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DETECTION AND CLASSIFICATION OF BRAIN TUMORS IN MRI IMAGES

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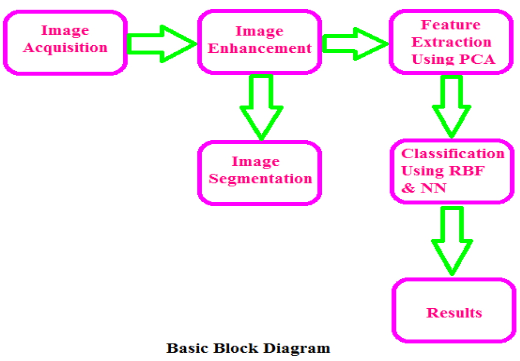
ABSTRACT

In this paper, detection of brain tumor is done using MRI images. Brain tumor is an abnormal intracranial growth caused by cells reproducing themselves in an uncontrolled manner. Curing cancer has been a major goal of medical researchers for decades. The early detection of cancer can be helpful in curing the disease completely. In this paper we propose an ANN base approach to identify brain tumor from MRI images. The algorithm incorporates steps for pre-processing, image segmentation, feature extraction and image classification using neural network techniques. A classification is done into two class's i.e brain into healthy brain or a brain having a tumor .Evaluation was performed on image data base of 25 Brain Tumor images. The proposed method gives fast and better recognition rate, finally the tumor area is specified by region of interest technique as confirmation step. A user friendly MATLAB GUI program has been constructed to test the proposed algorithm.

Index Terms: brain tumor; image segmentation; feature extraction; neural networks

1. INTRODUCTION

In the last decades, we have been observed a dynamic growth in the number of research works conducted in the region of cancer diagnosis. Many university centers [1] are focused on the issue because of the fact that cerebral cancer is spreading among the world population. For example in the US, nearly 3000 children are diagnosed with brain tumors. Almost half will die within five years, making it the most fatal cancer among children. It's associated with neurological disabilities, retardation and psychological problems and increased risk of death. Magnetic resonance imaging (MRI) is considered now as an important tool for surgeons. A brain tumor is any intracranial mass created by abnormal and uncontrolled cell division. Magnetic resonance imaging (MRI) or magnetic resonance tomography (MRT) is a medical imaging technique used in radiology to investigate the anatomy and function of the body in both health and disease. MRI scanners use strong magnetic fields and radio waves to form images of the body. The technique is widely used in hospitals for medical diagnosis, staging of disease and for follow-up without exposure to ionizing radiation. If the location of a brain tumor is accessible for surgery, the neurosurgeon may remove as much as possible of the tumor. The paper is organized as follows. In Section 1, image enhancement techniques are applied to remove noise. In Section 2, Image segmentation techniques are applied. Feature extraction methods used is explained in section 3. In section 4, neural network classifiers are employed to classify weather the MRI image is normal or consisting of brain tumor and classification is done using radial basis function based Linear Regression Algorithm.



Basic Block Diagram

1.1 IMAGE ACQUISITION

The MRI images of brain tumor are collected from internet. The images are converted into standard size of 200 x 200. The images are converted to gray scale images for further processing.

1.2 IMAGE ENHANCEMENT TECHNIQUES

It refers to accentuation, or sharpening, of image features such as boundaries, or contrast to make a graphic display more useful for display & analysis. This process does not increase the inherent information content in data. It includes gray level & contrast manipulation, noise reduction, filtering. Image enhancement is done by following methods.

Image Filtering: In Image filtering Gaussian Filter is used and laplacian of gaussian is obtained. In two dimensions, it is the product of two one dimensional Gaussians, one per direction:

$$g(x,y) = \frac{1}{2\pi\sigma^2} \cdot e^{-\frac{x^2+y^2}{2\sigma^2}}$$

where *x* is the distance from the origin in the horizontal axis, *y* is the distance from the origin in the vertical axis, and σ is the standard deviation of the Gaussian distribution. The Laplacian *L*(*x*,*y*) of an

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image with pixel intensity values $I(x,y)$ is given by:

$$LoG(x,y) = -\frac{1}{\pi\sigma^4}\left[1-\frac{x^2+y^2}{2\sigma^2}\right]e^{-\frac{x^2+y^2}{2\sigma^2}}$$

Laplacian filters are derivative filters used to find areas of rapid change (edges) in images. Since derivative filters are very sensitive to noise, it is common to smooth the image (e.g., using a Gaussian filter) before applying the Laplacian. This two-step process is call the Laplacian of Gaussian (LoG) operation.When the image is uniform, the LoG will give zero. Wherever a change occurs, the LoG will give a positive response on the darker side and a negative response on the lighter side. At a sharp edge between two regions, the response will be

positive just to one side

zero away from the edge

negative just to the other side

zero at some point in between on the edge itself

Unsharp Masking: The "unsharp" of the name derives from the fact that the technique uses a blurred, or "unsharp", first image is blurred and subtracted from original image so edges can be obtained and then these edges are added to original image itself so resultant image is good in contrast.

This sharpen image is now eroded using morphological filter. This image is very smooth. We convert this image into binary image with a threshold of 0.6. Thus we get a black and white image in which white part indicates tumor.

2. IMAGE SEGMENTATION

Image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image (see edge detection). Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture.

Thus, there was no need to investigate more sophisticated image segmentation algorithms. The Canny Edge detection technique is used. The goal of edge detection is to mark the points in a digital image at which the luminous intensity changes sharply. Sharp changes in image properties usually reflect important events

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Canny Edge detection proceeds thorough following steps:

- ❖ Smooth the image with a Gaussian filter,
- ❖ Compute the gradient magnitude and orientation using finite-difference approximations for the partial derivatives,
- ❖ Apply non-maxima suppression, with the aid of the orientation image, to thin the gradient-magnitude edge
- ❖ Track along edges starting from any point exceeding a higher threshold as long as the edge point exceeds the lower threshold.
- ❖ Apply edge linking to fill small gaps

3. FEATURE EXTRACTION

In this section, we used PCA to extract features. First, PCA was performed on the metabolite concentration dataset to extract feature vectors. We obtained all eigen values and their corresponding eigen vectors for image. The eigen Vector corresponding to the highest eigen value is used as feature vector.The length of vector is 200. For convience 5 elements are shown here.

-0.00328	-0.00114	-0.0013	-0.00334	-0.00034

A new dataset was reconstructed for all the normal healthy brain images and brain tumor images.

4. CLASSIFICATION USING RADIAL BASIS FUNCTION

In Neural networks based classification; training of neural networks is done to perform the required classification task using different input features (Feature vectors obtained using Eigen Values). The neural network is used to classify brains into healthy brain or brain with tumor. The number of Neurons used are 20 and which gives a Mean Square Error of 0.012. As the number of Neurons increases . Mean Square Error decreases and the output is close to the desired one and reduces the chances of misclassification increasing the accuracy of correct classification.

Radial basis networks can be used to approximate functions. It adds neurons to the hidden layer of a radial basis network until it meets the specified mean squared error goal. The larger spread is, the smoother the function approximation. Too large a spread means a lot of neurons are required to fit a fast-changing function.

Too small a spread means many neurons are required to fit a smooth function, and the network might not generalize well. Commonly used types of radial basis functions include:

$$r = \|\mathbf{x} - \mathbf{x}_i\|$$

Radial basis functions are typically used to build up function approximations of the form

$$y(\mathbf{x}) = \sum_{i=1}^{N} w_i \, \phi(\|\mathbf{x} - \mathbf{x}_i\|),$$

where the approximating function $y(\mathbf{x})$ is represented as a sum of N radial basis functions, each associated with a different center $\mathbf{x}_i$, and weighted by an appropriate coefficient w_i. The weights w_i can be estimated using the matrix methods of linear least squares, because the approximating function is *linear* in the weights.

5. CONCLUSION

Input image is taken and pre-processing is done on it. For image enhancement LOG is used along with Unsharp Masking giving an output image as shown in figure 1.

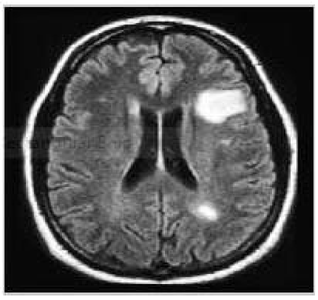

Fig 1: input image with LoG and unsharp masking

Morphological operations performed using Ball Structuring element.

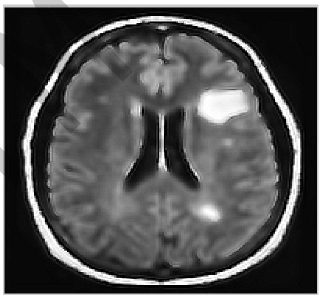

Fig 2: morphological eroded image

The above image is threshold to binary using threshold value 0.6 and is shown in fig3

Fig 3: Binary image

Canny edge detector is applied on the black and white segmented image and the tumor is detected(outer boundary of tumor) as shown in fig 4.

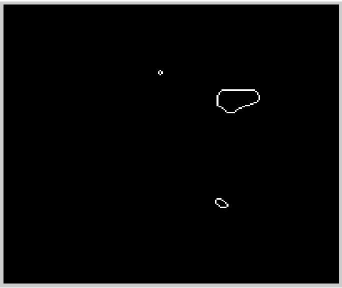

Fig 4: segmented image

6. CLASSIFICATION

	CORRECTLY CLASSIFIED	INCORRECTLY CLASSIFIED
TRAIN INPUTS	25	0
TEST INPUTS	5	3

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REFERENCES

[I] Issac H. Bankman, Hand Book of Medical Image processing and Analysis, Academic Press, 2009.

[2] Sarah Parisot, Hugues Duffau, sr ephane Chemouny, Nikos Paragios, "Graph-based Detection, Segmentation & Characterization of Brain Tumors",. 978-1-4673-1228-8/12/2012 IEEE.

[3] Neil M. Borden, MD, Scott E. Forseen, MD, "Pattern Recognition Neuroradiology", Cambridge University Press, New York,2011.

[4] Noramalina Abdullah, Umi Kalthum Ngah, Shalihatun Azlin Aziz" Image Classification of Brain MRI Using Support Vector Machine", 978-1-61284-896-9/11/2011 IEEE.

[5] M. J. Er, W. Chen, S. Wu, "High speed space recognition based on discrete cosine trans form and RBF Neural Network". IEEE Trans. On Neural network, Vol, 16, NoJ,pp 679,691,2005.

[6] Z.Pan, AG. Rust, H. Bolouri" "Image redundancy reduction for neural network classification using discrete cosine trans form", Prop. Int. Conf on Neural Network,Vol.3,pp 149,154, Itali,2000.

[7] AK. Jain, R.P. W. Duin, J. Mao, Statistical pattern recognition: a review, IEEE Trans. Pattern Anal. Mach.lintell. 22 (2000) 4 - 37.

[8] K. Fukunaga, Introduction to Statistical pattern recognition, 11 nd Edition. Academic Press, New York, 1990.

[9] N. Kwak, and C.H. Choi, "Input Feature Selection for classification

problem", IEEE Transactions on Neural Networks, 13(1), 143-159,2002.

[10] D.F. Specht, "Probabilistic Neural Networks for classification, mapping, or associative memory", Proceedings oj IEEE International Conjerence on Neural Networks, Vol I, IEEE Press, New York, pp. 525-532, june 1988.

[11] D.F. Specht, "Probabilistic Neural Networks" Neural Networks, Vol. 3, No l,pp.1 09-118, 1990.

[12] Mohd Fauzi Othman and Mohd Ariffanan Mohd Basri, "Probabilistic Neural Network For Brain Tumor Classification", Second International Conference on Intelligent Systems, Modeling and Simulation, IEEE Computer Society, 2011,001 10.11 09/ISMS. 2011J2.

[13] Li, H. Y., Fan, W. Y., 2008. Matlab Realization of Sensing Image Classification Based on Probabilistic Neural Network. journal oj Northeast Forestry University, 36(6),pp. 64-66.