# Comparative Review on Magnetic Resonance Images for Brain Tumor Image Classification

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## Abstract

The irregular development of brain tissues inside the brain is termed as "Brain Tumor", and the area occupied by tumor cell is a very challenging task that is to be performed because of the complex structure of the brain. Detection of "Brain Tumor", is a very stimulating job since there is similarity between the tumor cells and the normal tissue in the brain. In medical science Magnetic Resonance Imaging (MRI) can provide detailed analysis of the soft tissue anatomy that is very much helpful in the diagnosis of tumor cells. Several stages are involved for detecting the brain tumor tissues namely: image preprocessing, Segmentation, feature extraction and classification. In this paper a review analysis is made upon image classification of brain tumor using MRI based on various techniques that are applied for detection of tumor cell.

Keywords: MRI, Segmentation, image preprocessing, feature extraction

## Introduction

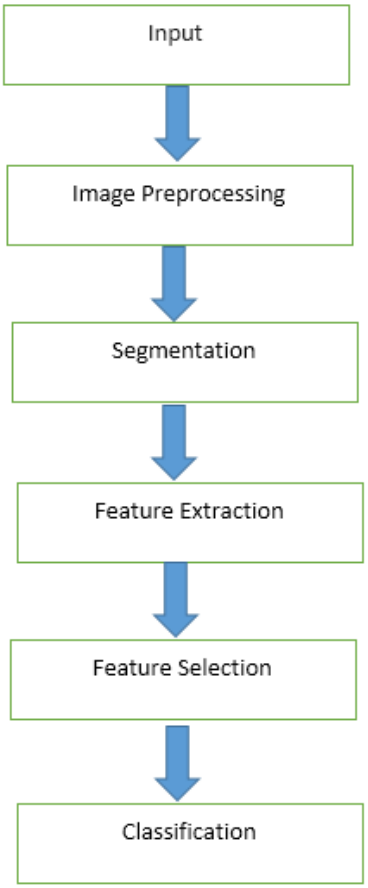
The present era has tremendously increased with the research and development of various techniques which are helpful in making the technological advancement in the medical field by easing he diagnosis processes with increased accuracy.

Brain tumor is a cluster of cells which reveal opaque brain growth. The tumor becomes cancerous as it taking up space and unites brain cells, that is necessary for working of the vital body. Exact diagnosis and earlier tumor projection are crucial tasks resulting in insufficient detection of this may leading to demise. Most of the patients severely affected by brain tumors dies within nine to twelve months and fewer than three percent survive more than 3 years.

The domain of clinical imaging advances its position to upsurge in the requirement for computerized & effectual detection in a lesser time duration. Mainframes and digital communication are most valuable when it comes to MRI, clinical diagnosis and classification. "Magnetic Resonance Imaging" (MRI) scan could be employed to generate photographs of each organs of the body and provide easy or quick method to diagnose brain tumor. It is employed as very useful resource in the medical and clinical environment due to its important features like quality differentiation of soft cell tissue, more contrast and huge spatial resolution. Moreover, MRI is correspondingly a significant investigative imaging procedure for premature discovery of "Brain Tumors". MRI brain imaging serves a vigorous role in helping radiologists to diagnose and treat patients with exposure to it. [1].

Brain tumor can be caused to anybody at virtually any age and its treatment sessions may be successive but its effects may not be constant for most of the persons i.e. it varies from person to person. It may be at any location and might have a varied no. of sizes and shapes. It may be classified in two types either malignant or benign. The malicious brain tumors encompass cancer cell. They have a heterogeneous structure. On the other hand, non-malicious "Brain Tumors" do not encompass cancerous tissues as they contain homogenous structure. These types of tumor can be examined radiologically or can be destroyed

surgically and it is a very rare case that they grow back again.




Block Diagram of MRI image classification.

The researches require a thorough study of medical image processing which includes a various number of no. steps such as: "Image Pre-processing, Segmentation, Feature Extraction, Feature Selection and Image Classification". Each step involved in the process is equally important. In the first step i.e. image preprocessing the images are subjected to analysis and are processed for getting the clarity of the images. After the first step i.e. image preprocessing the images are classified or broken into various segments that is known as segmentation. The images are segmented for examining the tissues to get more clarity with the help of which the medical practioner will can carry on with his treatment in the affected area or segment. The segmentation step is monotonous and taking more time. It basically trusts on changeability of the operator. Therefore, it is necessary to develop an automatic approach that helps reduction in time consumption in this process. [2]

Next step is the feature extraction i.e. each segment after the clustering process is examined with the help of proper algorithm and features are recognized i.e. tissues are studied to find out the tumor area weather it is a malignant or benign or neither of the above. All the data are then clubbed together and classified into a group. This process is termed as classification.

In this paper we will mainly deal with the MRI brain tumor image classification methods those are applied earlier by various authors using different types of classifiers and algorithms.

## Overview of Magnetic Resonance Imaging (MRI):

"Magnetic resonance imaging" is clinical imaging procedure employed in the domain of radiology to produce photographs of structure & biological processes of the human body in both fitness and disease. MRI scanners generate pictures of the tissues in human body employing robust magnetic & electric field gradients and radio waves. MRI procedure does not include the usage of ionizing radiation and does not include the usage of X-rays, that extricates the images from "CT" or "CAT scans". MRI is clinical application of "nuclear magnetic resonance" (NMR). Various others NMR procedures such as "NMR Spectroscopy" could moreover be employed for clinical or medical imaging.[34]

**MRI Mechanism:** To execute a procedure, the human is sited within a medical imaging scanner that produce a robust magnetic field around the portion to be scanned for imaging. In many other clinical applications, protons (hydrogen atoms) for tissues containing $H_2O$ atom molecules produce a stimulus which is administered to produce a body image. Firstly, radiation from an oscillating magnetic field is temporarily passed on to the patient at the correct resonant frequency. The

stimulated molecules of hydrogen release a pulse of radio frequencies which is specified through detecting coil. Utilizing gradient coils, the radiowave signal can enabled to represent position details by altering principal magnetic field. Since these coils are turned on and off quickly hence the coils form the typical repeating noise of a medical resonance imaging scan. The image contrast amid the respective cells is defined by the frequency rate that stimulated atoms to return back to the state of equilibrium.

The key constituents of an medical resonance imaging scanner are: the foremost magnet, that differentiates the sample, the "Shim Coils" for amending shifts in the homogeneousness of core magnetic field, gradient resource employed for the MR signal localization and last the RF resource that fascinates the sample resulting nuclear magnetic resonance signal is detected. The entire system is managed by one or more mainframes. MRI needs a magnetic field that is altogether robust and unvarying. The ground strength of the magnet is evaluated in teslas And whereas most systems workat 1.5 T, profitable systems are obtainable amid "0.2 and 7 T". Almost all clinical magnets are highly conductive magnets that need liquid helium for conducting clinical imaging. Permanent magnets that frequently employed in "Open MRI Scanners" to suffocate neurological patients generates weaker field strengths.

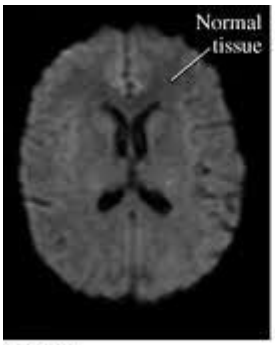


Figure 1

Figure 2

Figure no. 1 represents the MRI image of normal tissue whereas fig no 2 represents the abnormal tissue.

## MRI Classification Methodology:

Classification is the final step in the image processing system. Many methods are available for classification to name some: "Artificial Neural network, Fuzzy Logics, Decision Tree, SVM, KNN, Kart & random Algorithm etc."

Various techniques applied by different authors are reviewed in literature survey are as follows:

| S.No. | Author | Algorithm |
|---|---|---|
| 1. | Haribabu Nandpuru et.al [1] | SVM Technique |
| 2. | Kalyani .A. Bhawar et.al [4] | CART & Random Technique |
| 3. | Nilesh Bhaskarrao [9] | SVM Based Classifier |
| 4. | Aparna.M.Nichat [10] | SVM Technique |
| 5. | Neha Rani & Sharda Vashisth[16] | Feed Forward Back prop Neural Network |
| 6. | A. Jayachandran et.al.[19] | Fuzzy SVM Technique |
| | | |
| 7. | Athency Antony et.al.[22] | Convolutional Neural Network |
| 8. | El-Dahshan et.al [23] | FEED FORWARD BACK-PROPAGATION NEURAL NETWORK |
| 9. | Ain et.al. [24] | Ensemble based SVM classification |
| 10. | Rathi et.al.[25] | PCA(Principle component analysis) & LDA(Linear Discriminant Analysis) for training data sets & SVM for classification |
| 11. | Zhang et.al [26] | SVM region growing Technique |

| | | |
|---|---|---|
| 12. | Zhang & Dong et.al [27] | Neural Network, PCA , BPNN based classifier |
| 13. | Selvaraj et.al [28] | LS-SVM (Lease square support vector machine) Technique |
| 14. | Jothi et.al.[29] | STRS-PSO |
| 15. | Jothi et.al.[30] | USQR ( UNSUPERVISED QUICK REDUCT)& SSUSQR (HYBRID SOFT SET BASED UNSUPERVISED QUICK REDUCT) |
| 16. | Inbarani.H.et.al[31] | PSO-RR & PSO-QR |
| 17. | Seera.et.al [32] | Fuzzy min-max (FMM Neural Network) classification & regression tree (CART) |
| 18. | Uzer et.al.[33] | ABC ( Artificial Bee Colony) / SVM |

Table No.1:Summary of work used for Image Classification

## Literature Survey:

Brain is an organism that governs activities of the substantial number of body parts. Acknowledgment of computerized brain tumor in "Magnetic resonance imaging" (MRI) is a bothersome job because of the problem of size and area unpredictability.

Brain tumor Magnetic Resonance Imaging process involves many stages before the classification process such as:

a) Image Preprocessing
b) Segmentation
c) Feature Extraction / Selection
d) Classification

**A)Image Preprocessing**:

Processing an image is a tedious task. Since before processing an image it is important to remove the unwanted material from it. Image preprocessing involves various processes such as Noise reduction,filtering, noise removal, image enhancement, image reconstruction, conversion to grayscale and in determining the medical images skull removal from an MRI is involved basically.

A.Jayachandran et.al [19] has proposed anisotropic filtertechnique to eliminate lower frequency ambient noise., t also normalizes the size of the individual particles & images by accentuating parts of images & eliminating reflections.

Hari babu Nandpuru et.al [1], Aparna.M.Nichat et.al [10],has used median filtering process, in which local pixel values are rated by intensity and mean value. i.e. the median becomes the pixel output value under the assessment process. Moreover by employing the median filter the edges are maintained and the geographic boundaries are much less blurred

Nilesh Bhaskar Raobahadure et.al [9] have applied adaptive contrast enhancement technique based on modified sigmoid function to enhancing the signal to noise ratio and enhancing the pictorial representation of the MR images.

Neha Rani et.al [16] has used DCT & Gabor filter for dimensionality reduction of the MR images.

C.H.Mohammed Koya [22] utilized intensity inhomogeneity correction method N3 (non-parametric non uniformity normalization) in N4ITK algorithm. This is a fully automatic method that maximizes high frequency content of distribution contents of tissue intensity.

**B) Segmentation:**

Segmentation technique is very important since it is used to separate an image into various slices and regions and it deals with the changes in the proper areas in the brain such as gray matter (GM), White Matter (WM), cerebrospinal fluid (CSF). A

minimal of the change in the tissue can be located & is differentiated between the diseased tissue & other tissue. The main aim of segmentation is partitioning the images into various meaningful regions those are non-overlapping with each other & these regions those are segmented share a similar feature. Therefore, the process includes distinguishing the tissue type in each voxel or pixel into two-dimensional or three-dimensional databases with regard to the information previously accessible from the MR Images.

Mustasem.K. Alsmadi [5] has proposed a hybrid firefly algorithm with Fuzzy –C Mean algorithm. Segmentation process involves a very tedious & complicated process, automatic brain image segmentation requires various approaches that diverses the induction ways mainly as classification based methods, region based methods etc. The hybrid firefly algorithm with fuzzy C means algorithm determines the types of MRI brain images & differentiates normal & abnormal images. Moreover the author mentions that the algorithm has the ability to prevent fuzzy clustering disadvantages like getting stuck in minima, convergence rate & sensitivity & has obtained more accuracy rate as compared with DCHS &fuzzy V gaps algorithms.

Nilesh Bhaskar Rao Bahadure et.al [9] uses Berkeley wavelet transformation technique for effectively segmenting the brain MR Image. Wavelet is a function which is specified over a finite amount of time interval and has a mean value of zero. The wavelet alteration methodology is employed to create different functions, operators, data or details of different frequency that allows the study of components separately.

Ms. Pooja .S.deshpande et.al [12] proposed Fuzzy C Means algorithm, Aparna M Nichat et.al [10], has proposed modified fuzzy C means algorithm for segmentation process.

N.nandha Gopal et.al [15] has utilized intelligent system that use MRI image processing method to detect brain tumor further employing clustering algorithms such as Fuzzy C-means along with optimization methods such as "Particle Swarm Optimization" with "Fuzzy C Means clustering ". Further author has compared with genetic algorithm& fuzzy c means & found that it requires less time wrt the PSO & fuzzy c means.

Michael Goetz et.al [11] proposed domain adaptation for learning from sparse annotations (DALSA).

Su Ruan et.al [26] has proposed fuzzy markovian method for segmentation of MR Images.

**C) Feature extraction /Selection:**

Feature extraction is referred to various measurement of medical images quantitatively and is mainly used in pathology of a tissue & its structure for decision making. If input data has unnecessary information then data is transformed & set into a compact representation. The feature extraction / selection is used to perform a desirable task & that too by using the reduced data representation than that of the full size input.

The high level information from the image is extracted namely texture, contrast, shape & color based.

Hari Babu Nandpuru et.al [1], Jayachandran et.al[19] has used PCA technique to reduce the dimensionality of the data.

Haralick et.al. Introduces widely used medical image analysis using GLCM (Gray Level Co-occurrence Matrix) & texture feature. The technique performs two steps in feature extraction, in the first step GLCM is computed & in the next texture features based on GLCM are calculated. Nilesh Bhaskarrao Bahadure et.al [9] & Aparna M.Nichat et.al [10] have used GLCM technique for feature reduction.

H.Hannah Inbarani et.al [29] have proposed RST-PSO (Rough set theory & particle swarm optimization technique)for feature selection which is mainly used for reducing the dimensionality along with preserving the semantics of the features. Feature reduction is performed using TRSPSO-RR( Tolerance rough set particle swarm optimization relative reduct) & TRSPSO-QR (Tolerance rough set particle swarm optimization quick reduct).

**D) Classification:**

This is the final step of MR Images here the data is clubbed together &similar feature values are classified into groups.

Hari babu Nandpuru et.al [1],Nilesh Bhaskar Raobahadure et.al [9],Aparna M Nichat et.al [10],Michael Goetz et.al [11] & A.Jayachandran et.al [19] have used SVM (Support vector machine) technique for classification to calculate various features such as accuracy, sensitivity, specificity etc.

Kalyani A.Bhawar et.al [4] has presented brain tumor classification based on the Metabolite values of brain MRI image. Author proposes CART & Random decision tree models developed using MATLAB programming. After the development of CART & Random decision tree models the classification of MR images is started. The vector pattern calculation is based on a metabolic feature extraction. The basic utilization of vector pattern is to minimize the huge data dimensionality

Ms. Pooja .S.deshpande et.al [12] has classified images based on firefly algorithm & further the results are compared with linear SVM, Radial SVM & Quadratic SVM techniques.

Neha Rani et.al [16] used RBFN (Radial basis neural network) & BPN (Back propagation neural network) techniques for classification purposes.

C.H.Mohammed Koya [22] has applied convolution neural network) for classification.

## Conclusion:

The technological advancement in the field of image processing has resulted improvement in accuracy. In this paper various methods of automated brain tumor detection through MRI are surveyed. The paper mainly deals with the image classification techniques that are applied by various authors in their studies. The researches requires a thorough study of medical image processing which includes a various number no. steps such as: image preprocessing, segmentation, feature extraction, feature selection and classification. After the selectionof features vectors, a classifier is to be selected for training & classification, which is the final part in image processing study & can be used to distinguish between the normal & abnormal condition of the brain tissues. If the condition is abnormal then the result will be presence of the brain tumor & if the result is normal condition then the brain tumor is not present.

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