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Survey on Brain Tumor Detection and Classification

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Abstract: ***Brain is the main part of the human body, it control all the activity of human. Under unhealthy problems like abnormal growth and unhealthy growth of the tissue may takes place and this process is called brain tumor. Brain tumor are divided into two type : benign(non-cancerous) and malignant tumor(cancerous) .The detection and classification of brain tumor done by using various image technique MRI, Computed Tomography (CT), Electroencephalography (EEG) ,PET . In this paper, it is focused on the review of image enhancement, segmentation, feature extraction and classification in MRI images***

Keywords: Benign, Malignant, Magnetic Resonance imaging (MRI), Enhancement

1. Introduction

Nowadays, Medical image processing is most challenging and emerging field. Early detection of brain tumor is necessary because many people died due having brain tumor. Brain tumor is most dangerous and deadly type of cancer. Tumors are different types, different characteristics and have different treatment. Tumors are mainly divided 2 types.

- Primary brain tumor
- Secondary brain tumor

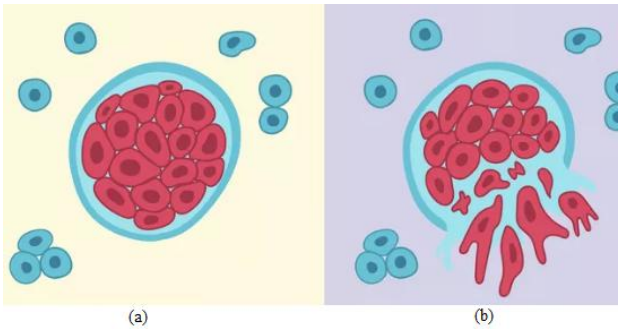


Figure 1: (a) Benign (b) malignant[1]

A primary brain tumor are grown in within the cell of brain. They can arise from any cell type but most commonly arise from supporting cell (glial cell). This tumor is called gliomas. Primary tumor includes benign and malignant. Benign tumor are non-cancerous.

Benign tumors: Benign tumor are non-cancerous. It can be removed and the rarely grow back. This tumors have border or edge. They don't spread to other parts of body. Tumors can press on sensitive area of brain and cause serious health problem. With time benign brain Tumors can become malignant.

Malignant tumor: it is cancerous cell. These type of cell will have rapid growth and leads to death of the patient. Secrete substances that cause fatigue and weight loss. Can spread via bloodstream or lymphatic system. May require aggressive treatment, including surgery, radiation, chemotherapy, and immunotherapy medication.

Secondary brain tumor also called as metastatic brain tumor originates from outside of the CNS and spread to brain typically through arterial circulation. For example, secondary brain tumors could have began as breast or lung cancer. Frontal lobe is the most common site.

The most widely used grading scheme has been issued by the world health organization [WHO].it classify brain tumor into grade I to grade IV. Grade I is benign. The cells look nearly like normal brain cell, they grow slowly.Grade II is malignant. The cells look less like normal cells than do the cells in a grade 1 tumor. Grade III is malignant tissue has cells that look very different from normal cells. The abnormal cells are actively growing. Grade IV is malignant tissue has cells that look most abnormal and tend to grow quickly. [2]

Size and location depend on tumor. When tumor presses the neuron the symptoms may be caused.Headaches, vomiting, Problems in balancing or walking, Problems with memory are the common symptoms of brain tumor

Doctors suggest following treatments according to their types, grade and position of tumor like surgery, radiotherapy, steroids, ant seizures medication. Central nervous system tumor in India ranges from 5to 10 per 100,000 population with 40% of all tumor spread to brain and central nervous system tumor are also the second most cancers in children, accounts for about 26% of childhood cancers.

This paper focus obtain tumor enhancement, segmentation and classification and present a detailed overview for the current existing methods for tumor classification

2. Brain Tumor Imaging Techniques

Recently medical imaging technique is very important for diagnosis of any diseases. For brain tumor detection imaging technique is used because it is very challenging to localize the tumor place in brain .The use image processing technique helps to enhance the information in image and get accurate and efficient imaging of brain. The existing technique of brain tumor imaging (are shown in figure.2) are

MRI, CT, Electroencephalography (EEG), PET, MEG, Biopsy and X-Ray.

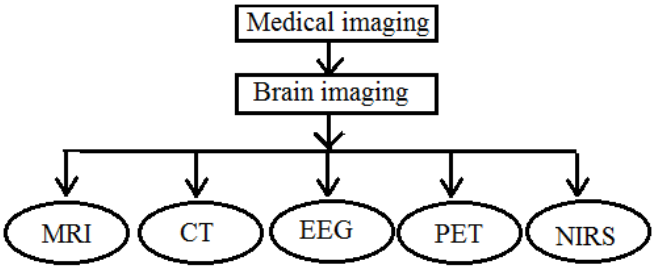


Figure 2: Brain imaging techniques [3]

A. Magnetic Resonance imaging (MRI)

MRI is a non-invasive and good soft tissue contrast imaging modality which provide valuable information of brain tumor without exposing the patient to a high ionizing radiation. An MRI uses a large magnet, radio waves and computer to create detailed, cross sectional image of internal organ waves, and structures.

For the identification of brain tumor, MRI illustrates the 3 slice such as T1, T2 and flair.T1 and T2 –weighted images are easily differentiated by cerebrospinal fluid comparison which is dark for T1 weighted and bright for T2 weighted. Flair sequence is same as T2 weighted except TE and TR times are longer. Figure.3 shows the three standard MR images.

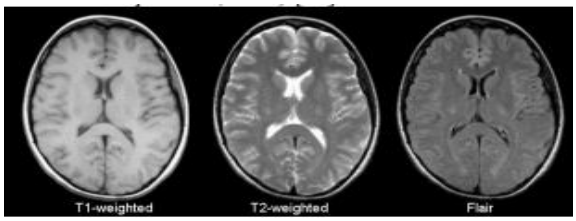


Figure 3: Basic types of MRI images [4]

B. Computed Tomography (CT)

Computer tomography also known as CT or CAT scan.it is a medical imaging test.it produces multiple images of the inside of the body. The test is painless. A CT scan is generally good for larger areas.50% of low grade glimmers are not able to detect by CT.it will help to locate the tumor and classify the tumor.it also help to identify the treatment effectiveness .

C. Electroencephalography (EEG)

An electroencephalogram (EEG) is a test that looks at the patterns and location of electrical activity in the brain. These patterns of electricity are recorded as wavy lines on a computer or on paper. Use of this wavy line help to detect the problems in brain. EEG can detect abnormal brain waves after a head injury, stroke, or brain tumor. The measures of electrical actions by placing electrodes on the head scalp.

D. Positron Emission Tomography (PET)

It is a nuclear medical imaging and it is noninvasive.it uses small amount of radioactive material to diagnose ,evaluate or treat a variety of diseases. It detect disease before it shows up on other imaging tests. PET scans show problems at the cellular level; giving your doctor the best view of complex systemic diseases.it is not painful.

E. Near Infrared spectroscopy (NIRS)

Near-infrared spectroscopy is a non-invasive technique. It uses low levels of light to measure blood flow changes in the brain associated with brain activity. .it can analyse the functional localization of the brain.it is an inexpensive device

3. The Pre-processing of MRI Images

Image pre-processing is used for enhancing the quality of image data by avoiding unwanted distortions. It includes conversion of grey scale image, binarisation, denoising and skull removal. By doing this result of brain tumor segmentation will be effective and accurate. Figure.4 shows the methods taking place in pre-processing unit.

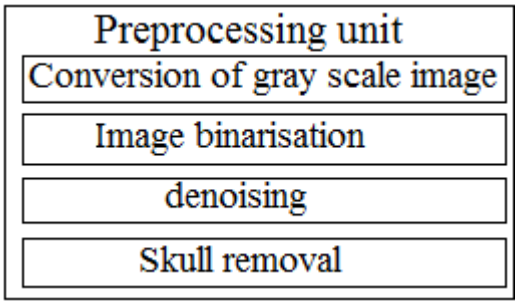


Figure 4: Preprocessing method

a) Conversion of gray scale image

Grayscale images are the images that contain bright information. Each pixel value of image corresponds to an amount or quality of light. In grayscale image different level of gray is present. There are 256 possible level from black and white. The main characteristic of grayscale image is equality of red, green and blue colour level. The colour code will be like RGB(R,R,R),RGB(G,G,G),OR RGB (B,B,B). Where R, G, B is a number between 0 and 255 individually. The reason for differentiating such images from any other sort of colour images is that less information needs to be provided for each pixel.[5]

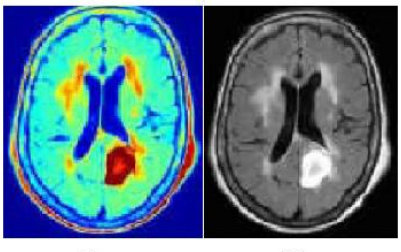


Figure 5: (a) Colour image (b) Grayscale image

b) Image Binarisation

Image binarisation is the process of taking a gray scale image and converting it to black and white, essentially reducing the information contained within the image from 256 shades of gray to 2: black and white, a binary image .this is sometimes called image thresholding, although thresholding may produce images with more than 2 level of

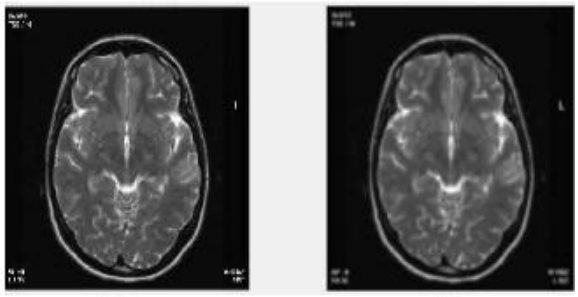
gray. Binarisation classifies into local and global binaraisation.

Global binarisation:-
It is divided into 3.fixed threshold method, OTSU method, kittler method.
Fixed threshold: In this method value is used to assign 0's and 1's for all pixel positions in a given image.
OTSU method: This method is used for automatic binarisation level decision based on shape of the histogram.[6]
Kittler method: It is mixture of Gaussian distribution to find the threshold value.t is the threshold that is used to segment the images into two parts background and foreground.

Local thresholding
It is used to convert an image consisting of gray scale pixels to just black and white scale pixels. Usually a pixel value of 0 represents white and the value 255 represents black with the numbers from 1 to 254 representing different gray levels.it is divided into adaptive binarisation method, niblack method and bernsen method.
Adaptive Binarisation methods: In this a window of NxN blocks slide over the entire image and threshold value is computed each local area under the window for binarisation.
Niblack method: The threshold value or the local area under the window is calculated pixel wise .The calculation depend upon the local mean and standard deviation of window area.
Bernsen Method: In this method which computes the threshold value from the pixel of image.

c) Denoising
Noise means "unwanted signal". Denosing is very important in preprocessing. Noise can be produced by the sensor and circuitry of scanner or digital camera. Digital images converts optical signal into electrical signal and then into digital signal and is one of the process by which the noise is introduced in digital images. The image will contain the information of the patient. The image also contain the information about the institute where the test done and machine used. This are unwanted information .This is termed as noise.[7]

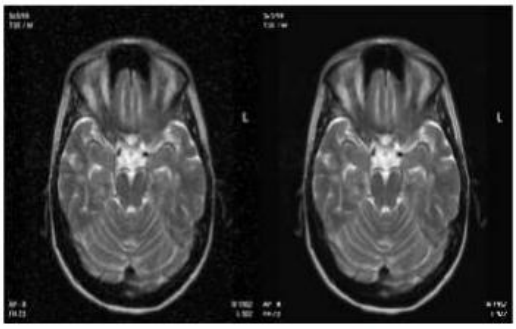
Gaussian filter or Gaussian smoothing:
A Gaussian filter is a linear filter used to blur the image or to reduce noise .It is not perfect to remove salt and pepper noise .It is a smoothing filter, defined by the Gaussian kernel. Figure.5 shows the Gaussian filtered image. This filter shows lower blurring effects compared to averaging filter. Gaussian filter not only corrects the spectral coefficients, but also all the amplitude spectrum coefficients that lies within the filter window. [8]



(a) (b)

Figure 5: (a) original image (b) Gaussian filtered image

Medium filter
It is a nonlinear digital filter technique, it used to remove noise from an image or signal. It is widely used as it very effective at removing noise while preserving edges. It is removing "salt and pepper" type noise. This filter works by moving through the image pixel by pixel, replacing each value with the medium value of the neighboring pixel. [8]



(a) (b)

Figure 6: (a) Original image (b) filtered image

Mean filter
Mean filter or average filter is windowed filter of linear class that smoother the Image. The filter works as low pass. Replaces the centre value in the window with the average filter is for any element of the signal take an average across its neighborhood. [8]

Anisotropic filtering
In MRI high Frequency noise is present.it is removed by filtering process . ADF is used to remove the noise and maintain the image edges.it is popular method used to restore MR image intensities capable of smoothing noisy filter.[9]

Smoothing filter
It pass low frequency and attenuate high frequency . The output of the smoothing linear filter is simply the average of the pixels contained in the neighborhood of the filter mask. By replacing the value of each pixel in an image with the intensity levels in neighborhood, a smoothing linear filter will reduce "sharp" transition in intensities.[10]

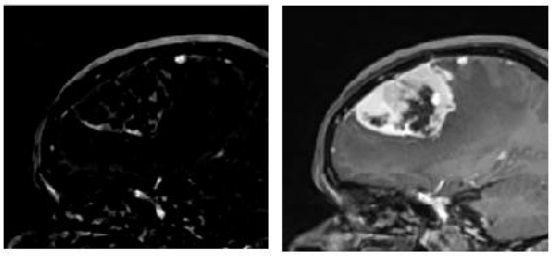
Sharpen filter
Sharpening an image increases the contrast between bright and dark region to bring out features. It is basically application of the high pass filter to an image.[11]
Wavelet filter:

It has been used for removing any type of noise in MRI images.

Non local means filter
It is denoising method. Here replacing the color of pixel with the average of the color of similar pixel. Similar pixel of given pixel have two reason to be close at all. To seen the portion of image in search of all pixels that are really resembles the pixels on wants to denoise.

d) Skull Removal
Skull removal is an important step in detection of brain tumor. It control the boundaries of the object. It will increase the processing speed. Noise free brain MRI is taken as the input to skull removal process by morphological operations. The presence of non brain tissue is considered as major obstacle for segmentation.

Skull removal is a nonlinear operation related to morphology of features in an image which include erosion and dilation. The skull removal process effect the efficiency in detecting tumor, pre-surgical planning, removal of skull region reduces the chances of misclassifying diseased tissues.[12]



(a) (b)

Figure 7: (a) Skull of MRI (b) Skull removed MRI

4. Brain Tumor Segmentation Methods

Brain tumor segmentation is most important task in medical image process. It involves large amount of data.it can improves treatment possibilities and increase the survival rate of the patients. Image segmentation is a procedure of divide a digital image into numerous regions or set of pixels. Based on texture or color we can make partitions. Segmentation is classified into manual method, semi-automatic methods and fully automatic method. [13]

In manual segmentation require a Radiologist to get information from MRI images along with anatomical and physiological knowledge through training and experience. It is time consuming.

In semi-automatic segmentation requires the user, interaction and software computing. User need to input parameters and is responsible for analyzing the visual information and providing feedback response for the software computing. User can evaluate the result .it is time consuming than manual method and obtain efficient result.

In fully automatic segmentation method no user interaction is required. Artificial intelligence and prior knowledge are used to solve the segmentation problem.

Image segmentation techniques mainly classified into edge based, region based and pixel based .

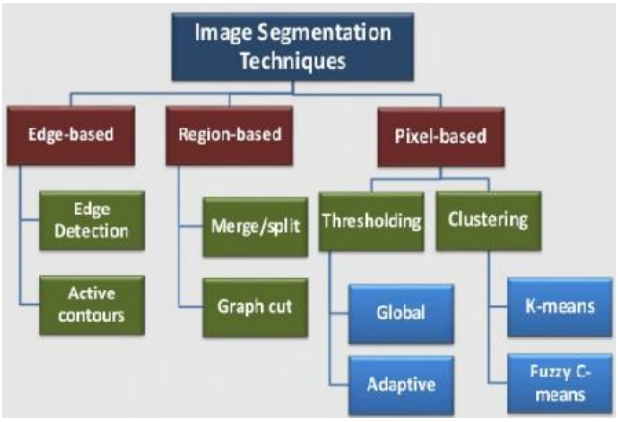


Figure 8: Image segmentation techniques

Edge based
It is detection of short linear edge segments(edgels). Here edge pixels are those places where image function changes sharply. Sobel, Prewitt Roberts and canny are several methods in edge detection.

Edge detection: shape information of image is enclosed in edges. So first we detect edges of an image and enhance those area of image which contains edges, sharpness of the image will increase the image will become clear.[14]

Active contour: it can be defined by use of energy force and constraints for segregation of the pixels of interest from the image for further processing contour are boundaries are designed for the area of interest required in an image. The main application of the active contour in image processing is to define smooth shape in the image and form closed contour for the region.

Region based
In this method different objects are separated by other kind of perceptual boundaries like neighborhood features. Region features are extracted and used to define “class”.[15]

Region growing:- It is a procedure that groups pixel or sub regions into large regions. Region growing techniques are better than the edge based. Where edges are difficult to detect.[3]

Region splitting /Region merging:- Region Splitting: Region growing starts from a set off seed point an alternate is to start with the whole image as a single region and subdivide the regions that do not satisfy a condition of homogeneity.

Region merging: region merging is opposite of region splitting. start with small region and merge the regions that have similar characteristic, splitting and merging approaches are used iteratively.[16]

Graph cut :- In graph cut, it provides a powerful way of extracting and understanding of the global impression of the image rather than focusing heavily on local features. In this

image is considered as a graph of image nodes and apply the solution in the way of graph partitioning problem. This method provide a new measure of graph partitioning called disassociation measure. The normalized cut by method is not only taking total dissimilarity between different group. But also it take total similarity within a group for graph partitioning process.[17]

Pixel based:- In pixel based segmentation ,feature of each pixel is determined depending on is intensity value ,pixel orientation , gradient of detection ,frequency.it is mainly divided into two, threshold and clustering methods.[19]

Thresholding: It is used to extract the objects from the background by selecting a threshold value T. Here more than one threshold value are the factor to segment the image. Global thresholding is a concept of choosing only one threshold value among the gray level in the image. When the value of T changes over an image, we use the term variable thresholding or sometimes referred to as local regional thresholding. T is a variable, if it depends on the spatial coordinates (x, y) themselves then variable thresholding is often referred to as dynamic or adaptive thresholding. [18]

(a) (b)

Figure 9: (a) before threshold (b) after threshold

Clustering

A cluster is a collection of objects which are similar between them and are dissimilar to the objects belonging to other clusters.it is again divided into two. K mean clustering and fuzzy mean clustering.

K-mean clustering: K-Means clustering is an algorithm to group objects based on attributes/features into k number of groups where k is a positive integer. The grouping (clustering) is done by minimizing the Euclidean distance between the data and the corresponding cluster centroid. The function of K-Means clustering is to cluster the data.[20]

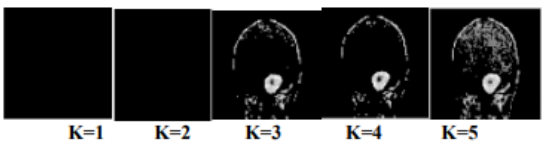


Figure 10: k mean clustering [21]

Fuzzy mean clustering: It is a method which divides one group of data into 2 or more cluster. FCM include giving best result for over lapping data set and comparatively better than k mean algorithm.it is possible to generate segmentation images that display clinically.it is a time consuming clustering method to reduce the execution time of this algorithm. Figure.11 shows the FCM method

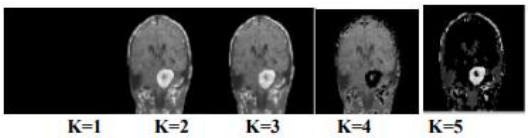


Figure 11: FCM method [21]

Watershed segmentation: Watershed is the one of the most important method in image segmentation.it has interesting properties that make it useful for much different image segmentation application. I is a powerful technique for rapid detection of both edges and region .this image segmentation based on mathematical morphology. Segmentation by watershed transform is a fast, robust and widely used in image processing and analysis, but it suffers from over-segmentation [22]

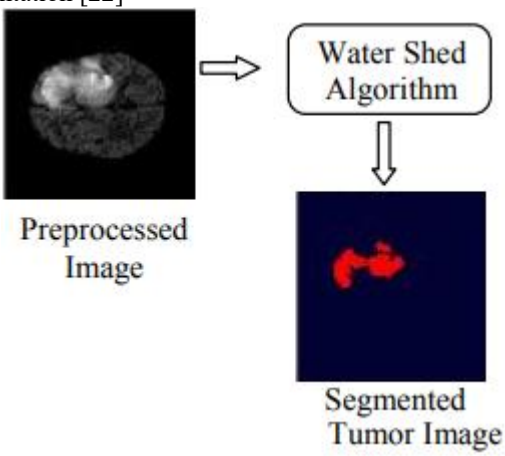


Figure 12: Watershed algorithm [23]

It can visualize an image in 3D that is spatial coordinates and grey levels in such a topographic interpretation, here are 3 types of points. that are points belonging to a regional minimum, points at which a drop of water would fall to a single minimum(the catchment basin or watershed of that minimum) and points at which a drop of water would be equality likely to fall to more than one minimum.(the divide lines or watershed lines).

Atlas based algorithm: It are used significantly in medical image segmentation and are widely employed in computer aided diagnosis to determine the object shapes. atlas requires more time to construct, which in turn represents the main drawback of this approach .it mainly have three steps: first, an registration brings the atlas and the patients into global correspondence; secondly, the seeding of a synthetic tumor into the brain atlas provides a template for the brain tumor ; third, the deformation of the seeded atlas by optical flow principles and brain tumor growth. It also provide probabilistic information about the tissue model. [13]

5. Feature Extraction

It is technique to represent images in feature set of object of interest. Features are important for analysis. Based on features we can classify whether it is normal or abnormal.

Various feature extraction method have been proposed .advantages of feature extraction is accuracy, risk reduction ,speed up in training ,improved data visualisation. Feature extraction aim to reduce the number of features in a dataset by creating new features from the existing ones.

LDA:
It is supervised learning method in feature extraction. The features extracted are shape –based feature ,texture –based feature and intensity –based feature. In LDA total 18features are extracted. [24]
Shape based features: circularity, irregularity, area, perimeter, shape index are extracted from the segmented regions. Circularity is the measure of how close an object should be to a true circle. Circularity is a 2-Dimensional tolerance that controls the overall form of a circle ensuring it is not too square, or out of round. Area of an image can be explained as the number of pixels confined inside the segmented region including the boundary. Perimeter is a path that surrounds a two-dimensional shape. Shape Index (SI) is a statistic used to quantify the shape of area.
Texture based features : Contrast, Correlation, Entropy, Energy are the texture based features extracted from the segmented region. Contrast can be defined as the difference in luminance and/or color of the image. Correlation refers to any of a broad class of statistical relationships involving dependence. Entropy (en) can be described as a measure of unpredictability or information content. Energy feature give the measure of uniformity in image.
Intensity based features: Mean, Variance, Median Intensity, are intensity based features that are extracted from segmented regions. Mean (μ) is average of the objects in consideration. Variance (σ2) measures how far pixels of the image are spread out. Median is the numerical value separating the higher of pixel values from the lower.

GLCM:
This method is used to extract texture from images .There are many type features extracted from GLCM techniques like contrast ,dissimilarity, energy ,entropy etc. A GLCM is a matrix where no rows and columns are equal to the grey level G .The matrix element P(i, j |del(x),del(y))is the relative frequency of each pixel and separated by the distance (del x, del y).every pixel have intensity I and j .the matrix element P(i , j| d, theta) contain the second order statistical probability values. Due to large dimensionality. GLCM is very sensitivity to feature with different grey level.[25] The extracted features include contrast, correlation, energy, homogeneity, mean, standard deviation, entropy, skewness, kurtosis, inverse difference moment.

DWT:
It is a linear transformation that operates on the data vector, and transformation it into anothevector.it is applied to each dimension separately to obtain 2D DWT. It can provide localized frequency information of image.[26] . The wavelet is a powerful tool for feature extraction, and will be used to extract the wavelet coefficient from MR images. It gives good frequency resolution for low frequency components and high temporal resolutions for high frequency components.

Select a mother wavelet from ‘Haar’, ‘Daubecheis’, ‘Morlet’ etc. The signal is now translated into shifted and scaled versions of this mother wavelet. This analysis divides the signal into detailed signals. The approximate sub signal shows the trend of pixel values a detailed sub signals on the horizontal, vertical, and diagonal details.

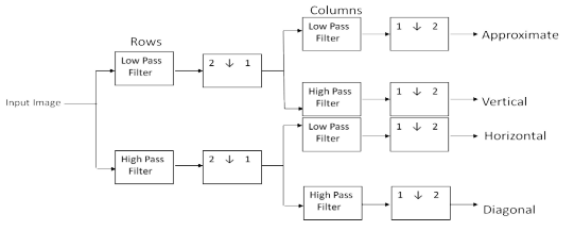


Figure 13: DWT Process

The diagonal details respectively. This is shown the rows are fed with low pass and high pass filter and then down sampled then both are filtered again by both low pass and high pass. The results are down sampled again and we get 4 different images with approximate, vertical, horizontal and in figure DWT method .[27]

6. Feature Selection

Feature selection can significantly increase the performance of learning algorithm.it is process of discarding some of the features of the patterns and only subset of the features.

PCA: It is linear dimensionality reduction technique. It is unsupervised learning algorithm. Therefore it doesn’t care about the data labels but only about variation. In using PCA, input data and try to find a combination of the input features which can best summarize the original data distribution .so that to reduce its original dimensions . PCA is maximizing the variance and minimizing the reconstruction error. [28]

PSO: Particle Swarm Optimization (PSO) is applied to decrease features size therefore reduces the computational cost of analysing new data. The parameters selection in practical applications has a countless impact on the wavelet analysis prediction effect. It is a population-based global search algorithm, which was established to optimize a problematic by iteratively increase a candidate solution with respect to a given measure of quality. A population (called a swarm) of candidate solutions (called particles) in the search space. [29] Independent component analysis (ICA): It is commonly used in medical application such as EEG and fMRI analysis to separate useful signal.it is linear dimensionality resolution .it take input data a mixture of independent components and aim to correctly identify each of them. Let v1 to v d denote the projection directions of independent components. It is used find these directions such that data projected onto these directions have maximum statistical independence.[30]

7. Classification

Feature classification is important step in the automation of the diagnostic system. Through classification method only we can classify whether the MRI is tumor or non -tumor. It is done to identify the tumor class present in the image.it will

improve the accuracy of our analysis. There are different type of classification methods.

A. Support vector machine (SVM)

It is a binary classifier defined by a separating hyper plane. it is supervised learning method.it is used for data analysis and classification .SVM has fast speed for large data . And it is based on the decision plane .Decision plane only separate between a set of items having dissimilar .It have two basic steps of training and testing. It is divided into linear and non-linear SVM.

Linear SVM: The training pattern will be linear divisible. ie, there exists a linear function of the form $f(x) = w^T x + b$ (1) such that for each training example xi, the function yields $(f(x)) \geq 0$ if x for =+1, y and f (xi) < 0 for yi = -1.

$F(x) = w^T x + b = 0$, where w is the unit vector and b is a invariable. For a given training set, while there may exist many hyper planes that maximize the separating margin between the two classes. SVM finds the hyper plane that causes the largest separation between the decision function values for the "borderline" examples from the two classes. SVM classification with a hyper plane that minimizes the separating margin between the two class [31]

Non –linear SVM: In this method also hyper plane is used to separate between two classes. But datasets or data points are always not separated by drawing a straight line between two classes.

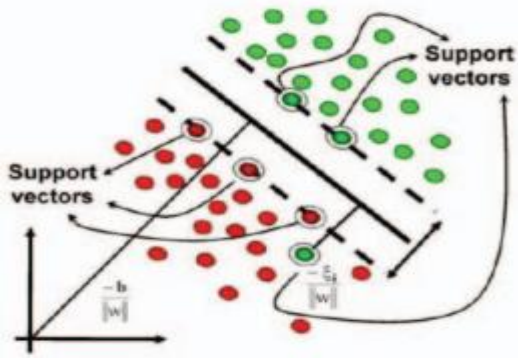


Figure 14: Non –linear SVM classification

The above figure is not separable by linear SVM. So, Kernel functions are used with SVM classifier. Kernel function provides the bridge between from nonlinear to linear.[7].

B. Convolutional neural network (CNN)

It is a supervised deep learning algorithm; it is used in various fields like speech recognition, image retrieval and face recognition. It can be used to progressively extract higher-and higher-level representations of the image content. A CNN works by extracting features from images. [23]

Typical CNN is 5 layer architecture consist of convolutional layers. Its begin with convolution layer that extract the unique features from input image. Next layer is pooling layer that reduce the dimensionality. Generally CNN is trained using back-propagation algorithm. It preserves spatial relationship between pixels by learning image image features using small squares of input data detect small, meaningful features. Such as edges with kernels.

C. Naïve Bayes Classification

It is a supervised classification of machine learning. It is suitable for binary and multiclass classification.it is a kind of classifier which uses the Bayes theorem. It is useful for making predictions.it predicts membership probabilities for each class such as the probability that given record or data point belongs to a particular class. It requires less training data. It is highly scalable. [32]

D. Decision tree

A Decision Tree is a simple representation for classifier. It is a Supervised Machine Learning where the data is continuously split according to a certain parameter. Decision tree arrives at a class membership by repeatedly dividing datasets into smaller and more uniform datasets. It can be used for classification or regression. Accuracy of decision tree can be defined by the number of correct predictions made divided by the total number of predictions made.it is more popular because they can be easily visualised **so** that a human can understand .[33]

E. KNN

KNN is a supervised learning algorithm used for classification and regression problem. K-Nearest Neighbours (KNN) is one of the simplest algorithms used in Machine Learning for regression and classification problem. It is power classification algorithm used in pattern recognition. The data is assigned to the class which has the nearest neighbours. K nearest neighbors stores all available cases and classifies new cases based on a similarity measures. An object is classified by a majority vote for its neighbor classes.

F. Ensemble base classifier

This is to combine multiple models (classifiers or features) to solve particular problems Ensemble learning is primarily used to improve classification or prediction performance, where a single model does not have these capabilities, especially in dealing with multiclass problems. In the work classification consist of three work they are support vector machine classifier, Extreme learning Machine and Feed Forwarded Artificial Neural Network.

SVM: It supervised learning methods used for classification and regression. It minimize the empirical classification error and maximize the geometric margin.

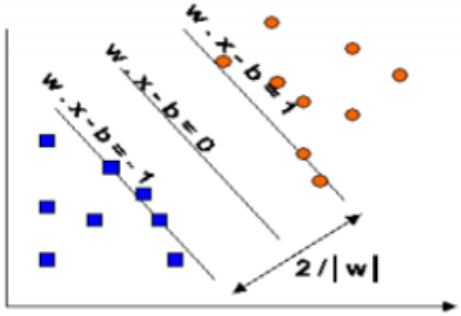


Figure 15: SVM

Extreme Learning Machine: is a single hidden layer feed forward neural network (SLFNN) which randomly selects input weights and hidden neuron biases without training. Main aim is to generate high resolution images from inputs with low-resolution. ELM learns a model that is capable of mapping the interpolated image and imposing it on the high frequency components predict the high frequency components using low resolution images.

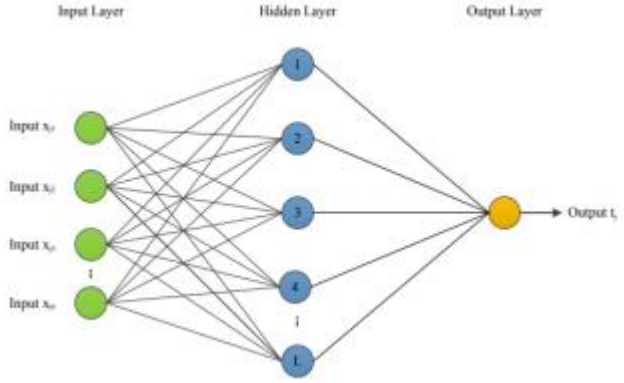


Figure 16: Overview of ELM

Feed Forwarded Neural Network: It is a nonlinear statistical data modelling tools. Feed forward Neural Network One of the simplest feed forward neural networks (FFNN) [38], it consist of a number of units, organized in layers. Every unit is connected with all the units in the previous layer. These connections are not all equal. Each connection will have a different weight. The weights will encode the knowledge of a network. Units are also called *nodes*. Data enters at the inputs and passes through the network, until it arrives at the outputs. During normal operation, it acts as a classifier, there is no feedback between layers.

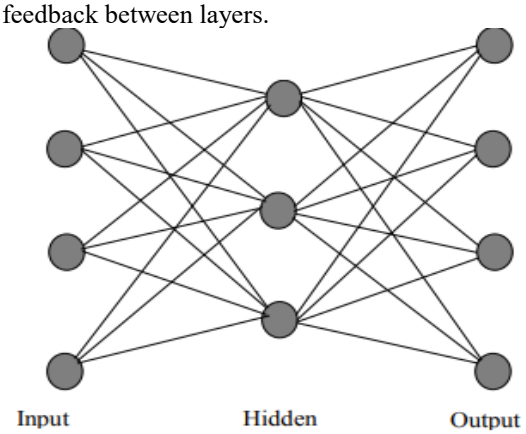


Figure 17: FIFO

G. Probabilistic neural network (PNN)

PNN is derived from Bayesian network and statistical algorithm. Here the operations are organised into multilayered feed forward network with 4 layers. That are input layer, hidden layer, pattern layer and output layer.it is much faster than multilayer perception network. This network are relatively insensitive to outliers.it require more memory space to store the model

H. Artificial neural network (ANN)

ANN is a classification method.it acquires a large collection of unit that are interconnected in some pattern to allow communication between the units. This units is also called node or neurons. Every node in one layer is connected to every other node in the next layer by increasing the number of hidden layer we can make the network deeper.

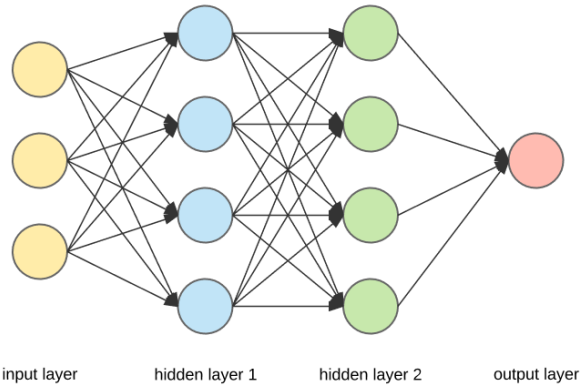


Figure 18: ANN

If we zoom in to one of the hidden or output nodes .it is seen in below

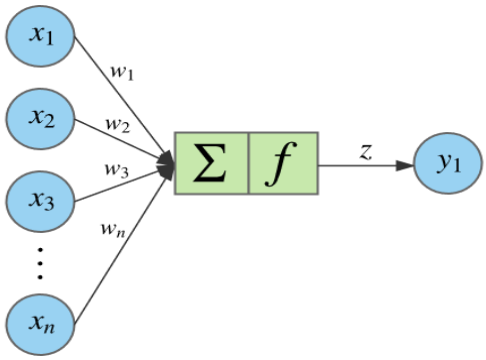


Figure 19: Hidden node

A given node takes the weighted sum of its inputs, and passes it through a non-linear activation function. This is the output of the node, which then becomes the input of another node in the next layer. The signal flows from left to right, and the final output is calculated by performing this procedure for all the nodes. Training this deep neural network means learning the weights associated with all the edges.

8. Comparative Analysis

This is a analysis of various segmentation, feature extraction, feature selection and class

Segmentation	
Edge based	It detect and links edge pixels to form contours.
Region based	It consider gray level from neighboring pixels by including similar neighboring pixels.it split and merge
Pixel based	Each pixel is segmented based on gray level value.no contextual information, only histogram.

Figure 15: Segmentation analysis

Feature Extraction	
LDA	It tries to project the sample onto a straight line.it is used to make the data points more distinguishable after dimension reducion.

GLCM	Texture description method-intensity change histogram
DWT	The wavelet transform for which the wavelets are descretely sampled.it capture both frequency and location information

Figure 16: Feature extraction analysis

Feature selection	
PCA	It is technique of multivariate and megavariate analysis which may provide arguments for reducing a complex dataset to lower dimension.
ICA	It is a statistical technique useful in systems involving multivariable data.
PSO	It uses real number code decided directly through solution having number of dimensions equal to the constants of the solution .

Figure 17: Feature selection analysis

Classification	
SVM	Accurate classifiers produced. Improve Performance in large dataset .robustness to noise
CNN	It learn complex features automatically from the data itself.it has achieved high performance using a new two way architecture
Naïve Bayes Classification	It gives high accuracy, this work for limited number of dataset
DT	It is suitable for real world problems and also handle missing value and split data
KNN	Simple, effective, easy to implement and non-parametric classifier and provide low error.
Ensemble classifier	Predictive, accuracy improved
ANN	It is a non-linear statically data modeling tools where relationships between inputs and output are modeled or pattern are found.

Figure 18: Classification analysis

9. Conclusion

This paper give an overview of brain Tumor detection and classification by different methods. There are different brain Tumor imaging technics. Several methods are taking place like pre-processing, segmentation, feature extraction, feature selection and classification. And in each section there are different methods. Every methods have its merit and demerit. All method purpose is to achieve accurate and efficient system developed so that it is easy to find Tumor in minimum time with maximum accuracy

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