Survey based Study of Various Techniques of Brain Tumour Detection System

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***Abstract*— Now a day's human life style and ecosystem is playing a vital role in human health. Lots of new diseases has taken place of indigenous diseases. Brain tumor is an intracranial solid neoplasm. They are created by an abnormal and uncontrolled cell division, usually in the brain itself, but also in lymphatic tissue, in blood vessels, in the cranial nerves, in the brain envelopes. Brain tumors may also spread from cancers primarily located in other organs. Knowledge of volume of a tumor plays an important in the treatment of malignant tumors. Manual identification of brain tumors from Magnetic Resonance images has always been a challenging and time consuming task. This paper is review of various techniques being implemented in brain tumor detection. In an automatic detection system prime target is to locate tumor and to calculate its geometrical dimension.**

Keywords:- Brian Tumor, MRI,K-Means Clustering, F C Means Clustering

I. INTRODUCTION

Brain controls memory and learning, senses (hearing, sight, smell, taste, and touch), and emotion. It also controls other parts of the body, including muscles, organs, and blood vessels. Brain tumors are diseases in which cancer (malignant) cells begin to grow in the tissues of the Brain.

Brain tumors are abnormal masses in or on the brain. Tumor growth may appear as a result of uncontrolled cell proliferation, a failure of the normal pattern of cell death, or both. Brain tumors can be either primary or secondary.

Primary tumors are composed of cells just like those that belong to the organ or tissue where they start. A primary brain tumor starts from cells in the brain. Most brain tumors in children are primary, and at least half of all primary tumors originate from cells of the brain that support the body's nervous system. Secondary tumors are made up of cells from another part of the body that has spread to one or more areas. Secondary brain tumors are actually composed of cancer cells from somewhere else in the body that have metastasized, or spread, to the brain.

MRI has become firmly established as the premier diagnostic modality for the head. It is most commonly utilized for lesion detection, definition of extent, detection of spread and in evaluation of either residual or recurrent disease. MRI is more sensitive for brain tumors than CT, both in terms of detection as well as in showing more completely the extent of the tumor. The major benefit of multiplanar imaging has been superior tumor localization, rather than increasing the detection rate of lesions. MRI provides significantly more information about intrinsic tissue characterization and parallels findings on gross pathology.

I. LITERATURE SURVEY

In recent years a great effort of the research in field of medical imaging was focused on brain tumors segmentation.

Ed-Edily et. al. [2014] proposed brain tumor detection and localization framework which comprises five steps: image acquisition, pre-processing under a median filter, edge detection by sobel edge detection, modified histogram clustering to color threshold and morphological operations. After morphological operations, tumors appear as pure white color on pure black backgrounds. They used 50 neuroimages to optimize our system and 100 out-of-sample neuroimages to test our system. Their proposed tumor detection and localization system was found to be able to accurately detect and localize brain tumor in magnetic resonance imaging. Watershed segmentation is used for opening-closing reconstruction technique which is basically the enhancing and dimming of foreground and background images. The contrast is then elevated. The proposed tumor detection and localization system was found to be able to accurately detect and localize brain tumor in magnetic resonance imaging. This system achieved an error rate of 8%.

Agrawal et. al. [2014] presented an algorithm for segmentation based on the symmetry character of brain MRI image. A color image edge detection algorithm is proposed using Pseudo-complement and matrix rotation operations. First, pseudo-complement method is applied on the image for each channel. Then, matrix operations are applied on the output image of the first stage. Dominant pixels are obtained by image differencing between the pseudo-complement image and the matrix operated image. Median filtering is carried out to smoothen the image thereby removing the isolated pixels. Finally, the dominant or core pixels occurring in at least two channels are selected. On plotting the selected edge pixels, the final edge map of the given color image is obtained. The algorithm is also tested in HSV and YCbCr color spaces. Results are compared for Robert, Priwett and Canny Edge Detectors.

Selkar et. al. [2014] presented the detection and segmentation of brain tumor using watershed and thresholding algorithm. Tumor detection is based on segmentation and morphological operators. Firstly quality of scanned image is enhanced and then morphological operators are applied to detect the tumor in the scanned image. After that edge detection operator is applied for boundary extraction and to find the size of the tumor. Segmentation by Using Watershed and thresholding algorithm and describes the comparative study about the tumor detection. Results show thresholding algorithm is better than watershed algorithm. Segmentation was done by canny edge detection operator.

Sivaramakrishnan et. al. [2013] proposed an efficient detection of brain tumor region from cerebral image is using Fuzzy C-means clustering and histogram. The histogram equalization calculates the intensity values of the grey level images and decomposition of image are extracted using principal component analysis is used to reduce dimensionality of the wavelet co-efficient. The Fuzzy C-means clustering algorithm finds the centroids of the cluster groups together the Brain tumor patterns obtained from MRI images. Segmentation result shows the extract suspicious tumor region. The Fuzzy C--means algorithm is used because of its simplicity and it is also preferred for faster clustering. By using this technique centroid point can be located easy and will give more accurate and high resolution result.

Sapra et. al. [2013] compared various methods of automatic detection of brain tumor through Magnetic Resonance. A modified image segmentation techniques were applied on MRI scan images in order to detect brain tumors. Also modified Probabilistic Neural Network (PNN) model that is based on learning vector quantization (LVQ) with image and data analysis and manipulation techniques is proposed to carry out an automated brain tumor classification using MRI-scans. The simulation results showed that the modified PNN gives rapid and accurate classification compared with the image processing and published conventional PNN techniques. Simulation results also showed that the proposed system out performs the corresponding PNN system presented and successfully handle the process of brain tumor classification in MRI image with 100% accuracy.

Dhanalakshmi et. al. [2013] described k-means clustering algorithm for detecting the range and shape of tumor in brain MR Images. Their method allows the segmentation of tumor tissue with accuracy and reproducibility comparable to manual segmentation. In addition, it also reduced the time for analysis. At the end of the process the tumor is extracted from the MR image and its exact position and the shape also determined. The stage of the tumor is displayed based on the amount of area calculated from the cluster.

Ali et. al. [2013] preprocessed magnetic resonance Images, T2 weighted modality, by bilateral filter to reduce the noise and maintaining edges among the different tissues. Four different techniques with morphological operations have been applied to extract the tumor region. These were: Gray level stretching and Sobel edge detection, K-Means Clustering technique based on location and intensity, Fuzzy C-Means Clustering, and An Adapted K-Means clustering technique and Fuzzy C-Means technique. The area of the extracted tumor regions has been calculated. Their work showed that the four implemented techniques can successfully detect and extract the brain tumor and thereby help doctors in identifying tumor's size and region.

Kowar et. al. [2012] presented a novel technique for the detection of tumor in brain using segmentation and histogram thresholding. The present work consists of following stages which were dividing into two equal halves around its central axis and the histogram of each part was drawn. Then threshold point of the histograms is calculated based on a comparison technique made among the two histograms. After which detected image is cropped along its contour to find out the physical dimension of the tumor. Their proposed method can be successfully applied to detect the contour of the tumor and its geometrical dimension.

Selvakumar et. al. [2012] implemented an algorithm for detection of range and shape of tumor in brain MR images. This method allows the segmentation of tumor tissue with accuracy and reproducibility comparable to manual segmentation. In addition, it also reduces the time for analysis. At the end of the process the tumor is extracted from the MR image and its exact position and the shape also determined. The stage of the tumor is displayed based on the amount of area calculated from the cluster.

Sharma et. al. [2012] used noise filters for noise removal and then enhancement techniques are applied to the given MRI scan of brain. After that the basic morphological operations are applied for extracting the region suffering from tumor. And then verification of region detected is done by using watershed segmentation. 2D Cellular Automata concept was used because the detection of edges depends on neighborhood pixels. The Cellular Automata rule number 252 provides strong edge detection. Their algorithm can be applied to the CT scan of the lungs and region suffering from cancerous cells can be identified.

Dahab et. al. [2012] proposed a modified Probabilistic Neural Network (PNN) model that is based on learning vector quantization (LVQ) with image and data analysis. The assessment of the modified PNN classifier performance is measured in terms of the training performance, classification accuracies and computational time. The simulation results showed that the modified PNN gives rapid and accurate classification compared with the image processing and published conventional PNN techniques. Simulation results also showed that the proposed system out performs the corresponding PNN system presented in, and successfully handle the process of brain tumor classification in MRI image with 100% accuracy when the spread value is equal to 1. These results also claim that the proposed LVQ-based PNN system decreases the processing time to approximately 79% compared with the conventional PNN which makes it very promising in the field of in-vivo brain tumor detection and identification.

Datta et. al. [2011] proposed a technique for tumour detection in which they pre-processed two-dimensional magnetic resonance images of brain and subsequently detect the tumor using edge detection technique and color based segmentation algorithm. Edge-based segmentation has been implemented using operators e.g. Sobel, Prewitt, Canny and Laplacian of Gaussian operators. The color-based segmentation method has been accomplished using K-means clustering algorithm. They converted the pre-processed gray-level brain MR image into RGB color image first. The RGB color image is then been coarsely represented using 25 bins. Coarse representation uses the spatial information from a histogram based windowing process. K-means is been used to cluster the coarse image data. In each of the segmented images *k*=6 has been taken. The color-based segmentation carefully selects the tumor from the pre-processed image as a clustering feature. The best algorithm among the Sobel, Prewitt, Canny and Laplacian of Gaussian is the canny operator.

Somasundaram et. al. [2010] extracted the brain by removing the unwanted non-brain regions like skull, scalp, fat and muscles. Then the brain is segmented into well known regions like WM, GM, CSF and background using FCM algorithm. In T2 scans the tumor intensity characteristics are similar to CSF. So the CSF class is analyzed for symmetric property along the central vertical line. If no symmetry is found then the image with CSF class is segmented further into CSF and tumor classes using extended maxima transform. This transform helps to separate the tumor region from the normal CSF region.

II. PROBLEM IDENTIFICATION

On the basis of literature survey various problems related with brain image acquisition and tumour detection had been identified. These problems are under listed:

1. Local Noise

Local noise corrupts the signal measured for each pixel. This noise effect is often modeled as gaussian which has no effect on underlying tissue type.

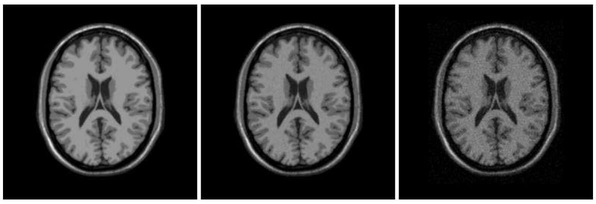

Fig 1 (a) Noise free image, (b) image with 3%, (c) image with 9% noise

2. Partial Volume Averaging

Partial volume averaging is the result of the finite resolution represented by acquired pixels. Since the pixels have a finite size, an individual pixel can represent more than one type of tissue, resulting in partial volume artifacts. The intensity recorded for these partial volume artifacts will be a combination of the intensities of the structures that intersect at the pixel location.

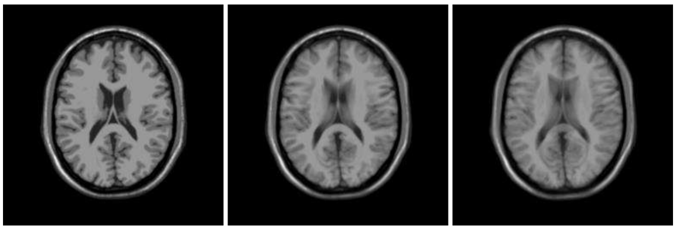

Fig 2 (a) Image with 1mm pixels, (b) image with 5mm pixel, (c) image with 9mm pixel thickness

3. Intensity Inhomogeneity

Intensity inhomogeneity refers to variations in the recorded intensity observed within a set of slices, that can lead to a 10% to 20% variation in the intensity values recorded for homogeneous tissues.

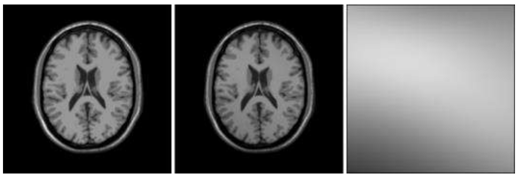

Fig. 3 (a) Original image, (b) image with 40% intensity, (c) inhomogeneity field

4. Inter-slice Intensity Variations

Inter-slice intensity variations are a specific type of intensity inhomogeneity that refers to rapid changes in the intensities of adjacent slices caused by gradient eddy currents and cross-talk between the slices in multi-slice acquisition protocols.

Fig.4 Even numbered slices are brighter than the odd numbered slices

5. Intensity Non-Standardization

Intensity non-standardization is versatility of MR imaging which is due to the existence of a large variety of protocols for generating images with similar visual properties. The acquisition of MR images is therefore not a calibrated measure, and the intensities represented in the image do not have an exact meaning with respect to the underlying tissue

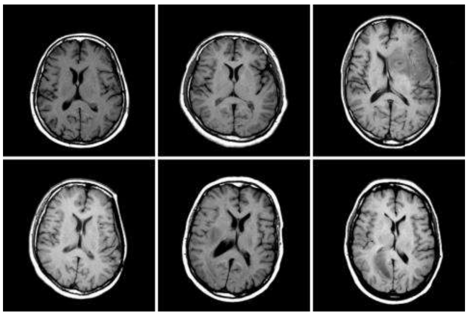

Fig.5 Intensity Variations

III. PROPOSED METHODOLOGY

On the basis of literature review and problems identified from these literatures, method for implementing automatic brain tumour detection is being shown in fig.6.

K-MEANS CLUSTERING- Clustering is the process of partitioning a group of data points into a small number of clusters. In the kmeans algorithm initially we have to define the number of clusters k. Then k-cluster center are chosen randomly. The distance between the each pixel to each cluster centers are calculated. The distance may be of simple Euclidean function. Single pixel is compared to all cluster centers using the distance formula. The pixel is moved to particular cluster which has shortest distance among all. Then the centroid is re-estimated. Again each pixel is compared to all centroids. The process continuous until the center converges.

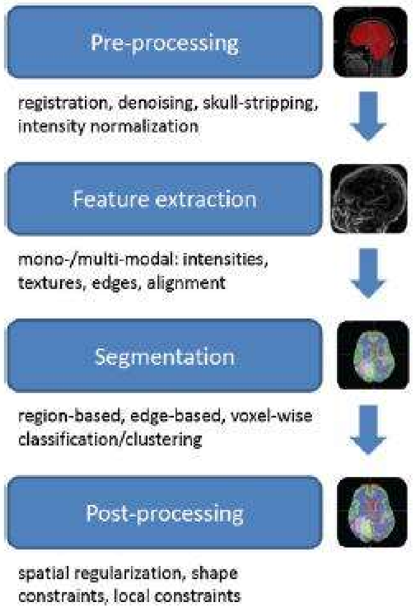

Fig 6 Flowchart of Proposed Method

FUZZY C-MEANS CLUSTERING- In fuzzy clustering, every point has a degree of belonging to clusters, as in fuzzy logic, rather than belonging completely to just one cluster. Thus, points on the edge of a cluster may be in the cluster to a lesser degree than points in the center of cluster. The degree of belonging, $w_k(x)$, is related inversely to the distance from x to the cluster center as calculated on the previous pass. It also depends on a parameter m that controls how much weight is given to the closest center.

IV. CONCLUSION

Brain Tumour detection has been studied and implemented from few years back. Various techniques implemented by researchers are studied and hence MRI segmentation techniques are listed out. Also problems related with brain tumour detection techniques are being studied. On the basis of these literature survey methodology is being drafted which is including K-means and FC-means techniques.

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