BRAIN TUMOR MRI IMAGE SEGMENTATION AND DETECTION IN IMAGE PROCESSING A REVIEW

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Abstract: Image processing is a method to convert an image into a digital form and perform some operations on it in order to get an enhanced image or to extract some useful information from image processing also involves medical image processing which is a highly challenging field. Medical imaging techniques are used to image the inner portion of the human body for medical diagnosis. Brain tumor is a serious life altering disease condition. Image segmentation plays a significant role in image processing as it helps in the extraction of suspicious regions from the medical images. In this paper segmentation of brain MRI image is proposed using K-mean clustering algorithm followed by morphological filtering which avoids the misclustered regions that can inevitably be formed after segmentation of the brain MRI image for detection of tumor location.

Index Terms: MRI Image segmentation, K-mean clustering, and Morphological filtering.

I. Introduction

Image processing is a method to perform some operations on an image in order to get an enhanced image or to extract some useful information from it.Image processing is a process where input image is processed to get output also as an image. Main aim of image processing technique is to recognize the image under consideration easier visually. The digital image processing deals with developing the digital system that performs operation on a digital image. Medical images are the images that show the physical attribute distribution. Medical imaging modalities as in MRI, CT scan mostly depend on computer technology to generate or display digital images of the internal organs of the human body which help the doctor to visualize inner portion of the body. Ultrasound CT scanner and magnetic resonance imaging(MRI) took over the conventional X-ray imaging by allowing the doctor to see the body's third dimension.

II.Methods of DIP: The major DIP techniques are

1. Pre- Processing
2. Image Compression
3. Edge Detection
4. Segmentation

1. Pre-Processing: Preprocessing of image commonly involves removing low frequency background noise, normalizing the intensity of the individual particle image,removing or enhancing data image prior to computational processing. Medical image pre-processing is an important step in medical image segmentation. Salt and pepper noise were more prevalent in Medical images. The conventional methods were not effective in filtering salt and pepper noise. Morphological erosion s the best filter for removing salt and pepper noise.

2. Image compression: Image compression is an application of data compression that encodes the original image with few bits. The objective of image compression is to reduce the redundancy of image and to store or transmit data in an efficient form. The main goal is to reduce the storage quantity as much as possible and the decoded image displayed in the monitor can be similar to the original as much as can be.

In medical image compression using integer multi wavelets transform for telemedicine application is an efficient compression and encoding performance based on integer multi wavelet transform of medical application. The algorithm result in better quality image. The work focused of the implementation of lossless image data.

3. Edge Detection: Edge detection is the name for a set of mathematical method which aim at identifying points in a digital

The two techniques of segmentation algorithm such as Canny edge detection and Otsu thresholding.The effectiveness of their algorithm was evaluated for medical and non-medical images. Canny segmentation is more suitable than Otsu to the tested endoscopic images because there is no clear distinction of the objects from the background and for MRI grey scale image.

4. Image segmentation: Segmentation partitions an image into distinct region containing each pixel with similar attributes.to be meaningful and useful for image analysis and interpretation, the region should strongly relate to depicted object or feature of interest. Meaningful segmentation is the first step from low level image processing transforming a greyscale or color image into one or more other images to a high level image description in terms of feature object and scenes. The success of image analysis depends on reliability of segmentation, but an accurate partitioning of an image is generally a very challenging problem. Segmentation techniques are either contextual or non-contextual. The later take no account of spatial relationship between features in an image and group pixels together on the basis of some global attribute,eg grey level or color contextual technique additionally exploit their relationships ,eg group together pixels with similar grey levels and close spatial location.

III.Magnetic Resonance imaging

MRI is a noninvasive imaging technology that produces three dimensional details, anatomical details without the use of damaging radiation. It is often used for disease detection diagnosis and treatment monitoring. It is based on sophisticated technology that excites and detects the change in direction of the rotational axis of protons found in water that makes up living tissue.

Working of MRI-MRI an employ powerful magnet which produces a strong magnetic field that forces proton in the body to align with that field. When a radiofrequency current is then pulsed through the patient, the protons are stimulated and spin out of equilibrium straining against the pull of the magnetic field. When the radiofrequency field is turned off, the MRI sensors are able to detect the energy released as the protons realigns with the magnetic field. The time it takes for the proton to realign with the magnetic field as well as the amount of energy released changes depends on the environment and the chemical nature of the molecule. To obtain an MRI image a patient is placed inside a large magnet and must remain very still during the image process /*in order not to blur the image. Contrast agents(often containing the element Gadolinium may be given to the patient intravenously before or during the MRI to increase the speed at which the proton realign with the magnetic field. The faster the proton realign the brighter the image.

What is MRI used for- MRI scanner are particularly well suited to image the non-bony parts or soft tissue of the body. They differ from computer tomography (CT) in that they do not use the damaging ionizing radiation of X-rays. The brain, spinal cord and nerves as well as muscles, ligaments and tendons are seen much more clearly with MRI then with regular X-ray and CT for this reason MRI is often used to image knee and shoulder injuries. In brain MRI can differentiate between white matter and grey matter and can also be used to diagnose aneurysms and tumor.

IV.K-mean Clustering

K-mean is one of the simplest unsupervised learning algorithms that solve the well-known clustering problem. The procedure follows a simple and easy way to classify a given data set through a certain number of cluster (assume K cluster) fixed apriori.The main idea is to define K centers one for each cluster. These centers should be placed in cunning way because of different location causes different result. So the better choice is to place them as much as possible far away from each other. The next step is to take each point belonging to a given dataset and associate it to the nearest Centre. When no point is pending the first step is completed and an early group age is done. At this point we need to calculate K new centroids as center of the cluster resulting from the previous step. After we have these k new centroids a new binding has to be done between the same data set points and the nearest new center. A loop has been generated as a result of the loop we notice that K center change their location step by step until no more changes are done or in other words center do not move any more. Finally this algorithm aims at minimizing an objective function known as squared error function given by

$$J(V) = \sum_{i=1}^{c} \sum_{j=1}^{ci} (\left| xi - vj \right|)^2$$

Where $(\left| xi - vj \right|)$ is the Euclidean distance between $xi \; and \; vj$

C_i is the number of data point in i^{th} cluster

Algorithmic steps for K-mean

Let $X=\{x_1, x2, x3 \ldots\ldots\ldots x_n\}$ be the set of data points and $V=\{v_1, v2, v3 \ldots\ldots\ldots v_c\}$ be the set of centers.

1. Randomly select 'Cluster centers.
2. Calculate the distance between each data point and cluster center.
3. Assign the data point to the cluster center where distance from the cluster center is minimum of all the cluster center.
4. Recalculate the new cluster center using

$$V_i = (1/c_i) \sum_{j=1}^{ci} x_i$$

Where c_i represents the no of data points and new obtain cluster centers

5. Recalculate the distance between each data point and new obtained cluster centers.
6. If no data point was reassigned then stop otherwise repeat from step3.

V.Morphological Filtering

Morphology is the study of shapes and structure from a scientific perspective. Morphological operation requires a structuring element. Morphological operation operates on two image structuring element and input image. Structuring element are small images that are used to probe an input image for properties of interest. Origin of structuring element is defined by the center pixel of the structuring element. In morphology the structuring element defined will pass over a section of the input image where this section is defined by the neighborhood window of the structuring element and the structuring elements either fits or not fit the input image.Whereever the fit takes place, corresponding image that represents the input image structure is got and suppression of the geometric feature of the input image that doesn't fit the structuring element neighborhood takes place.

VI.Literature review

Techniques:

1.Automated Technique: Automatic detection ,extraction and mapping of brain tumor fromMRI scanned images using frequency emphasis homomorphic and cascaded hybrid filtering technique by Rana Banic Electrical & Electronics Engineering Chittagong university, Bangladesh and Md.Rabiul Hasan,Md.Saif Iftekhar from Electrical&Electronics Engineering Chittagong university, Bangladesh proposed a very simple efficient and automated technique to detect brain tumor from MRI scanned images. Usually the water content and Hydrogen atom of tumor region is more than the normal tissue, hence MRI images show different intensities of tumor region than normal tissue. The methodology presented here utilizes the intensity difference immaculate by using frequency emphasis in homomorphic filtering. The tumor region are intensified and noises are reduced by Gaussian equation based algorithm Hybrid filter is used in cascading method with spatial domain filter to eliminate time domain noises. After that thresholding segmentation and morphological operations are performed and tumor region is extracted and mapped in edge detected image of brain.

2. Expectation maximization approach: An untrained and unsuspected method for MRI brain tumor segmentation By Tom Heack, Fredrik Mcees and Paul Sutan of Ku Leuven dept. Of Electrical Engineering ESAT PSI Leuven Belgium presented a fully automated MRI brain tumor segmentation method that does not require any manually annotated training data. The method is independent of scanner or acquisition protocol and is directly applicable to any individual patient image. The technique used here is named as an expectation maximization approach to estimate intensity models for both normal and tumorous tissue. The segmentation is represented by the level set which is iteratively updated to level voxels as normal tumorous, based on which intensity model explains the voxel intensity the best. The proposed method is composed

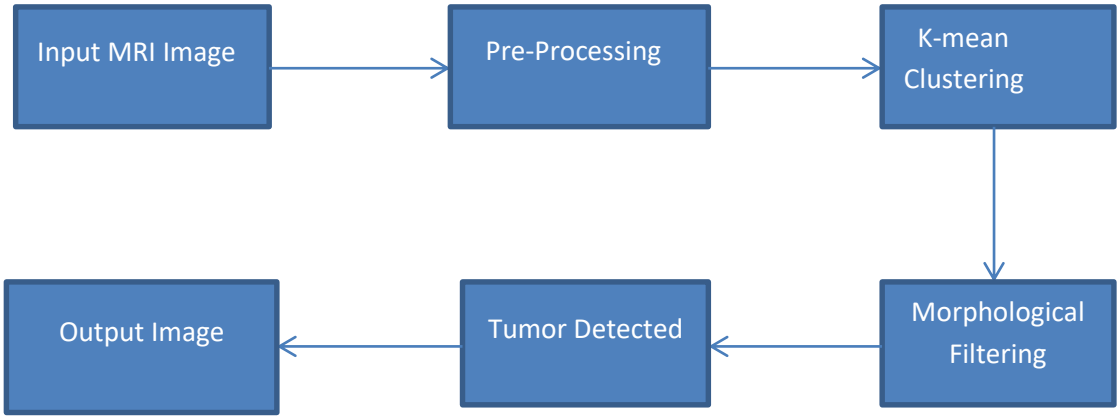
3. Meta Heuristic method: RI brain tumor classification using support vector machine and Meta Heuristic method by Ahmed Kharrat and Mohamed Ben Halima from Research Group in intelligent machine University of SFax, Tunisia presented an approach for automated diagnosis based on classification of magnetic resonance (MR) human brain images. Wavelet transforms and spatial grey level dependence matrix (DWT-SGLDM) is used for feature extraction. For feature selection simulated annealing (SA) is applied to reduce feature size. The next step is stratified K fold cross validation to avoid over fitting. To optimse support vector machine (SVM) parameter Genetic algorithm and support vector machine (GA-SVM) model is applied to construct the classifier.

4.Fuzzy C-mean and SVM: Detection of brain tumor in MRI images, using combination of Fuzzy C-mean and SVM by Praveen and Amritpal Singh of Dept. of Computer science and engineering Govt.Women Engineering college Ajmer ,India proposed the method of data mining methods for classification of MRI images. The Hybrid technique based on the support vector machine (SVM) and Fuzzy C mean for brain tumor classification is proposed. The proposed algorithm is a combination of support vector machine (SVM) and Fuzzy C mean a hybrid technique for prediction of brain tumor. In this algorithm the image is enhanced using enhancement technique such as contrast improvement and midrange stretch. Double thresholding and Morphological operations are used for skull stripping. Fuzzy C mean clustering is used for segmentation of image to detect the suspicious region in brain MRI image.Grey level run length matrix(GLRLM) is used for extraction of feature from the brain image after which SVM technique is applied to classify the Brain MRI image.

5. Alignment based feature: Segmenting brain tumor using alignment based feature by Mark Schmidt,Ilya Levner,Russel Grainer from Dept. of computer science university of Albesta Canada suggested in their paper the quantitive evaluation of the performances of four different types of alignment based (AB) feature encoding spatial anatomic information for use in supervised pixel classification is done. It is the first work to compare several types of AB feature, explore ways to combine different type of AB feature and explore combining AB feature textured features in a learning framework. It was found that combining textured and AB feature allows a substantial performance increase and achieve segmentation that very close resemble expert annotation

6. Mathematical morphological reconstruction: Brain tumor extraction from MRI image using mathematical morphological reconstruction by Yamini Sharma and Yogesh .K.Meghrajan from Dept. of Electronics and communication Dharamsingh Desai University Nadiad,India describes an approach based on mathematical morphological reconstruction for extraction of tumor from labeled brain tumor from the processed image. Algorithm is further modified for non-uniform intensity regions of the brain tumor .optionally mathematical morphological operator is utilized to remove pepper noise if present in tumor region.

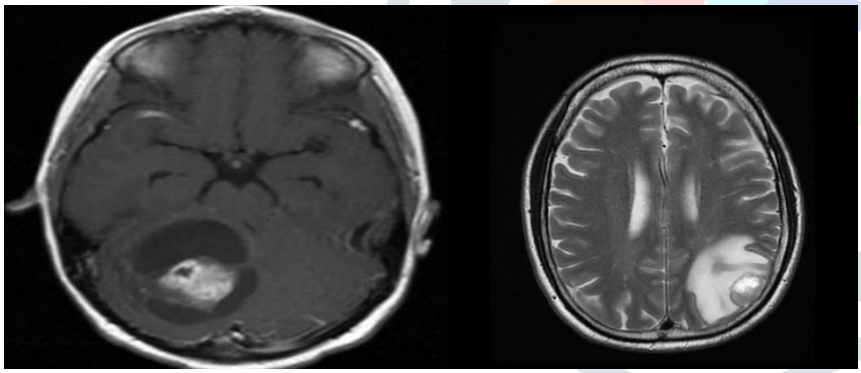
VII.Proposed methodology



Proposed block diagram

Proposed methodology includes the segmentation of Brain MRI images for detection of tumor using Clustering technique. A cluster can be defined as a group of pixels where all the pixels in certain group defined by a similar relationship clustering is also known as unsupervised classification technique. K mean clustering algorithm for segmentation of the image followed by morphological filtering is used for tumor detection from the brain MRI image. RI image of the human brain forms the input image for the system which takes the grey scale MRI input image as input. Preprocessing stage includes the conversion of RGB input image to grey scale. Noise present if any will be removed using a Median filter. Preprocessed image is then given for image segmentation using K means clustering algorithm. Morphological filtering is performed so as to remove the misclusterd region in the image after the application of K-mean clustering algorithm.

VIII.Database



IX.Conclusion

Segmentation of brain image is imperative in surgical planning and treatment planning in the field of medicine. This work presents a computer aided system for brain MRI image segmentation for detection of tumor location using K mean clustering algorithm followed by morphological filter

References

1. N. Moon, E. Bullitt, K.V. Leemput and G. Gerig, "Model Based Brain and Tumor Segmentation", ICPR Quebec, pp. 528-531, August 2002

2. P.Y. Lau and S. Ozawa, "PCB: A Predictive System for Classifying Multimodal Brain Tumor Images in an Image- Guided Medical Diagnosis Model", in Proc. 12th International Conference on Intelligent System for Molecular Biology, Glasgow, UK, 2004.

3. P.Y. Lau and S. Ozawa, "A Region- and Image-Based Predictive] Classification System for Brain Tumor Detection", in Proc. Symposium on Biomedical Engineering, Hokkaido, Japan, pp. 72-102, 2004.

4. P.Y. Lau and S. Ozawa, "A Multipara meter Hierarchical Representation using Region-Based Estimation Model For Detecting Tumor in T2- Weighted MRI Brain Images", Malaysian Journal Of Computer Science, Vol. 18,No. I, pp.I-19, 2005

5. T.Kalaiselvi, S.Vijayalakshmi, K.Somasundara"Segmentation of Brain Portion from MRI of Head Scans Using Kmeans Cluster", *International Journal of Computational Intelligence and Informatics* ,vol. 1,no. 1, pp. 75-79,2011.

6. S.S Mankikar , "A Novel Hybrid Approach Using Kmeans Clustering and Threshold filter For Brain Tumor Detection", *International Journal of Computer Trends and Technology*, vol. 4, no.3, pp. 206-209,2013.
7. M.C. Jobin Christ, R.M.S.Parvathi, "Segmentation of Medical Image using Clustering and Watershed Algorithms", *American Journal of Applied Sciences*, vol. 8, pp. 1349-1352, 2011.
8. Manali Patil, Mrs.Prachi Kshirsagar, Samata Prabhu, Sonal Patil, Sunilka Patil," Brain Tumor Identification Using K-Means Clustering", *International Journal of Engineering Trends and Technology,vol. 4,no. 3,pp*.
9. A Kharrat, K. Gasmi, M. Ben Messaoud, N. Benamrane and M. Abid, "A Hybrid Approach for Automatic Classification MRI Brain Using Genetic Algorithm and Support Vector Machine", Leonardo Journal of Sciences (US), 9 (17), pp. 71-82,2010.
10. A Kharrat, N. Benamrane, M. Ben Messaoud and M. Abid,] "EVOLUTIONARY SUPPORT VECTOR MACHINE FOR PARAMETERS OPTIMIZATION APPLIED TO MEDICAL DIAGNOSTIC", International Joint Conference on Computer Vision. Theory and Applications (VISAPP 2011), pp. 201-204, 2011.
11. S. Chaplot, L.M. Patnaik and N.R. Jagannathan, "Classification of magnetic resonance brain images using wavelets as input to support vector machine and neural network", Journal of Biomedical Signal Processing and Control, vol. I, pp. 86-92, 2006
12. S.H.S.A. Ubaidillah, R. Sallehuddin and N.A. Ali, "Cancer detection using artificial neural network and support vector machine: A Comparative study", journal technology (science & engineering), 201365:1.
13. O.P. Verma, M. Hammandlu, S. Susan, M. Kulkami and P.K. Jain, "A simple single seeded region growing algorithm for color image segmentation using adaptive thresholding," 2011 International Conference on Communication] G.V. Kumar and Dr G.V. Raju, "Biological early brain cancer detection Systems and Network Technologies©2011 IEEE.
14.] G.V. Kumar and Dr G.V. Raju, "Biological early brain cancer detection using artificial neural network", International Journal on Computer Science and Engineering Vol. 02, No. 08, 2010, 2721-2725
15] B. Gupta and S. Tiwari, "Brain Tumor Detection using Curvelet Transform and Support Vector Machine", International Journal of Computer Science and Mobile Computing, Vol.3 Issue.4, April- 2014
16. M.J. McAuliffe, F.M. Lalonde, D. McGarry, W. Gandler, K. Csaky, and B.L. Trus. Medical image processing, analysis and visualization in clinical research. *IEEE CBMS*, pages381–386, 2001