TUMOR DETECTION IN BRAIN USING HYBRIDIZATION

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***Abstract*—**Detection of brain tumor is very common fatality in current scenario of health care society. Image segmentation is used to extract the abnormal tumor portion in brain. Brain tumor is an abnormal mass of tissue in which cells grow and multiply uncontrollably, apparently unregulated by mechanisms that control cells. Several techniques have been developed for detection of tumor in brain. The primary concentration is on the techniques which use image segmentation to detect brain tumor. Tumor classification and segmentation from brain computed tomography image data is an important but time consuming task performed by medical experts. In the present research, Image segmentation has been used to extract the abnormal tumor portion in brain. Brain tumor is an abnormal mass of tissue in which cells grow and multiply uncontrollably, apparently unregulated by mechanisms that control cells. The challenge of the research work was to enhance the accuracy and acceptance rate as well as to reduce the rejection rate of the detection. For this purpose, the preprocessing has been performed by using neural network to train the images. Further, optimization has been performed by using cuckoo search optimization to optimize the selected features such as texture, size, color, edge, contrast, location etc. Then linear discriminant analysis (LDA) classifier has also been applied to detect the tumor in the image. The performance of the research work has been evaluated on the basis of parameters such as accuracy, Specificity, Sensitivity and F-score. The proposed research gives the accuracy rate is 99.98% which proves that the proposed research gives better results as compared to the existing work.

***Keywords*—** *ANOVA; LDA; cuckoo search; MSE; PSNR*

I. INTRODUCTION

A brain tumor is a collection, or mass, of abnormal cells in the brain. The skull, which encloses the brain, is very rigid. Any growth inside such a restricted space can cause problems. Brain tumors can be cancerous (malignant) or noncancerous and it can be life threatening. So when most of the normal cells grow old or get damaged, they die, and new cells take their place. Sometimes, this process goes wrong. New cells form when the body doesn't need them, and old or damaged cells don't die as they should. The buildup of extra cells often forms a mass of tissue called a growth or tumor.

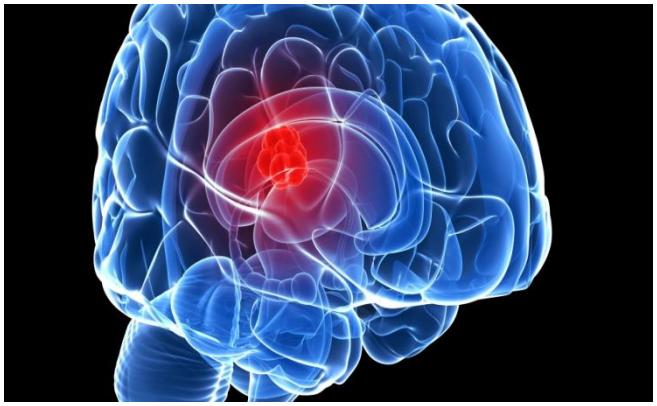

Fig. 1 A tumor in brain

II. BRAIN TUMOR

A. Types of Brain Tumor

Brain tumors are categorized as primary or secondary. A primary brain tumor originates in your brain. Many primary brain tumors are benign. The primary brain tumor cell develops in following brain organs:-

- brain cells
- The membranes that surround your brain, which are called meanings
- nerve cells
- glands

B. Secondary brain tumors

A secondary brain tumor, also known as a metastatic brain tumor, occurs when cancer cells spread to your brain from another organ, such as your lung or breast. Secondary brain tumors make up the majority of brain cancers. They start in one part of the body and spread, or metastasize, to the brain. The following can metastasize to the brain:

- lung cancer
- breast cancer
- kidney cancer
- skin cancer

Secondary brain tumors are always malignant. Benign tumors don’t spread from one part of your body to another.

C. Methods Of Detection Of Brain

1) Watershed Method : A watershed is a transformation defined on a grayscale image. The watershed transformation treats the image it operates upon like a topographic map, with the brightness of each point representing its height, and finds the lines that run along the tops of ridges. A watershed is formed by 'flooding' an image from its local minima, and forming 'dams' where waterfronts meet.

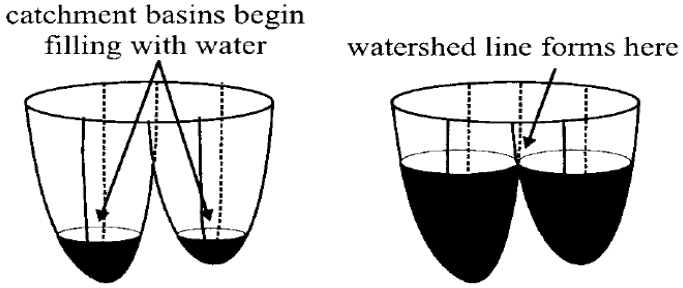

Fig. 2 Watershed method

When the image is fully flooded, all dams together form the watershed of an image. The watershed of an edginess image can be used for segmentation.

2) Patch Based Method: The patch based technologies, which are based on local gray value representations and correlations between gray values, have proven to be successful in many computer vision domains, and suggest an appealing alternative to filter bank approaches. Segmentation algorithm that iterates between inferring local label patches and merging these local segmentations to produce a globally consistent image segmentation.

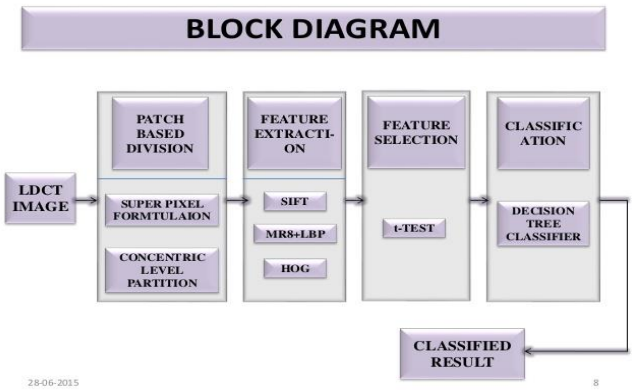

Fig. 3 Block diagram of path based segmentation method.

*3) Active Contours Method with HMM, SVM Method :*This method includes building a tumor probability map and then either classifying by using SVM the normal and abnormal part or building Markov Chains or Hidden Markov chains, web based version of algorithm for the same purpose has found.

4) Random Decision Forests & Density Forest Method: This can be applied to a number of machine learning, computer vision, and medical image analysis tasks. Forest-based techniques unify classification, regression, density estimation, manifold learning, semi-supervised learning, and active learning under the same decision forest framework.

5) Active Contours Method : Active contour model, also called snakes, is a framework in computer vision for delineating an object outline from a possibly noisy 2D image. The snakes model is popular in computer vision, and snakes are greatly used in applications like object tracking, shape recognition, segmentation, edge detection and stereo matching The B-Spline snake is a typical representation of the active contour is used for brain tumor detection due to its capture corners, curves in detail.

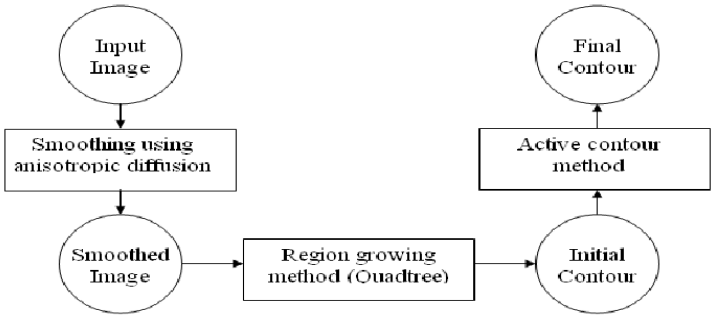

Fig. 4 Working of Active Contours Method

6) Graph Cuts on. Markov Random Field method: This method of segmentation is also used in conjuncture with other methods that help to reduce the cost of optimization and searching surface problem of tumor Detection as it is able to overcome problem of overlap of tissue s in an iterative manner with shortest distance with great smoothness.

7) K-Means Method: K mean clustering is vector quantization method which partition image into different cluster on the basis of mean of similar pixel set whereas no of cluster are pre defined. In this each cluster have a centriod which represent mean of the cluster.

III. LITERATURE REVIEW

Literature of the detection and segmentation of brain tumor is given below:

Patil et al. (2017) reviewed work shows the detection and segmentation of brain tumour. Due to MRI Images we can detect the brain tumor. For detection of unusual growth of tissues and blocks of blood in nervous system can be seen in an MRI Images. The first step of detection of brain tumor was to check the symmetric and asymmetric Shape of brain which will define the abnormality. After this step the next step is segmentation which was based on two techniques F-Transform (Fuzzy Transform) and Morphological operation. These two techniques were used to design the image in MRI. Now by this help of design it can detect the boundaries of brain tumor and calculate the actual area of tumor. The f-transform was used to give the certain information like rebuilt of missing edges and extracting the silent edges. Accuracy and clarity in an MRI Images was dependent on each other. It proposed different techniques to detect and segment Brain tumor from MRI

images. To extract and segment the tumor it used different techniques such as SOM Clustering, k-mean clustering, Fuzzy C-mean technique, curve let transform

Hebli et al. (2017) analyzed work shows the image processing technique to find brain tumour. Brain Tumor is the abnormal growth of cell inside the brain cranium which limits the functioning of the brain. Early detection of the brain tumor was possible with the advancement of machine learning (ML) and image processing (IP). The work consist of stages of image processing were discussed and overview of the analogous which were quoted by analyzing several researchers. Several methodologies are examined to denote the conventional stages of MRI image processing also analyzed individual segmentation approach. In conjunction with this different Methodologies proposed by the researchers were considered that machine learning shows an important role in brain tumor detection and classification together with appropriate segmentation approach. Along with this comparison between K means and fuzzy c, GA and PSO have also being drafted.

Samriti et al. (2016) proposed work represented the detection technique of brain tumour through segmentation. It reviewed some primary and critical research question of the methods that involve non-invasive approach for detection of brain tumor using image processing techniques and the main question whether the process can be webified with intelligence algorithm. The work includes a study of recent state of art technologies, techniques and algorithms used in tumor detection. Exhaustive lists of machine learning algorithms that have been used for this purpose have been examined for the reason and importance of their use for tumor detection. Then one of the section the quality and quantity of the image dataset which has been used have been surveyed, question like whether real type of cases or simulated cases have been used to build the premises, solicited on this particular topic, it too has also been done questioning the relevance, significance of features being used in tumor detection.

Chandra et al. (2016) presented works shows that detection of brain tumor was common fatality in current scenario of health care society. Image segmentation is used to extract the abnormal tumor portion in brain. Many techniques have developed for detection of tumor in brain. Our main concentration was on the techniques which used image segmentation to detect brain tumor. Tumor classification and segmentation from brain computed tomography image data was an important but time consuming task performed by medical experts. The work focused on the interest of soft thresholding DWT for enhancement and genetic algorithms for image segmentation. It shows that type of approach could be applied either for grey-level magnetic resonance images. The developed method uses the ability of GA to solve optimization problems with a large search space. The developed method could also integrate some a prior knowledge it was available. The developed method successes SNR value from 20 to 44 and segmentation accuracy from 82 percent to 97 percent of detected tumor pixels based on ground truth.

Deepa et al. (2016) presented work shows the image processing in detection scheme of brain tumour. Today image processing plays an important role in medical field and medical imaging is a growing and challenging field. Medical imaging is advantageous in diagnosis of the disease. Many people suffer from brain tumour, it is a serious and dangerous disease. Medical imaging provides proper diagnosis of brain tumor. There are many techniques to detect brain tumor from MRI images. These methods face challenges like finding the location and size of the tumor. To detect the tumor from the brain is most important and difficult part, image segmentation was used for this. Already, various algorithms were developed for image segmentation. In this survey it covers the basic terminologies of brain tumor and MRI images, review of various brain tumor segmentation techniques.

Tayade et.al(2016)analyzed work shows the brain tumor detection using Magnetic Resonance Imaging (MRI) is very important but difficult task which further used in medical field for the detection of tumor medical imaging techniques get used, in which different segmentation techniques get evolved. If the segmentation is done by the researchers manually using their own medical knowledge then it will result in more time consumption. Therefore researchers provides different techniques for automatic detection of brain tumors using MRI images, which helps in diagnosis The proposed work includes the different techniques such as k-means, Fuzzy C-Means and region growing algorithm, curve let transform, multi fractional Brownian motion (MBM), Proximal Support Vector Machines(PSVM) etc. for brain tumor detection from MRI images. It has proposed different techniques to detect and segment Brain tumor from MRI images. To extract and segment the tumor it used different techniques such as SOM Clustering, k-mean clustering, Fuzzy C-mean technique, curvelet transform. It can be seen that detection of Brain tumor from MRI images is done by various methods

Telrandhe et al. (2016) Presented work shows the implementation of an automated system for brain tumor detection, the main functionality of this system was divided in some parts are Segmentation, Object Labeling, HOG (Histogram Oriented Gradient), feature extraction and linear SVM implementation. For Segmentation it was using K-means algorithm, for Object Labeling HOG was use, HOG also used to extract texture feature, shape context feature and color feature. Then implementing the SVM based on this feature we can train the SVM and further test is on other infected MRI images. The proposed system is the combinations of some technologies like k-means for segmentation, HOG for object labeling, median filter, morphological filter and wavelet transform for the preprocessing and skull masking. So the result of this all combination was very faire than the individual of them or the some other combinations. The linear SVM and HOG are work with coordination because the HOG extracts the feature and SVM used that data for learning the SVM, so the SVM was able to make the patterns and after training in testing it will work for the test the pattern.

Sharma et al. (2016) analyzed work describes the concept of brain tumor that Brain Tumor is an abnormal growth caused by cells reproducing themselves in a uncontrolled manner. Brain Tumor segmentation aims to separate the different tumor tissues such as active cells, necrotic core & edema from normal brain tissues of White Matter(WM), Gray Matter (GM), Cerebrospinal Fluid (CSF). Tumor segmentation from MRI

data is an Important but time consuming manual task performed by medical experts. Image Processing is an active Research area in which medical image processing is highly challenging field. In this paper various feature extraction and classification methods which are used for detection of brain tumor from MRI images are reviewed. In the method various automated brain tumor detection methods through MRI has been surveyed and compared. It was used to focus on the various combinations of techniques proposed by different people in medical image processing and their performances. The work deals with the sequence of methods in image processing as Image Acquisition, Image Preprocessing, Segmentation, Feature Extraction and Selection and Classification. Many algorithms have been proposed in the literature for each image processing stage. The Advantages & disadvantages of various classification techniques are discussed.

IV. PROBLEM FORMULATION

Segmentation is the one of the important task in detection of subparts in image processing. So it plays a significant role in detection of tumour regions in medical applications. Prior works on brain tumour segmentation can be mainly separated into three categories:

- Window based,
- Classifier based and
- Tracking based.

Physical detection and examination of the tumour images is a time consuming and undependable task; and as the number of images increases; the study becomes very tough. However it is comparatively time consuming when the seed become quite large and need to be applied recurrently with different orientations. The main problems are whether it is possible and, if yes, how to choose an acceptable threshold or a number of inceptions to separate one or more desired objects from their background. In many applied cases the simple thresholding is unable to segment objects of interest. Detection of brain tumour is very common fatality in current scenario of health care society. Image segmentation is used to extract the abnormal tumour portion in brain. Brain tumor is an abnormal mass of tissue in which cells grow and multiply uncontrollably, apparently unregulated by mechanisms that control cells. There are many methods to building completely mechanized computer aided diagnosis framework to help therapeutic experts in recognizing and diagnosing brain tumor. No matter what the approach or the features may be of the system the easy use and the accuracy of the System is main criteria of considering the computer aided design. The problem of this research work is to enhance the accuracy and acceptance rate as well as to reduce the rejection rate of the detection. For this purpose, the preprocessing will be done by using neural network to train the images. Further, optimization will be performed by using cuckoo search optimization to optimize the selected features such as texture, size, color, edge, contrast, location etc. Then linear discriminant analysis (LDA) classifier will be used to detect the tumor in the image. The performance of the research work will be analyzed on the basis of parameters such as accuracy, Specificity, Sensitivity and F-score.

A. Objectives

This proposed research encompasses with a set of objectives that is associated with milestone of this process. The objectives are mentioned below:

- To study various techniques and algorithms of image segmentation and their vulnerabilities.
- To implement the pre- processing of image this deals with the GUI having uploading image, region-based and detection of image.
- To implement feature optimization using cuckoo search and classification using Linear discriminant analysis (LDA)
- To evaluate the performance parameters like as PSNR, MSE and detection accuracy.

V. RESULTS AND DISCUSSIONS

Medical images segmentation has the significant benefit that operational and intensity appearances are well recognized up to a natural organic variability or the existence of pathology. Segmentation is considered to be a medium level activity in an image processing system. When an image is segmented mainly five conditions should be satisfied.

1. First, the segmentation process must be complete that means each pixel belongs to at least any one of the region.
2. Second, the pixels in a region must be connected i.e. each region is a connected set of pixels.
3. Third, two regions cannot intersect with each other. This condition may be violated in case of fuzzy segmentation.
4. Fourth, each region of the segmented image must gratify a predicate based on the grey scale value, texture etc.

1) Algorithm used:

a) Cuckoo Search: In intelligent research, cuckoo search deals with the optimization algorithm which is inspired by the brood parasitism of various cuckoo species using lying of their spawns in the shells of other species or birds. Some birds can involve direct struggle with the interfering cuckoos. For instance, if a crowd bird determines the spawns are not their individually, it will throw these eggs far away or simply unrestraint its house and build a new house away. Some species have changed in such a method that female cuckoos are often actual specialized in the imitation in standards and decoration of the spawns of a few selected host species. Cuckoo search flawless like breeding behaviour which can be functional for numerous optimization difficulties

CS is based on three idealized rules:

Each cuckoo lays one egg at a time, and dumps its egg in a randomly chosen nest

The best nests with high quality of eggs will carry over to the next generation.

The number of available host's nests is fixed, and the egg laid by a cuckoo is discovered by the host bird with a probability (0, 1). Discovering operates on some set of worst nests, and discovered solutions dumped from farther calculations.

b) Linear Discriminant Analysis: Linear discriminant analysis (LDA) is a generalization of Fisher's linear discriminant, a method used in statistics, pattern recognition and machine learning to find a linear combination of features that characterizes or separates two or more classes of objects or events. The resulting combination may be used as a linear classifier or, more commonly, for dimensionality reduction before later classification.

LDA is closely related to analysis of variance (ANOVA) and regression analysis, which also attempt to express one dependent variable as a linear combination of other features or measurements. However, ANOVA uses categorical independent variables and a continuous dependent variable, whereas discriminant analysis has continuous independent variables and a categorical dependent variable (i.e. the class label). Logistic regression and probity regression are more similar to LDA than ANOVA is, as they also explain a categorical variable by the values of continuous independent variables. These other methods are preferable in applications where it is not reasonable to assume that the independent variables are normally distributed, which is a fundamental assumption of the LDA method.

2) Performance Evolution:

Peak Signal to Noise Ratio: It computes the peak signal-to-noise ratio, in decibels, between two images. This ratio is often used as a quality measurement between the original and a compressed image. Higher the PSNR, better the quality of the compressed or reconstructed image

The Mean Square error (MSE) and the Peak Signal toiNoise Ratio (PSNR) the two error metrics used to compare image compression quality. The MSE deals with the cumulative squared error between the compressed and the original image, PSNR represents a measure of the peak error. The lower the value of MSE, lower the error rate.

To compute PSNR, the block first calculates the mean-squared error using the following equation:

$$MSE = \frac{\sum_{M,N} [I_1(m,n) - I_2(m,n)]^2}{M * N}$$

In the previous equation, Miand N is the number of rows and columns in the input images, respectively. Then the block computes PSNR using following equation:

$$PSNR = 10 \log_{10}\left(\frac{R^2}{MSE}\right)$$

Accuracy: It is the difference between the true value and the mean of the underlying process that generated the data.[26]

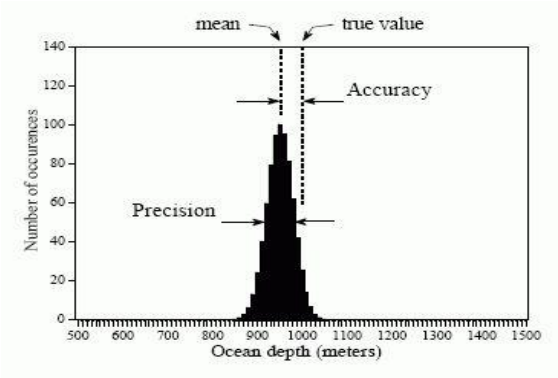

Fig. 5: Accuracy

Below are the result explanations for the result evaluation using proposed technique

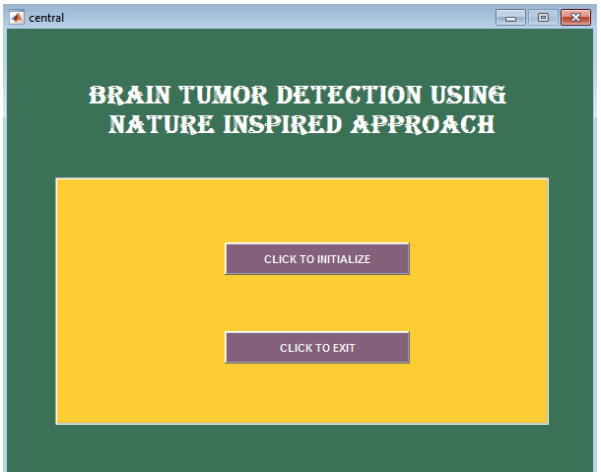

Fig. 6 Main Panel

The Fig. 6 shows the main panel which is made using graphical user interface. The GUI is made in MATLAB environment which deals with the user interface controls using pushbuttons, static text, edit texts and panels

Fig. 7 GUI panel

The Fig. 7 shows the GUI panel in which the uploading of the data takes place and the performance evaluations are taken place in terms of mean square error rate , peak signal to noise ratio and detection accuracy.

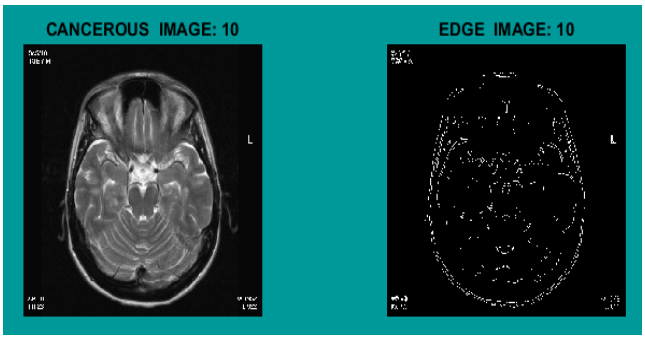

Fig. 8 Uploaded sample and edge detection

The Fig. 8 shows the cancerous image which is uploaded in the graphical user interface and shows that the image is uploaded in GUI panel and also the edge detection of the image is done using canny edge detector which gives the edges of the image in terms of the maximum intensity of the image boundaries

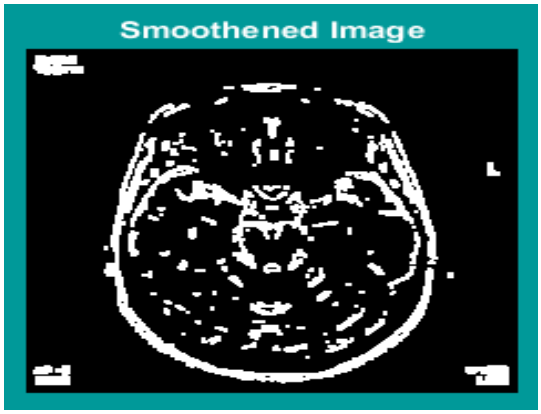

Fig. 9 smoothening of Image

The Fig. 9 shows the smoothening of the uploaded image using cuckoo search algorithm and shows that the optimization is done and the smoothening of the image is done. The normalization will gives the high intensity of the image in the image uploaded sample which gives the high frequency components and is usable for the high classification to get the high region of interests

Fig. 10 Detected Tumour Region

The Fig. 10 shows the detected tumor region which gives the unnecessary growth of the tissues in the uploaded current sample and is done using the classification with linear discriminant analysis which classifies the region in which the tumor exists.

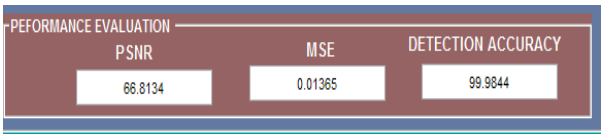

Fig. 11 Performance evaluation

The Fig. 11 shows the performance evaluation of the system using such performance evaluations like mean square error rate, peak signal to noise ratio and accuracy of the systems. The accuracy deals with the evaluation that how much our proposed approach is able to achieve high detection rates with less mean square error rate and high signal to noise ratio

The accuracy must be high, peak signal to noise ratio must be low and the mean square error rate must be less for high recognition rates and less error rate probabilities.

TABLE I. PROPOSED PERFORMANCE TABLE

Samples	Peak Signal to Noise Ratio (db)	Mean Square Error Rate	Detection Accuracy
Image 1	66.81	0.013	99.984
Image 2	62.89	0.023	98.43
Image 3	65.77	0.0188	99.93
Image 4	63.45	0.016	99.29
Image 5	67.36	0.018	99.19

TABLE II. PERFORMANCE COMPARISON

Parameter	Base	Proposed
Detection Accuracy (%)	97.94	99.984

VI. CONCLUSION AND FUTURE SCOPE

The automated brain tumor segmentation is still a challenging task. One of the reasons is tumor's unpredictable properties such as size, shape and location unless the tumor development in time is investigated and images from previous scanning are available. Considering only the independent scanning, all of the mentioned properties are unknown. Medical imaging is performed in various modalities, such as magnetic resonance imaging (MRI), computed tomography (CT), ultrasound etc. Segmentation is typically performed manually by expert physicians as a part of treatment planning and diagnosis. Due to the increasing amount of available data and the complexity of features of interest, it is becoming essential to develop automated segmentation methods to assist and speed-up image understanding tasks. In the present research, Image segmentation has been used to extract the abnormal tumor portion in brain. Brain tumor is an abnormal mass of tissue in which cells grow and multiply uncontrollably, apparently unregulated by mechanisms that control cells.

The problem of the research work was to enhance the accuracy and acceptance rate as well as to reduce the rejection

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