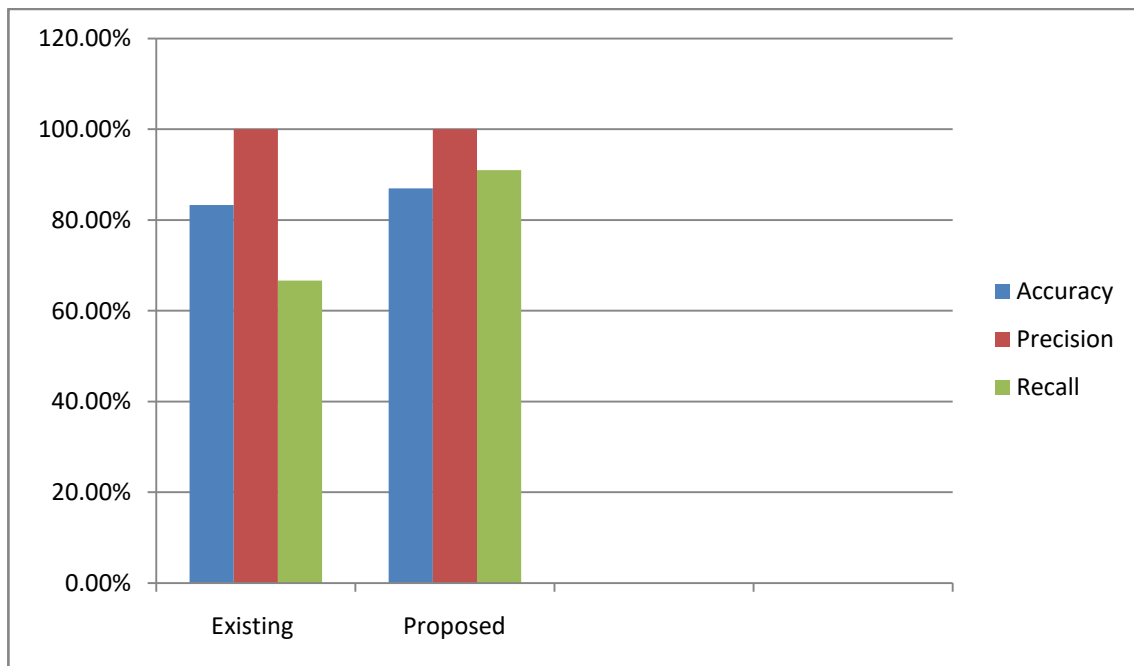

Fig: Graph based on Linear accuracy
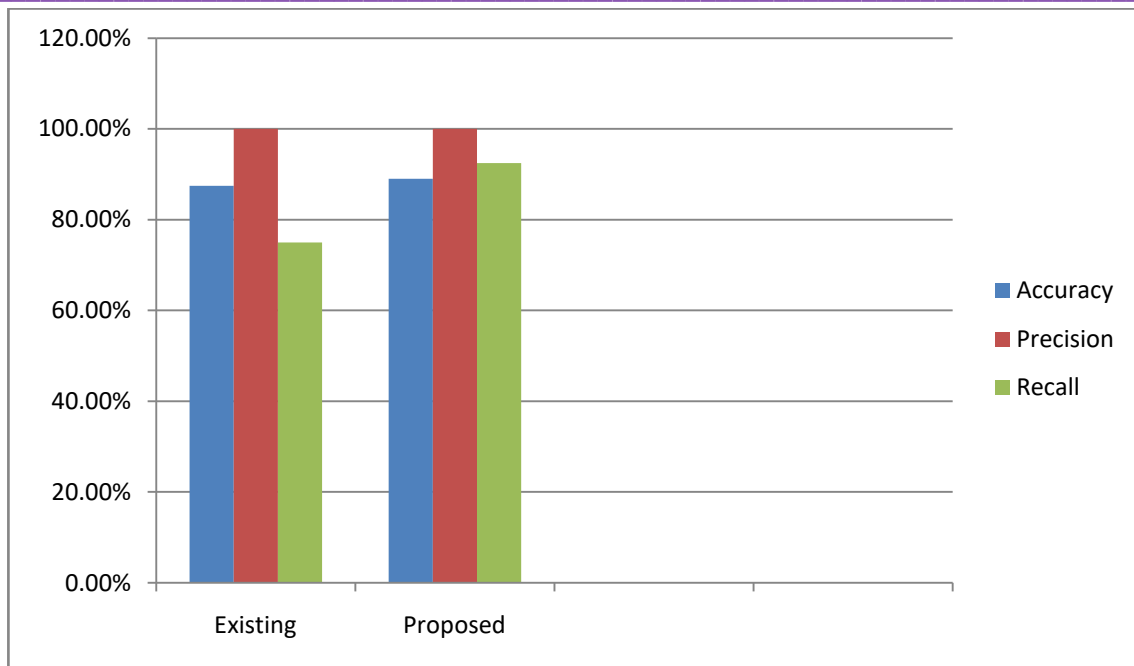

Fig : Graph based on Quadractic Accuracy

Fig : Graph based on Polygonal Accuracy

Table: Percentage of Tumor Classification

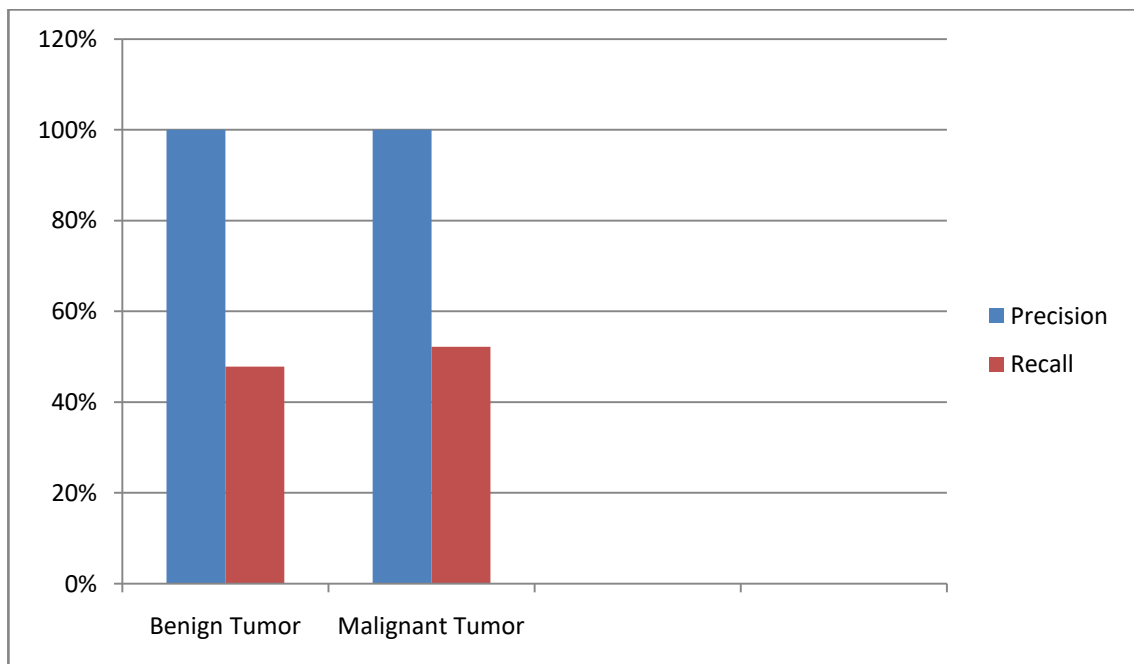| Sr.No.	Tumor Type	Precision	Recall
1	Benign Tumor	100%	47.82%
2	Malignant Tumor	100%	52.17%

Fig: Graph for Tumor Classifications

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Conclusion

The project presented that automated brain image classification for early stage abnormality detection with use of neural network classifier and spotting of tumor was done with image segmentation. Pattern recognition was performed using probabilistic neural network with radial basis function and pattern will be characterized with the help of fast discrete curvelet transform and haralick features analysis. From an experiment, system proved that it provides better classification accuracy with various stages of test samples and it consumed less time for process.

Future Work

Currently our proposed system works on only two types of brain tumor. In future ,the proposed system can be improved by adding different different type tumor for classification. Also the accuracy of the proposed system can be improved by including different different dataset available from doctors throughtout the world.The proposed system can also be further extended for detecting cancer and other tumors.

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