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Image Segmentation and Identification of Brain Tumor from MRI Image

Sonam S. Gavhande, S.B.Jadhav

ME (1st year) Student, Computer Engineering, Dr.V.B.Kolte College of Engineering, Malkapur, Maharashtra, India
Asst. Professor, Computer Science and Engineering, Dr.V.B.Kolte College of Engineering, Malkapur, Maharashtra, India

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Abstract— The image processing is an important aspect of medical science to visualize the different anatomical structures of human body. Sometimes it is very difficult or impossible to detect or visualize such hidden abnormal structures by using simple imaging. For such abnormalitical structures, some planar imaging methods are helpful. One of the significant techniques for examining human body is the Magnetic Resonance Imaging (MRI). It is useful for distinguishing and clarifying the neural architecture of human brain. Magnetic resonance imaging (MRI) technique is one of the many imaging modalities that are available to scan and capture the internal soft tissue structures of the body. This paper describes the proposed strategy to detect & extraction of brain tumor from patient's MRI scan images of the brain. It includes some noise removal functions, segmentation and morphological operations which are the basic terms of image processing. By using MATLAB software we can detect and extract tumor from MRI scan images of the brain.

Key Words: MRI, segmentation, morphology, MATLAB.

1. INTRODUCTION

Brain tumors are mainly result of abnormal or uncontrolled growth of cells [13]. Primary tumors are those tumors which originate in the brain. And Secondary tumors originate in some other part of the body. Finally these tumors reach to the brain through the process of metastasis. The symptoms for Brain tumors are headache, vomiting, nausea, sudden change in personality or behavior, weakness and numbness. In some cases loss of memory and sensation. Neurons in brain generate electro-chemical impulses, that act on other neurons, glands, and muscles this generates thoughts, feelings, and actions. Epilepsy is a one kind of brain disorder, in which group of nerve cells (neurons), in the brain signals abnormally. In epilepsy following are some symptoms:

a) Regular arrangement of neurons disturbs and results
1) Improper sensations
2) Strange behavior,
3) Disturbed emotions

b) Sometimes muscle disorder even unconsciousness can result [3]. MRI (Magnetic Resonance Imaging) is an advanced medical imaging tool. This gives us good Quality images of the parts/organs of the human body. MRI technique is one of the available imaging modern techniques like CT-Scan, X-Ray and Mammography. It provides good quality visual details/ pictures about the anatomy and the brains overall structure. To study the study of supply of blood in brain, MRI scan can be used. That is why MRI scan technology became an important tool for tracking the progress or growth of the disease, detecting abnormality, and for diagnosis too. MRI scan is oftenely used for brain tumor treatment. MRI scan gives high resolution images, in which we can get detailed anatomical information to check brain development and find abnormalities. In this new era of medical science there are different ways/methods are developed for classifying MR images, these are atlas methods, Fuzzy logic based methods, image variation segmentation and shape methods, neural networks, knowledge based techniques.MRI is consists of T1 weighted, T2 weighted and Proton Density (PD) weighted images. These images then processed by a system which integrates fuzzy logic based technique with multispectral analysis [2]. Pre-processing of MRI images is the primary step in image analysis which performs image enhancement and noise reduction (This improves the image quality), then some morphological operations are performed to detect the tumor in the image. The morphological operations are basically applied on some assumptions about the shape and size of the tumour. The end the tumour is mapped onto the original gray scale image with intensity of 255. This make the tumour visible in the image. The algorithm has been tried on lots of patients.

2. LITERATURE REVIEW

Analyzing the processing of MRI images is the most challenging and emerging field.[9][11]Magnetic Resonance Imaging (MRI) is an advanced medical imaging technique used to produce high quality images of the parts contained in the human body. The paper brings out the methodology, which includes preprocessing of the given MRI image, its segmentation and lastly morphological operations on it, for the detection and extraction of brain tumour of real time patient's MRI scan images. Some have used the technique of Watershed algorithm operation for

the Brain Tumor segmentation of an MRI image. The paper includes Marker based Watershed algorithm. The results have been shown to be very accurate through the paper. Watershed based segmentation and thresholding based segmentation is a powerful tool for the detection of Brain tumour in MRI images. The paper further contains the analysis of persons suffering and dying from this fatal problem of brain tumour. The main emphasis of the paper lies on the various segmentation techniques. The methodology mentioned in the paper consists of Image Acquisition, Preprocessing, Processing and Post Processing of the input MRI image. Introduced a new technique of Marker Controlled Watershed Algorithm to carry out the segmentation of MRI images. The paper shows how this technique overcomes the problem of over segmentation with watershed algorithm. Introduction to variation of the fuzzy clustering technique was also used with a gradient vector flow snake model in order to segment the brain image .Integrated image segmented by fuzzy c-means and the images transformed by Wavelet and have later enhanced the edges using Kirch's mask.

3. PROPOSED METHODOLOGY

The algorithm has two stages, first is preprocessing of given MRI Image and second is segmentation.Then perform morphological operations on them.
Algorithm steps are as follows:-

I. Give MRI images as input (this is images of brain).
II. Convert this image into gray scale.
III. Use High Pass filter to remove noise.
IV. Use Median filter to improve/enhance the image quality.
V. Compute threshold segmentation.
VI. Compute watershed segmentation.
VII. Compute morphological operation.
VIII. Finally we will get a final output a tumor region.

All above steps are explained in detail.

3.1 Convert brain image into gray scale.

In MRI scan strong magnetic fields and radio waves are used to form image of human body/organ. In MRI Test the area of body (for which study is required) is placed under a machine which contains strong magnet. The images which obtained from MRI scan are digital images and stored in computer for more/ detail study. We can get MRI images of the part of the body/organ which is under observation/test. These images obtained from MRI scan are black and white. This type of image is also known as halftone (which means pure black and pure white). This halftone technique is also useful for printing photographs/pictures in newspapers/magazines. Since MRI image is taken on computer it can be adjusted as per requirement. In the case of transmitted light (for example, the image on a computer display) the brightness intensity of the red (R), green (G) and blue (B) components are each represented as a number from binary00000000 to 11111111 or decimal 0 to 255. For every pixel in a red-green-blue (RGB) gray scale image, R=G=B. The lightness of the gray is directly proportional to the number representing the brightness levels of the primary colors. Black is represented by R=G=B=0 or R=G=B= 00000000, and white is represented by R=G=B=255 or R=G=B=11111111. This because there are 8 bits in the binary representation of the gray level, this imaging method is called 8-bit gray scale. Grayscale is a range of shades of gray without apparent color. The darkest shade which is possible is black, which is the total absence of transmitted or reflected light. The lightest shade which is possible is white, the total transmission or reflection of light at all visible wavelengths. So for the above reasons first we convert our MRI image to pre-processed in grayscale images.

3.2Use High Pass filter to remove noise

A high-pass filter is used to make an image sharper (i.e. clear).To sharpen the image contrast is enhanced between the adjoining areas with little changes/variations in brightness or darkness. As the name suggest this high pass filter retains high frequency information and reduces low frequency information. If we see the Kernel of the high pass filter, it is designed to increase the brightness of the center pixel compared to neighboring pixels. The Kernel array generally contains a single positive value at its center, which is completely surrounded by negative values. The high pass filter uses negative weighting coefficients for the neighboring pixels. This negative coefficient effectively enhances regions of high intensity gradient in the image. As a result we get sharp and fine image.

3.3Use Median filters to improve/enhance the image quality.

Now our next step is to remove impulse noise. To remove this impulse noise Median filter is used. Median filter is less sensitive compared to outliers as value of each pixel is obtained by the median of the neighboring pixel.[11]. The main reason for use of the median filter is to go through the signal entry by entry and replacing each entry with the median of neighboring entries. The pattern of neighbors is called the "window", these slides, entry by entry, over the entire signal. We should note that if there are odd numbers of entries in window, and then the median is simple to define. It is just the middle value after all the entries and these are sorted numerically in the window. For an even number of entries, there are more than one possible median. The MRI image quality is enhanced significantly after use of Median filter.

3.4 Compute threshold segmentation.

In this Image segmentation the image is divided into multiple parts. By doing this we can identify objects or other related information in the given digital image. We can say that this also refers to the partitioning of an image into multiple sets of pixels (that share some common characteristics such as color or intensity).
There are different ways to perform this type of image segmentation:

a) O'stus method.
b) Colour based segmentation (K-means).
c) Transform methods (Watershed method).

But the simplest available method for image segmentation is thresholding method. This method is based on threshold value, to turn gray scale image into the binary image. The accuracy of this method is to select the threshold value (or values when multiple-levels are selected). Image thresholding is a simple and effective, way of partitioning the given image into a foreground and background [1]. In this image analysis technique, the objects are isolated by converting gray scale images into the binary images. In images which have high level of contrast this thresholding is most effective.

3.5 Compute watershed segmentation.

Since every pixel has different intensities compared to each other, the Watershed segmentation is done on the intensity basis. In this type of image processing, different watershed lines can be computed. In graphs, some lines may be defined on the nodes, some lines on the edges, or some hybrid lines on both nodes and edges. Watersheds can also be defined on the continuous domain. A watershed is a basin-like landform defined by ridgelines and highpoints that descend into stream valleys and lower elevations. There are Different watershed algorithms. One of the most common algorithms that is used, was introduced by Mr. F.Meyer.

3.6 Compute watershed segmentation.

Meyer's flooding Watershed Algorithm:
For this algorithm Gray scale images are necessary. During the successive flooding of the grey value watersheds, reliwith adjacent catchment basins is constructed. This flooding process is performed on the gradient image (i.e. the basins shall emerge along the edges). Generally this will make an over-segmentation of the image. Especially for noisy image material like medical CT data. The image should be pre-processed or the regions must be merged on the basis of a similarity criterion afterwards.
The algorithm is as follows:

1. Choose the set of markers and pixels where the flooding should start. Each one will be having a different label.
2. With a priority level use priority queue corresponding for the inserting neighboring pixels of every marked area to the gray level of the pixel.
3. The pixel which is having highest priority level shall be extracted from the priority queue. If the neighbors of the extracted pixel that have already been labeled all have the same label, then the pixel is labeled with their label. All nonmarked neighbors that are not still in the priority queue are put into the priority queue.
4. Repeat step 3 until the priority queue is completely empty. The non-labeled pixels are watershed lines.

3.7 Compute morphological operation.

Morphology operations are a broad set of image processing operations that process the images based on its shapes. Morphological operations apply a structuring element to the input image which creating an output image of same size. In these operations, the value of each pixel in the output image is based on a comparison of the corresponding pixel in the input image with its neighbors. By choosing the shape and size of the neighborhood, you can construct a morphological operation that is sensitive to specific shapes in the input image. Morphological techniques probe an image with a small shape or template called a structuring element. The structuring element is positioned at all possible locations in the image and it is compared with the corresponding neighbourhood of pixels. The structuring element is a small binary image, i.e. a small matrix of pixels, each with a value of zero or one:

- The matrix dimensions specify the *size* of the structuring element.
- The shape of the structuring element is specified by the pattern of ones and zeros.
- An *origin* of the structuring element is usually one of its pixels, although generally the origin can be outside the structuring element.

4. CONCLUSION

Previous researches shows that brain tumors can be detected at an earlier stage using various medical image processing techniques. The medical image processing techniques which they used to examine the location of tumor in the brain is Magnetic Resonance Imaging (MRI).For image segmentation watershed segmentation method is used successfully. The stage of tumour is based

on the area of the tumour. So, size of the tumour can be calculated by calculating the number of white pixels (digit 0) in binary image. Tumor can be classified according to its type.

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BIOGRAPHIES

Sonam Gavhande received her bachelor of engineering in Information Technology from R T M Nagpur University, Wardha in 2011. She is presently a master student at the Amravati University, Maharashtra.Her research interests include image segmentation and tumor detection.

