ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

A Survey on Brain Tumor Segmentation.

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ABSTRACT

Segmentation is a main method for premature diagnosis of brain tumor. Brain tumor segmentation consists of dividing the various tumor tissues from usual brain tissues: gray matter (GM), white matter (WM), and cerebro-spinal fluid (CSF). Brain tumor removal and testing are difficult jobs in medical image processing. The specialist alone evaluated the image of the brain and its arrangements it is a very difficult task. Segmentation plays an important task within the medical image processing. Medical diagnostic tool works with the help of Magnetic Resonance Imaging used for brain diagnosis. Segmentation algorithms include planned towards Magnetic Resonance Image segmented brain tissue, a small number of them combine the tissue segmented tissue and correcting the bias field as well as remove the noise. This summary represents the segmentation methods of detecting a brain tumor. This analysis of Magnetic Resonance Imaging segmentation of brain tumor targeted to improve the MRI diagnostic imaging.

Keywords: Segmentation, Magnetic Resonance Imaging, Human Brain Tumor, Medical Imaging

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ISSN: 0975-8585

INTRODUCTION

The human brain is an organ working as a central soft nervous tissue and integrated with center of sensitivity, creativity and nervous activity. using Magnetic Resonance imaging techniques can take with high resolution of structural and anatomical data, it is suitable techniques for medical imaging processing. Brain tumor analysis and location are clearly reflected by Magnetic Resonance Imaging it is challenging task, its intension is segmented various tumor tissues. This image processing, segment frequently communicates to various tissue classes, anatomy and organic related structure. The segmentation of medical imaging is complicated through less variation, noise, and uncertainty of another image. Here various computer vision techniques for image segmentation, few of them fit for medical image processing. This paper presents methods of brain tumor segmentation tested after the image recovery. Working of segmentation shown in Figure 1.

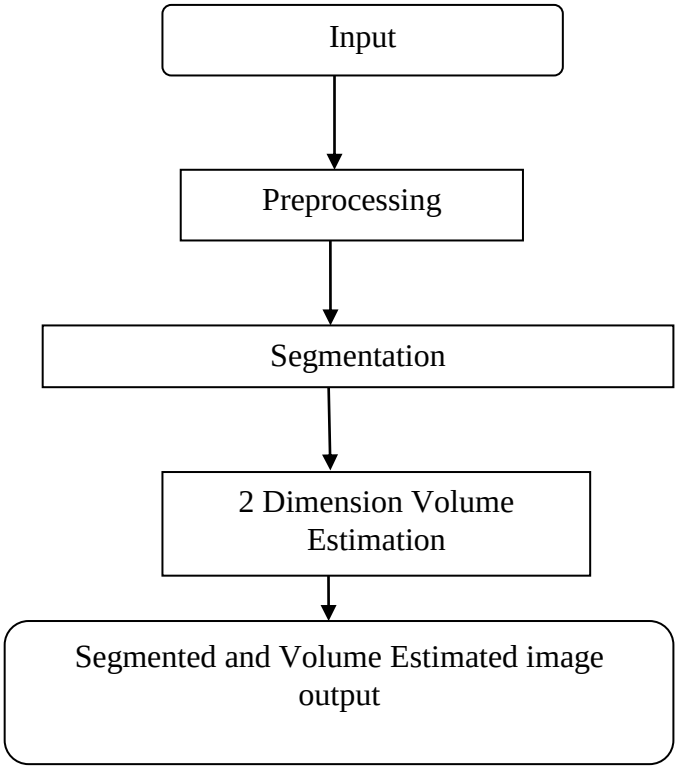

Figure 1: Flowchart of segmentation process

- Input
- Preprocessing
- Segmentation
- 2 Dimension volume Estimation
- Segmented and volume Estimated output

SEGMENTING WHITE MATTER (WM)

The Histogram regional maximal cost for selecting pixels it represented White Matter. Mostly White Matter pixels segmented using region growing select the few steps of neighborhood white matter pixels with starting place the value 1 within a disguise. Then describe a white matter picture element, having strength is maximum when compare the starting values as well as four points associated every picture within the disguise is place the value 1. Then, satisfied the If condition, the picture element related intention within mask place the value 1. This method is continuously used previously definite no. of. Iterations. Finally White Matter mask was developed, then image arithmetic used between two images such as an image of skull stripped and the White Matter disguise to remove White Matter shown in Figure 2.

ISSN: 0975-8585

Figure 2 : Segmented White Matter

SEGMENTING GRAY MATTER (GM)

This section discusses about removing the GM and cerebro-spinal fluid within the skull. The GM picture element shows lower contrast, compare the WM picture elements. Gray Matter picture elements detect from the White Matter strength values. We develop Gray disguise picture elements through set the picture elements within the threshold of GM place 1 within the disguise. Then continue the method of seed growing in the neighborhood connectivity points remove the Gray Matter is shown in Figure 3. The updated Gray Matter mask combines the skull stripped and segmented White Matter.

Figure 3 : Segmented Grey Matter

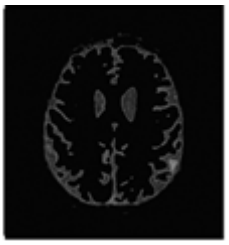

Figure 4 : segmented cerebrospinal fluid

SEGMENTING CEREBRO-SPINAL FLUID (CSF)

Skull stipped segmented White Matter as well as Gray Matter is removed shown in Figure 4. The seed growing beyond skull stripped image was starting segmentation to cerebro-spinal Fluid. It is removed using image arithmetic.

REGION GROWING METHOD

This method is used to recognize the accurate tumor position. Then specify seed point position of voxel having maximum intensity between different areas and differentiate other related voxels [1]. Then similarly measured using compared among the capacity of voxel and measured capacity of the primary area. Related voxels given the minimum value for similarity measure, joined within the considered area, then certain area is mature continuously. This method simultaneously processed every voxels [2]. This outcome given following region growing method given removing the tumor cover is shown in Figure 5 and Figure 6

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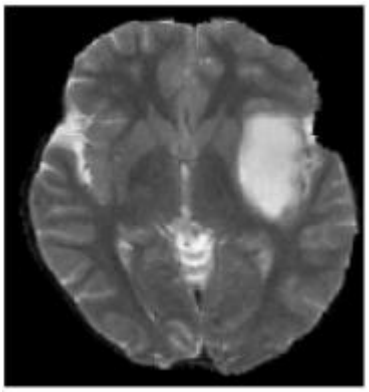

Figure 5 : MRI Image of Brain tumor

Figure 6 : Image after Region growing method

MANUAL SEGMENTATION

This method involves brain tumors image was manually drawing. The segments of the tumors structure, or else drawn the anatomy structured area in the brain shown in fig 3. This method not human experts (radiologists/anatomist/trained technologists) alone drawn the brain data offered in the picture as well as anyone drawn having extra information about anatomic structure [3]. Physical description required software tools complicated GUI to make easy drawn ROI and display the image. Region of Interest removed, which area we want to analysis. It prohibits rest of the region was a decrease complication within the image. However the region of interest (ROI) was the slow performing choice.. In this segmented method brain tumor was completed with the enhancing intensity of the single image [4]. But that human is not a radiologist or anatomist or trained technologist drawn the Region of Interest. Who are in experienced about anatomic brain information they are mostly given not satisfied segmented outcome shown in Figure 7.

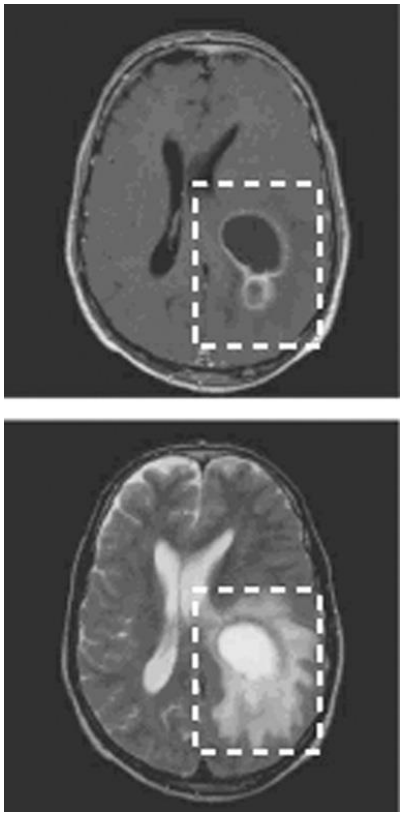

Figure 7 : Images of Manual Segmentation

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SEMI AUTOMATIC SEGMENTATION

In this method involvement worker of human is needed to regularly verify the correctness of the outcome as well as yourself correcting the segmented outcome. In this brain tumor segmented technique within the target of less human communication [5]. There is the major mechanism of brain tumor segmented methods. Initially the computational element corresponding more than one piece of some parameters given competent programming generated a description of the tumor. Next, the interactive element acts like a mediator and exchange the data between the user and the computational element. This method translated the result given through computational element in visual response to the user [6]. The input and output devices helps between the computer and user interaction completed successfully, it is fully managed via the user interface. Finally projected visual information on the screen and given computational response these are analyzed by the user shown in Figure 8.

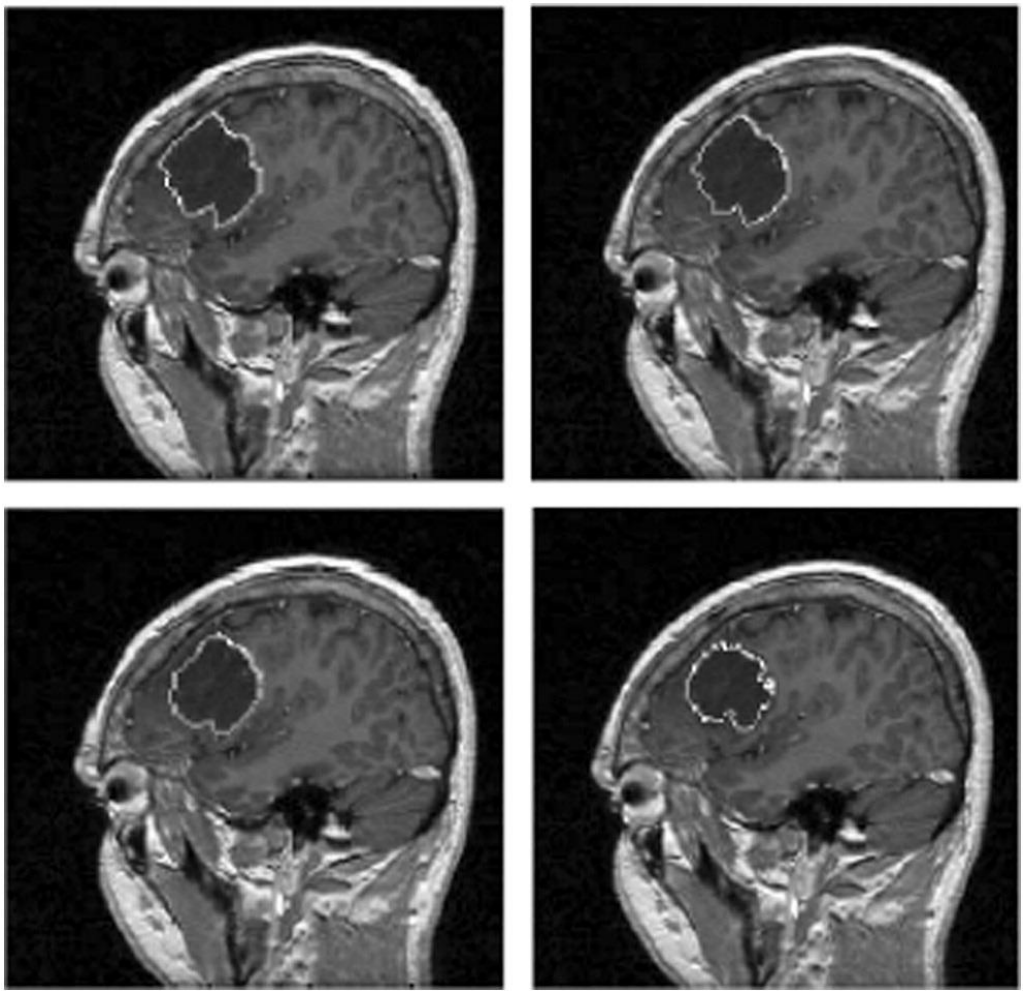

Figure 8 : After segmentation of Semi automatic

THRESHOLDING

It is one of the simplest and fastest segmentation method, the image objects are divided through compared with more than one threshold intensity. This threshold method having two types they are global threshold and local threshold [7]. Using single threshold the histogram expresses the background image divided the bimodal pattern. It denotes global thresholding. But that picture having two types of regions, corresponding towards various objects, local thresholding should accept segmented method.

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GLOBAL THRESHOLDING

It is simple method share the intensity of pixels in the area. Therefore, this is naturally segmented the area by threshold technique the partition of light and dark regions [7-8]. Threshold technique obtains binary related image from gray level ones through every pixel under several thresholding to zero and every pixels regarding the thresholding to one. In the equation (1) show that g (x, y) is a thresholding version of f (x, y) at some global threshold T,

$$G(x, y)=\begin{cases}1 & if\ f(x,y) \geq p \\ 0 & otherwise\end{cases} \quad (1)$$

The picture element places the value 1 corresponding towards the Region Of Interest, and the picture element places the value 0 correspond towards the background.

Global thresholding performed well the image having homogenous intensity objects and compared the objects of the image as well as high background. The correctness of Region of Interest is questionable since it is spilt from the surroundings related to the single threshold value [9]. A number of regional is increased and noise level, low variation image shown in Figure 9 and Figure 10.

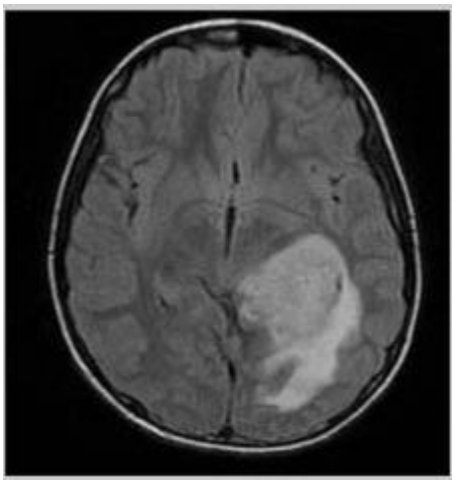

Figure 9 : Original Image

Figure 10 : After thresholding

Initially this system applies intensity of thresholding technique towards choosing manual ROI shown in Figure 11 then express a right approach for segmented image objects that are having various intensity backgrounds. Even though the condition of manually segmentation otherwise selected ROI is a disadvantage, another problem, not efficiently presented the hyperintense pixels it express usual structure within T1 weighted image.

LOCAL THRESHOLDING

This thresholding technique decided the local area around the pixel. These methods can be useful for threshold values may not be decided histogram for the whole image otherwise single thresholding may not give excellent segmented outcome [7]. This thresholding technique used intensity histogram to estimate thresholding cost for the various areas shown in Figure 10. Prior knowledge normally estimate the thresholding value. Threshold value as well as estimate with the local arithmetic property equal to the value of mean intensity within Magnetic Resonance Imaging of T1 weighted through calculating partial volume of every area towards deciding thresholding used for the segmented of every element on T2 MR images [3]. This Local thresholding, region, was calculated delineate as pathologic tissue shown in Figure 11. Normally thresholding related segmented methods [10], local and global they are measured not able to develop every data given through Magnetic Resonance Imaging, are used initial point in the segmented method.

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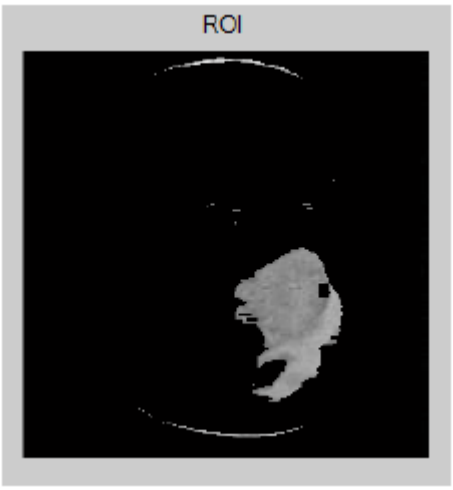

Figure 11 : Region of Interest

GENETIC ALGORITHM (GA)

The Genetic Algorithm discovers "survival of the fittest". Because fittest is used within optimization event and searched through the algorithm. The execution of GA randomly selected with an original people chromosome [11]. A gene is a DeoxyriboNucleic Acid). The exact qualities decided through individual hereditary. Every quality is coded through DNA bases contains several grouping.

The four main bases of DNA

- A (Adenine)
- C (Cytosine)
- T (Thymine)
- G (Guanine)

ADVANCED K-MEANS CLUSTERING WITH GENETIC ALGORITHM (GA)

K means clustering is helping to achieve Brain tumor detection. It includes many post-processing techniques: Visualization and Analysis. It is an efficient algorithm. Usually this method is responsive towards the primary clustering center. If these cluster fluctuations within various primary inputs and difficulty arise more segmentation then unsucessive edge and other difficulty a raise in normal k-means method [11-12]. This scheme decided accurate location of the brain tumor region becomes very difficult [35], so we have to suggested GA. Genetic Algorithm helps variation of transformation operation, increases the speed of convergence also less compute time. Some experimental outcomes suggested that k- means based GA not simply eliminate the more segmentation problem alone and also given faster as well as effective cluster methods shown in Figure 12.

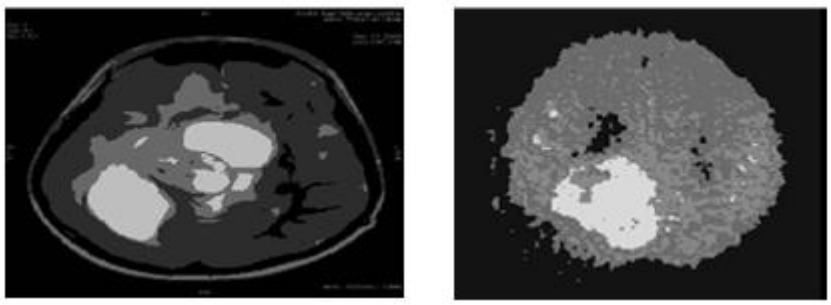

Figure 12 : K mean clustering

ISSN: 0975-8585

FUZZY-C MEANS (FCM) ALGORITHM

This FCM method for segmenting an image based clustering. The image contains objects and surrounding areas are well balanced through k means and Fuzzy-C Means algorithms [13]. This FCM is mainly used for pattern recognition. Optimal C partition produced by this algorithm and decreases the cost function. Let $X_z = (x_1,x_2,..,x_N)$ an image with N pixels divided into c cluster, where X_i represented multispectral (features) information.

FUZZY CLUSTERING

The FCM algorithm is used to works clustering successfully. In this method Fuzzy clustering the data element can survive one or more cluster, then collection of membership levels is set to every component. This indicates relationship between that data element and cluster [14]. Fuzzy-C Means divides a fixed set of n elements into a set of C Fuzzy clustering with responsible towards given criterion. This removes the tumor region presented the segmented image. The enhanced image given the intensity of tumor Figure 13 and Figure 14.

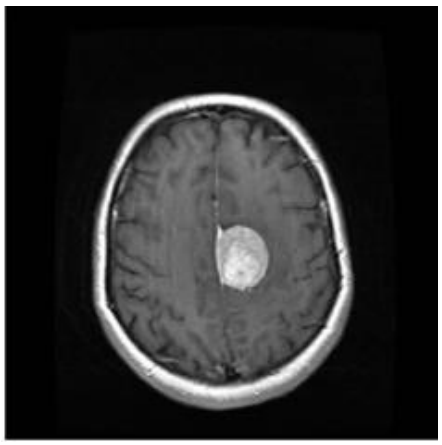

Figure 13 : Image after Segmentation

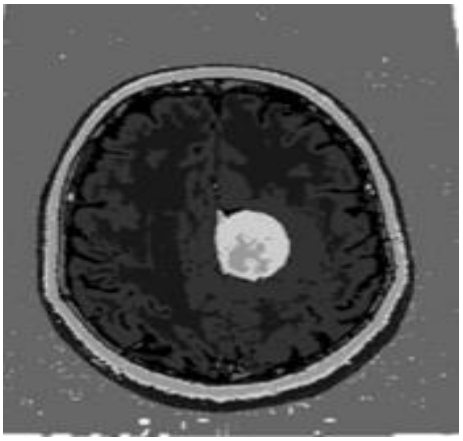

Figure 14 : Image after FCM Clustering

ARTIFICIAL BEE COLONY (ABC) ALGORITHM

The value gray scale threshold estimate searched by ABC algorithm. A Global threshold technique also used this algorithm for searching. A fitness function is used to essentially work for the Artificial Bee Colony algorithm [15]. It is greatly optimized implemented technique.

MRI IMAGE SEGMENTATION BASED ON ABC ALGORITHM

This method examines the achievable solutions in the Artificial Bee Colony algorithm. The suggest technique for segmented satellite image is modified Magnetic Resonance Imaging of segmented image [16].The unique image is decomposed through three-level Discrete Wavelet Transform and less density coefficient follows the approximation information rebuild the approximate picture. Next level, acquiring data having high frequency boundaries and structure is rebuilding the image of the gradient. The approximation image and a filtered image were obtained deals with low pass filter. The image of the gradient is I and image of filtered is G are normalized. Then filtered and gradient 256x256 co-occurrence matrix C is constructed two dimensional grey entropy to obtain improvements. The 2D gray decline is considered an ABC algorithm fitness function sets the ABC algorithm control parameters [17] the maximum number of iterations. The optimal threshold is gradually achieved through multiple cycles and meanwhile the whitened gray numbers (s, t). Then I denotes filtered image segmented with optimal thresholds and the final segmented image is obtained

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WATERSHED SEGMENTATION

It is a well versed edge based segmentation algorithm [18] Watershed denotes area of land where all the water drains off it and goes into the same place. The method of solving problems planned to use image processing. One pixel next to another through correct location and structure are decided different parameters like perimeter, eccentricity, entropy and centroid have been calculated by using Connected Component Labelling (CCL). Applications of watershed mainly used Segmentation of brain tumor [19]. Magnetic Resonance Imaging helps brain tumor data segmented by Watershed method shown in Figure 15. The significant as well as approximate outcomes show improvement at the time of segmentation, compare than manual segmentation it gives more accuracy [20] and testing recognizes few unsuccessive outcomes within the techniques of watershed the outlines are define poor data, then specify the trends in manually segmented outcome towards systematically larger segmentations.

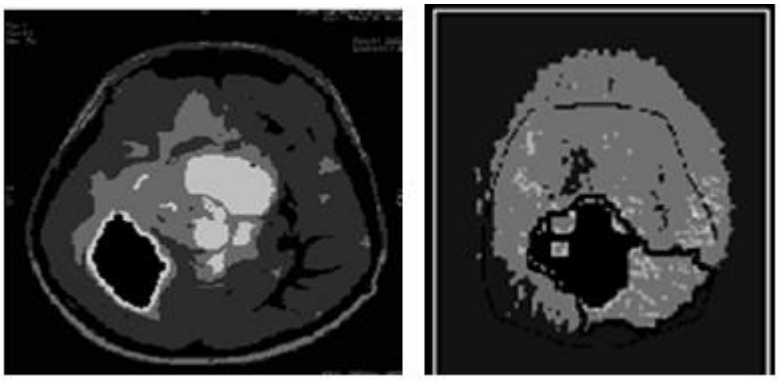

Figure 15 : Results of Watershed Algorithm

WAVELET TRANSFORM

The efficient MRI image extraction is achieved discrete wavelet transform. The wavelet is an extraction of effective mathematical tool. The advantage of wavelet transforms exacting given information regarding signal both in frequency and time domains [29]. Discrete Wavelet Transform is regularly used spatial domain techniques of image processing it execute the transforming images function to the frequency domain. Discrete Wavelet Transform, decompose a picture into the related sub-bands with coefficients of Discrete Wavelet Transform [30]. The cascaded filter banks are used to implement the Discrete Wavelet Transform it satisfy the specific constraints such as low pass and high pass filters. The coefficient of high pass filter denotes h (n) and coefficient of low pass filter denotes g (n). In each scale, there are four sub-band images LL, LH, HH, HL. The LL sub-band consider estimating the image component, the LH, HL, HH sub-bands consider detailed image components. The next scale sub-band LL is used for DWT decomposition as well as an LL sub - band at the last level is used as output feature vectors. A Discrete Wavelet Transform [31] layout sub-bands with three-scale dyadic Lena image decomposition is shown in Figure 16

MARKOV RANDOM FIELD

MRF gives spatial information for clustering process. This method probably reduces the cluster extending difficulties then noise development about the outcome of clustering. Brain tumor segmentation task used Markov Random Field to project when the difficulties contained in data instances, then it provides more accuracy [21]. The approach of unsupervised using Markov Random Field method analytically controls the related picture element must include about every label extract the operations of morphological use. MRF contains an algorithm of Iterated Condition Modes [22]this scheme that exposes irregularity within the brain applying multi layer Markov Random Field framework. While Layer of information contains Intensity of picture element, consisting of anatomical, region of spatial, and user information. During spatial accuracy weighted Hidden Markov Random Field [23] and Expectation Maximization Algorithm, an efficient spatial, defining the every voxel resampled spatial efficiency popularized analysis also model updating. Using segmentation algorithm concludes through images of first aligning low resolution. To segment the tumor using SHE algorithm

applies image like as T2-weighted and FLAIR. The high-interpolation accuracy and vice versa, given more weight to the voxels. Hence the segmented tumor results given efficiently shown in Figure 17 [24].

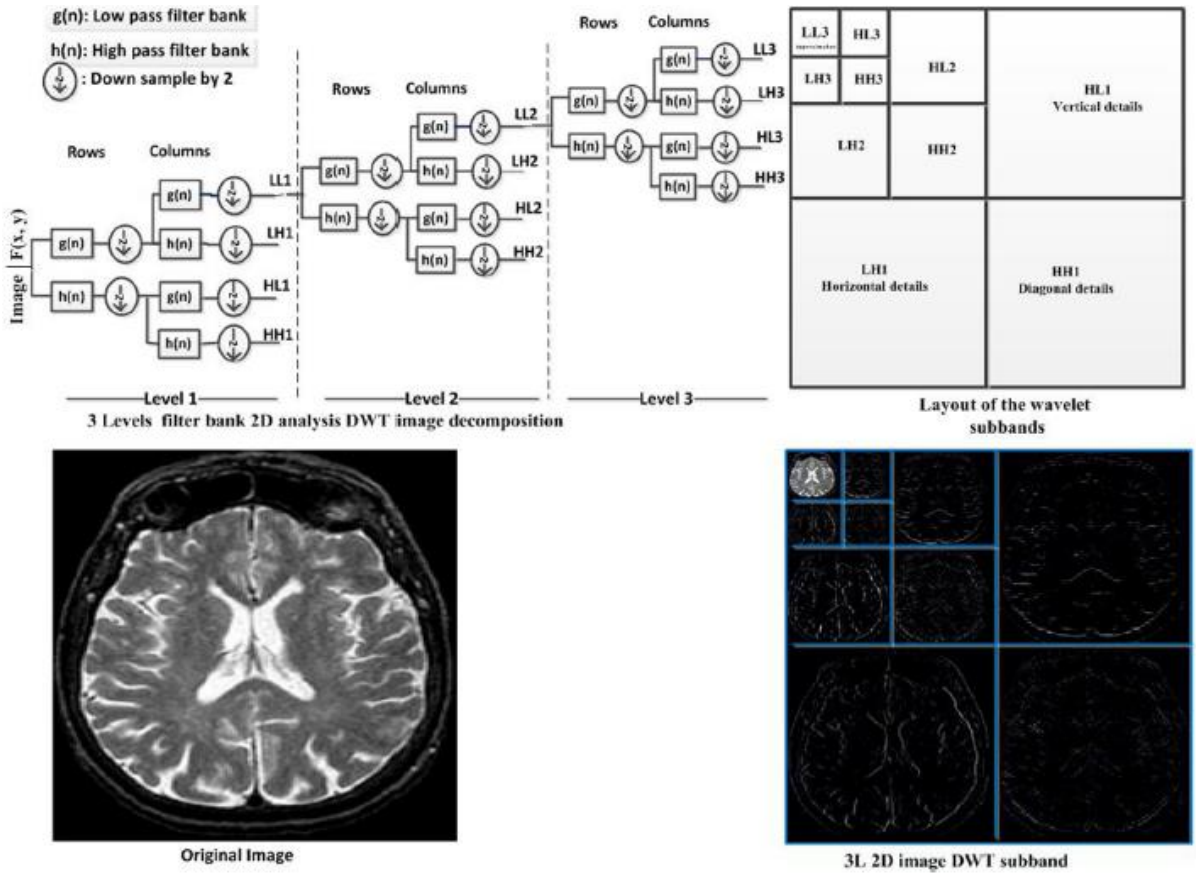

Figure 16 : Process of Discrete Wavelet Transform

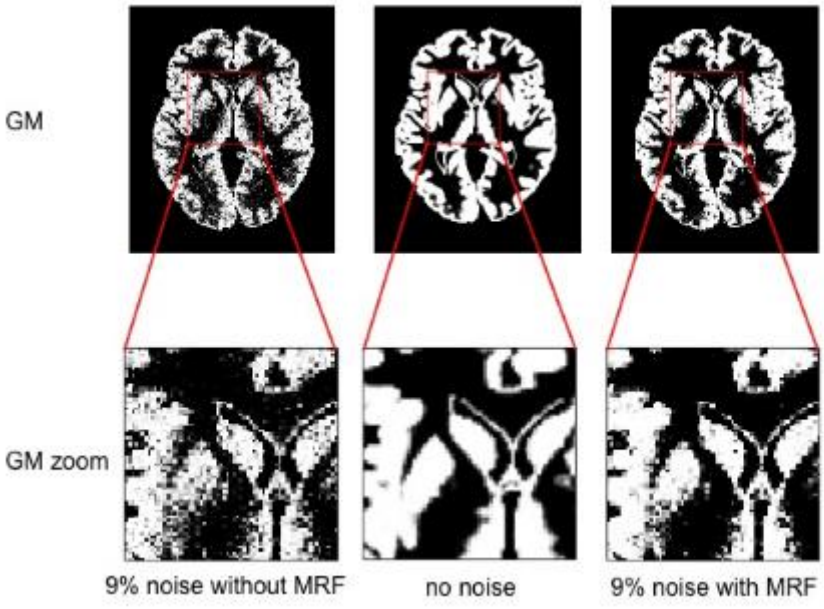

Figure 17 : Segmented image using Markov Random Field

ISSN: 0975-8585

ARTIFICIAL NEURAL NETWORKS

ANN is a division of artificial intelligence (AI). This technique is one of the unsupervised clustering methods [25]. This classifier gives the appearance of nodes series, input nodes are tested by mathematical operation, then the final nodes outcome given by classification. The Neural network method benefit is mostly when training process contains strong computation [26]. The specific task is trained by ANN, becomes fast process and indefinite model is recognized. The execution of ANN used for segmenting the brain tumor Includes complexity problem then this task is time consuming,becomes huge network size,improper training, maximum no.of pictures is necessary used for training the network [27].Then introduce the method neuro difference fuzzy model to overcome these difficulty, time and conclude the ROI contour essential points within storage space applied Artificial Neural Networks.Artificial Neural Network architecture has three layers: Input, output and hidden layers [28]. The hidden layer is interact between external input and network output shown in Figure 18.The output of Artificial Neural Network is explained in the equation shown in Figure 19. W_{oj} denotes neurony synaptic weights contains in the hidden layer to the single output neuron, x_j denotes ith element input vector, F_h and Fo are the neurons activation function since hidden and output layer, w_{ji} are the connection weights between hidden layer neurons and the inputs.

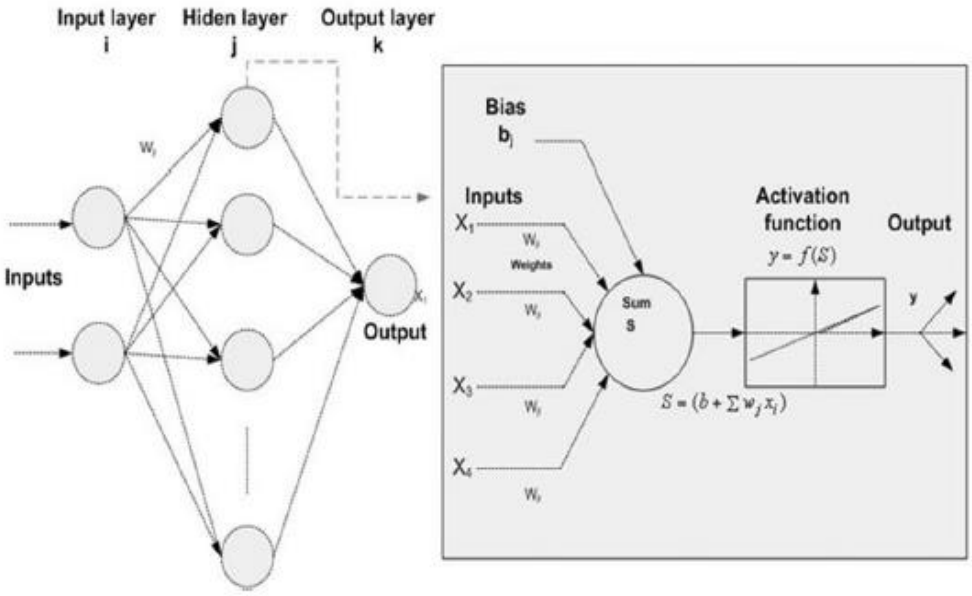

Figure 18 : Architecture of Artificial Neural Network

$$y = F_o\left(\sum_{j=0}^{M} w_{0j}\ \left(F_h\left(\sum_{i=0}^{N} w_{ji}x_i\right)\right)\right)$$

Figure 19 : Output of ANN equation

PULSE-COUPLED NEURAL NETWORK

The PCNN is regarding the high efficient front-end processor, which is used in an image recognition system. Pulse Coupled Neural Network [32] is the third generation of neural network models, then enlarge the

realism level in a neural simulation. The PCNN is advisable to solve tasks such as the feature generation of picture, detection of pattern, removal of edge and segmenting image [33]. The Pulse couples neural network used process of segmenting an image for Region Of Interest can be analysis as a region growing method where seed picture element are determined through neurons [34]. The PCNN gives a dynamic outcome, such as edges, textures and segmented data shown in Figure 20.

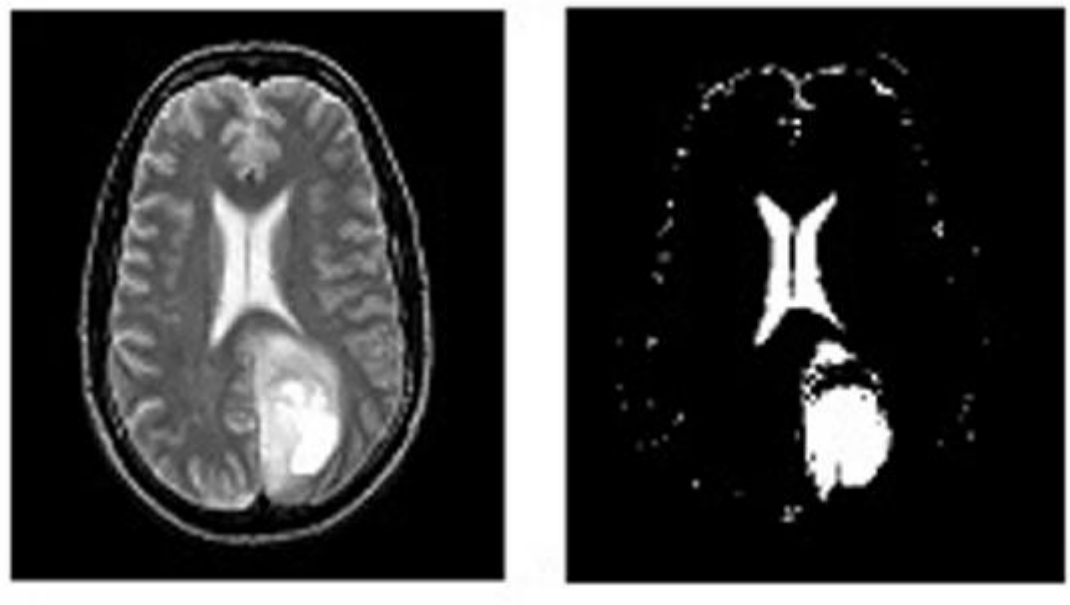

Figure 20 : MRI brain image before and after segmentation using PCNN

Table 1: Summary of Segmentation Methods

Approach	Advantage	Disadvantage
Region Growing	Region growing method properly split the region. It performs together with consideration of noise	This method desire manually selected the seed point which is respective to noise
Manual Segmentation	This method not human experts alone drawn the brain data offered in the picture as well as anyone drawn having extra information about anatomic structure	The human is not a radiologist or anatomist or trained technologist drawn the Region of Interest. Who are in experienced about anatomic brain information they are mostly given not satisfied segmented outcome
Threshold Techniques	This method is used for linearization of the picture. It is a necessary function for all segmentation	In all MRI of brain image this algorithm is not functioning regularly As a result of foreground and background image of large intensity
Genetic Algorithm	This algorithm established process of population. The problem is discovering an exact solution for a biological organism of genetic processes	It depends upon the fitness function
K-mean	The real time image segmentation executes faster	This segmentation huge side effect on the outcome
FCM	This is a familiar scheme for	The huge computational time is a

	segmentation in medical imaging, which recognize the intensity of the image	major disadvantage. The result of intensity based on the image given deficient outcome
Watershed	This algorithm Segmented multiple regions concurrently	Still occur the over segmentation problem
DWT	Protect the edge independent sharpness of segmented image, then the signal function offers local frequency information	The medium of shift is changing. In time shifting about the signal of input occurs irregular modify within coefficients of transforming.
MRF	Statistical properties are considered in this method, it does not deterministic. MRF project the difficulties contained in data instances	Parameter selection is not easy, manage the spatial interaction strength. This method allows only the homogenous segmented single brain tissue, not generally apply the heterogenous tumor to identify the tumor structure
ANN	This method performs complex, tricky event on segmented tumor	Artificial Neural Network is highly time consuming task

CONCLUSION

Magnetic Resonance Imaging detects the brain tumors in a faster, efficient, and effective way is a challenging problem. The medical image processing is actually dynamic and faster grown range towards evolvate an recognize. The techniques of brain tumor segmentation include huge possible detected tumors in analytic images. Normal tissue tumors can be differentiated through image intensities, method of threshold, region growing methods. Using segmented method other tumors are identified through structures and techniques of model based. Even though the report efficiency on segmented brain tumor proposed the automated methods is quite promising. Segmentation algorithm using the maximum frequency for enhancing the images. This method is numerically simple and associated with scanning and control for exact intensity value. Using seeded values according to selected and a reset edges with tissue. The classes of tissue addressed and allow the smallest variation in intensity value. Our algorithm made fully automated. The fuzzy classification iteration is compared to the number of seed growing iterations is less. The 3D tissues connectivity among the portion of adjacent can be improved and checking the segmentation algorithm. The histogram and the variation of intensity values passed among the White Matter, Gray Matter and Cere-brospinal Fluid. Segmentation algorithm expresses slightly related Cere-brospinal Fluid segmentation. T1 weighted axial images mid slices used to execute this algorithm. Segmentation algorithm gave good results.

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