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Brain Tumor Detection and Segmentation based on Object labeling algorithm

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ABSTRACT:

The segmentation of magnetic resonance images plays a very important role in medical field because it extracts the required area from the image. Generally there is no unique approach for the segmentation of image. Tumor segmentation from MRI data using K means is an important but time consuming manual task performed by medical experts. The research which addresses the diseases of the brain in the field of the vision by computer is one of the challenge in recent times in medicine. This paper focuses on a new and very famous algorithm for brain tumor segmentation of MRI images by object labeling algorithm to diagnose accurately the region of cancer because of its simplicity and computational efficiency. In this an image is divided into a number of various groups or clusters. By experimental analysis various parameters such as global consistency error ,variation of information, area, elapsed time and rand index have been measured

Keywords *: area (A), global consistency error, Object labeling, K means, rand index, segmentation accuracy (SA), and variation of information.*

INTRODUCTION

Brain tumor is an abnormal growth of cells inside the skull. Normally the tumor will grow from the cells of the brain, blood vessels, nerves that emerge from the brain. There are two types of tumor which are- benign (non-cancerous) and malignant (cancerous) tumors. The former is described as slow growing tumors that will exert potentially damaging pressure but it will not spread into surrounding brain tissue. However, the latter is described as rapid growing tumor and it is able to spread into surrounding brain. Tumors can damage the normal brain cells by producing inflammation, exerting pressure on parts of brain and increasing pressure within the skull. Figure 1 shows the presence of tumor in the Brain. Radiologists examine the patient physically by using Computed Tomography (CT scan) and Magnetic Resonance Imaging (MRI). MRI images showed the brain structures, tumor's size and location. From the MRI images the information such as tumors location provided radiologists, an easy way to diagnose the tumor plan the surgical approach for its removal.

Fig.1,Brain tumor

MRI's use radiofrequency and magnetic field to result image's human body without ionised radiations. Imaging plays a central role in the diagnosis of brain tumors. On MRI, they appear either hypo (darker than brain tissue) or iso tense(same intensity as brain tissue) on T1-weighted scans, or hyper intense (brighter than brain tissue) on T2-weightedMRI.In medical, doctors don't have method that can be used for brain tumor detection standardization which leads to varying conclusions between one doctor to another .Edge-based method is by far the most common method of detecting boundaries, discontinuities in an image and segmentation. The parts on which immediate changes in grey tones occur in the images are called edges. Edge detection techniques transform images to edge images benefiting from the changes of grey tones in the images. As a result of this transformation, edge based brain segmentation image is obtained without encountering any changes in physical qualities of the main image [24].This image processing consist of image enhancement using histogram equalization, edge detection and segmentation process to take patterns of brain tumors, so the process of making computer aided diagnosis for brain tumor grading will be easier.

II. LITERATURE SURVEY

The image segmentation is entailed with the division or separation of the image into regions of similar features. In this paper, we will discuss an illustrate a number of approaches and show improvements in segmentation performance that can

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be achieved by combining methods from distinct categories such as techniques in which edge detection s combined with thresholding. The definitive aim in image processing applications is to extract important attributes from the image data, from which a descriptive, interpretative, or understandable prospect can be obtained by the machine. Time consumption during the segmentation of brain tumor from magnetic resonance imaging is a crucial drawback. Thus, we have studied the foundations of brain segmentation and edge detection, by various techniques employed by researchers. The segmentation & edge detection approaches were studied under 5 categories.

These are as follows-

1) Thresholding approaches,
2) Region growing approaches,
3) Genetic Algorithm approaches,
4) Clustering approaches ,

Jianping Fan,Yau Elmagarmid & Aref's [2] paper presents an automatic image segmentation method using thresholding technique. This is based on the assumption that adjacent pixels whose value (grey level, color value,texture, etc) lies within a certain range belong to the same class and thus, good segmentation of images that include only two opposite components can be obtained. **Jaskirat Kaur, Sunil Agrawal & Renu Vig.'s** paper presented thresholding and edge detection being one of the important aspects of image segmentation comes prior to feature extraction and image recognition system for analyzing images. It helps in extracting the basic shape of an image, overlooking the minute unnecessary details.

In this paper using image segmentation (thresholding and edge detection) techniques different geo satellite images, medical images and architectural images are analyzed. To quantify the consistency of our results error measure is used [29]. **V. Dey, Y. Zhang, M. Zhong** proposed a method based on histogram thresholding [1]. They follow a concept that there is a uniform background and objects are irregularly placed on it. This makes image histogram the choice for object delineation & finding an appropriate threshold between object and background fulfils the task of object identification. **Zhang** presented the analysis and comparison of these evaluation methods are performed according to the classification and assessment criteria for methods and performance metrics proposed in that survey. The results reveal the advantages and limitation of these new methods, and provide additional understanding about the evaluation procedure. This review presents also some novel procedures for image generation under different conditions. **Dzung L. Pham, Chenyang Xu, Jerry L. Prince** proposed the basics that thresholding approaches segment scalar images by creating a binary partitioning of the image intensities. It attempts to determine an intensity value, called the threshold, which separates the desired classes. Segmentation is achieved by grouping all pixels with intensity greater than the threshold into one class, & all other pixels into another class.Determination of more than one threshold value is a process called multi thresholding.

SYSTEM ANALYZE

EXISTING SYSTEM:

In Existing Different types of methods are implemented such as Max shift Method, Contextual SPHIT, Contextual Vector Quantization.

PSNR value of these compression methods are provide the low value than our proposed method.

PROPOSED SYSTEM:

Here we provide a novel method in the compression of MRI image. For the compression we use contextual Listless set partitioning hierarchical trees (LSPIHT).

In pre-processing we remove the noise from the image. In this method, a contextual region is defined as a region containing the most important information and must be encoded without considerable quality loss.

Attempts are made to encode this region with high priority and high resolution (low compression ratio and high bit rate) LSPHIT algorithm. Here Background region will be compressed by LSPHIT in High bit rate.

Then the CROI will be compressed by Listless set partitioning in hierarchical trees (LSPIHT).

The background, which has a lower priority, is separately encoded with a low resolution (high compression ratio and low bit rate). The ROI is set on higher priority, since it has more important information for diagnostic purposes.

The information of the ROI image should not be loss. Finally both of the encoded contextual region and the encoded background region is merged together to reconstruct the output image

I. METHODOLOGY

Implement and test pulse coupled neural network (PCNN) and back propagation network (BPN) model for enhancing and segmenting the two-dimensional MR brain images: The medical data used is magnetic resonance head data. The data is obtained from a lab and consists of normal and abnormal MR images of human volunteers. The scope of this work is to investigate the application of a pulse coupled neural network (PCNN) and back propagation network (BPN) model for the enhancement and segmentation of MR brain images. This section presents pre-processing and segmentation methods that have

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been applied to MR brain images. Fig.1 illustrates the basic components of a generic image processing system. Image segmentation is usually preceded by image pre-processing and feature extraction and can be followed by a classification step which assigns labels to the segmented regions.

BRAIN TUMOR

brain tumor is an abnormal growth of cells in the brain, which can be cancerous (malignant) or noncancerous (benign). Is defined as any intracranial tumor created by abnormal and uncontrolled cell division, normally in the brain itself (neurons, glial cells (astrocytes, oligodendrocytes, ependymal cells, myelin producing Schwann cells), lymphatic tissue, blood vessels blood) in the cranial nerves, in the brain envelopes (meninges), skull, pituitary and pineal gland, or spread from cancers primarily located in other organs tumors (metastases).Brain tumors (true) are usually located in the posterior fossa in children and in the anterior two thirds of the cerebral hemispheres in adults, although it can affect any part of the brain. United States in 2005, there were approximately 43,800 new cases of brain tumors (Central Brain Tumor Registry of the United States, primary brain tumors in the United States, Statistical Report, 2005-2006), which represented 14 percent of all cancers, 2.4 percent of all cancer deaths, and 20-25 percent of pediatric cancers. Ultimately, there are about 13,000 deaths per year in the U.S. alone due to tumors.

SEGMENTATION ALGORITHMS

REGION GROWING

Region growing is a technique for extracting an image region that is connected based on some predefined criteria. These criteria can be based on intensity and/or edges in the image . In its simplest form, region growing requires a seed point that is manually selected by an operator and extracts all pixels connected to the initial seed based on some predefined criteria. For example, one possible criterion might be to grow the region until an edge in the image is met. Like thresholding, region growing is seldom used alone but usually within a set of image-processing operations, particularly for the delineation of small, simple structures such as tumors and lesions. Region growing is a simple region-based image segmentation method. It is also classified as a pixel-based image segmentation method since it involves the selection of initial seed points.

This approach to segmentation examines neighboring pixels of initial "seed points" and determines whether the pixel neighbors should be added to the region. The process is iterated on, in the same manner as general data clustering algorithms. A general discussion of the region growing algorithm is described below An auxiliary FIFO (First In First Out) structure is used when the seeds are first located, and where neighbors belonging to the area to visit are spooled. In Algorithm 1,we can see the growth Voxel pseudo-code algorithm in detail. The algorithm takes successively the elements of the queue. Each of these elements is a voxel volume already accepted. For each of them should go to their neighbors and decide if it belongs to the neighboring region in accordance with the selection criteria. To compare the 6-neighbor connection is used. [2] One of the strengths of this technique is that it always grows by neighbors, thus maintaining connectivity between elements that are included in the segmented

PROPOSED METHODOLOGY:

Main cause for increasing mortality among children and adults is brain tumor. It has been concluded from the research of most of the developed countries that number of peoples suffering and dying from brain tumors has been Increased to 300 per year during past few decades. The National Brain Tumor Foundation (NBTF) for research in United States estimates the death of 13000 patients while 29,000 undergo primary brain tumor diagnosis. This high mortality Rate of brain tumor greatly increases the importance of Brain Tumor detection. Hence the MRI, 3D, Image Segmentation, Watershed & Morphological Operators are the fundamental problem of Tumor Detection. Image Segmentation is Performed on the Input Images.

Following are the Steps of Tumor Detection:-

IMAGE ACQUISITION:

Are obtained using MRI scan and these scanned images are displayed in a two dimensional matrices having pixels as its elements. These matrices are dependent on matrix size and its field of view. Images are stored in Image File and displayed as a gray scale image. The entries of a gray scale image are ranging from 0 to 255, where 0 shows total black color and 255 shows pure white color. Entries between these ranges vary in intensity

From black to white.

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PROCESSING STAGE:

In this phase image is enhanced in the way that finer details & they can give results. Three methods are used:

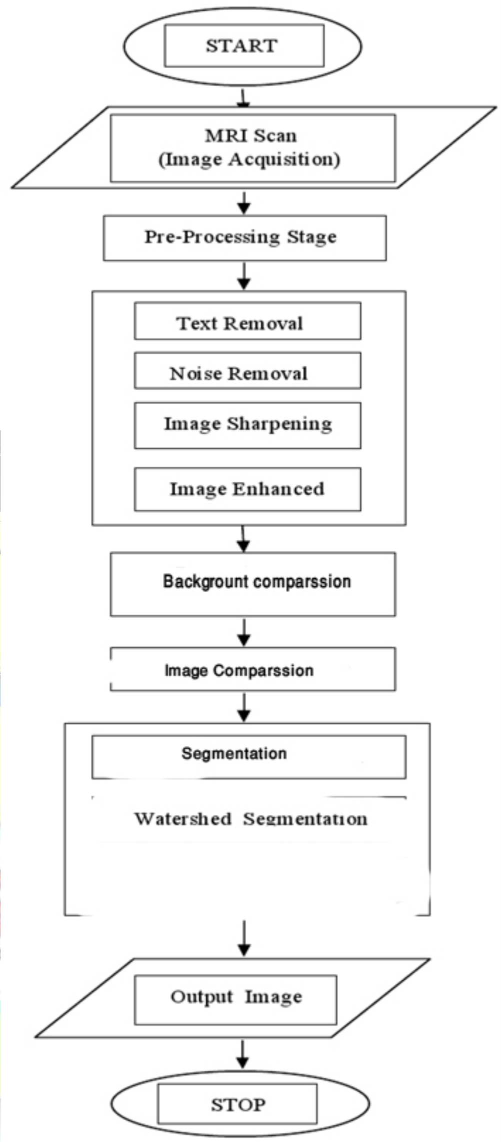
Text Removal: In this phase all unwanted text-noise will be removed.

Noise Removal: Many filters are used to remove the noise from the images. **Image Sharpening:** It will help us to detect the boundary of the tumor.

1) SEGMENTATION:

Image segmentation is based on the division of the image into regions. Division is done on the basis of similar attributes. Similarities are separated out into groups. Basic purpose of segmentation is the extraction of important features from the Image, from which information can easily be perceived. Brain tumor segmentation from MRI images is an interesting but challenging task in the field of medical

Noise Removal is applied on Input Image- all unwanted noise will be removed. MRI scan images may contain some noise.



In Processing Stage Segmentation is performed on the Input Images. In Threshold Segmentation, the input gray scale image is converted into a binary format. After Watershed Segmentation is performed which is only normally used for checking output rather than using as an input segmentation technique because it usually suffers from over segmentation and under segmentation? After converting the image in the binary format, some morphological operations are applied on the converted binary image. The purpose of the morphological operators is to separate the tumor part of the image. Now only the tumor portion of the image is visible, shown as white color. Morphological operators are applied after the

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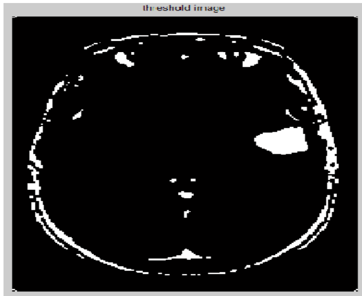

Image processing has been one of the useful tools for processing of medical images and its use and benefits are rapidly growing in this advanced technical world. Using some of the image processing techniques we are able to develop an algorithm which is useful for detecting abnormal formation of the cells in the brain. Here we present an approach that detects the tumor within the brain. In this proposed algorithm we have applied a series of operation first some image enhancement techniques and then morphological techniques to detect the tumor in the brain.After the application of frequency domain method we then apply histogram enhancement technique. This is the technique that can be used to improve the visual appearance in an image. We have applied the histogram enhancement technique to the FFT image with the objective to have a uniform intensity throughout after we have got the uniform intensity values throughout the image by using histogram techniques the next step in our proposed methodology is image thresholding. Thresholding is a common technique in image processing on images in which they are relatively fewer objects of interest whose shape is more important than surface properties. Here we using thresholding as a segmentation algorithm to segment the image's desired part, in this case the tumor we want to segment. Here we first analyze the histogram of the image obtained after histogram enhancement technique. After analyzing the image histogram we select an appropriate value for T , threshold value. We then apply the selected value to the image

After segmentation of abnormal regions using thresholding we then apply a series of morphological operations. Morphological operation is a branch of image processing which is used for representing, describing and analyzing shapes in the images. The basic neighborhood structure that is associated with the morphological operations is the structuring element. In morphological operations structuringelements plays vital role in the result. They shape and size impacts the results of applying a certain morphological operator to an image. In the algorithm first we apply Erosion, whose effect is to shrink or thin objects. This operation is controlled by the size and the shape of the structuring element. Then we apply dilation, whose effect is to grow or thicken objects. The structuring element plays a central role in this operation too. Then we apply the operations which are made by the combination of these basic operations (erosion and dilation) such as opening and closing operations

II. METHODOLOGY

The National Cancer Institute (NCI) estimated that 22,070 new cases of brain and other central nervous system (CNS) cancers would be diagnosed in the United States in 2009. The American Brain Tumor Association (ABTA) clarifies this statistic further by estimating that 62,930 new cases of primary brain tumors would be diagnosed in 2010 [1-3]. Today, tools and methods to analyze tumors and their behaviour are becoming more prevalent. Clearly, efforts over the past century have yielded real advances; however, we have also come to realize that gains in survival must be enhanced by better diagnosis tools [1, 3]. Although we have yet to cure brain tumors, clear steps forward have been taken toward reaching this ultimate goal, more and more researchers have incorporated measures into clinical trials each advance injects hope to the team of caregivers and, more importantly, to those who live with this diagnosis [1-3]. Magnetic Resonance Imaging (MRI) is the state-of the-art medical imaging technology which allows cross sectional view of the body with unprecedented tissue contrast [4-5]. MRI is an effective tool that provides detailed information about the targeted brain tumor anatomy, which in turn

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enables effective diagnosis, treatment and monitoring of the disease. Its techniques have been optimized to provide measures of change within and around primary and metastatic brain tumors, including edema, deformation of volume and anatomic features within tumors, etc [6]. MRI provides a digital representation of tissue characteristic that can be obtained in any tissue plane. The images produced by an MRI scanner are best described as slices through the brain. MRI has the added advantage of being able to produce images which slice through the brain in
both horizontal and vertical planes. This makes the MRI-scan images an ideal source for detecting; identifying and classifying the right infected regions of the brain. Most of the current conventional diagnosis techniques are based on human experience in interpreting the MRI-scan for judgment; certainly this increases the possibility to false detection and identification of the brain tumor. On the other
hand, applying digital image processing ensures the quick and precise detection of the tumor [7]. One of the most effective techniques to extract information from complex medical images that has wide application in medical field is the
segmentation process [5, 8]. The main objective of the image segmentation is to partition an image into mutually exclusive and exhausted regions such that each region of interest is spatially contiguous and the pixels within the region are homogeneous with respect to a predefined criterion. Widely used homogeneity criteria include values of intensity, texture, color, range, surface normal and surface curvatures. Color based segmentation using K-means clustering for brain tumor detection has been proposed, in which better results were obtained using the developed algorithm than that in other edge detection algorithms [9]. A modified method was proposed that additionally takes into account the symmetry analysis and any significant prior information of the region of interest as well as the region area and edge information in the tumor location of pathological cases [10]. This is why with the recent developments. On computational intelligence; the design of computerized medical diagnosis systems has received more and more attention. These reasons motivated us to propose two automated diagnosis systems; the first system is completely based on modified classical image processing algorithms, while the second system is based on probabilistic artificial neural network classifier to interpret medical images obtained from clinical tests. The rest of the paper is organized as follows.

CONVENTIONAL IMAGE SEGMENTATION TECHNIQUES

Image segmentation plays a critical role in all advanced image analysis applications, a key purpose of segmentation is to divide image into regions and objects that correspond to real world objects or areas, and the extent of subdivision depends on requirements of specific application. Complete segmentation of an image scene, where objects correlate with real world objects, cannot be usually achieved without inputs from the user or specific knowledge of the problem domain Advanced processing is required to obtain edges corresponding to meaningful objects. Several algorithms introduced for edge-based segmentation, the widely accepted segmentation methods are edge-image thresholding which is used to eradicate insignificant edges that occur due to factors such as noise and improper lighting conditions [13]. Edgeimage thresholding leads to stray edges in presence of noise where the actual edges are often missing [11]. Stray edges problem can be solved if the edge properties are determined with respect to the mutual neighbours, while presence of edge is substantiated depending on the strength of edges in local neighbourhood [11]. Region-based segmentation is then used which is based on finding similarity measures to merge and split regions in an image so as to form semantic or useful division in the processed image.

IMPLEMENTATION AND RESULTS IMAGE PROCESSING PROPOSED APPROACH SIMULATION

IMAGE ACQUISITION

In our proposed approach we first considered that the MRI scan images of a given patient are either color, Gray-scale or intensity images herein are displayed with a default size of 220×220. If it is color image, a Gray-scale converted image is
defined by using a large matrix whose entries are numerical values between 0 and 255, where 0 corresponds to black and255 to white for instance. Then the brain tumor detection of a given patient consist of two main stages namely, image
segmentation and edge detection.

IMAGE SEGMENTATION

The objective of image segmentation is to cluster pixels into prominent image region. In this paper, segmentation of Gray level images is used to provide information such as an atomical structure and identifying the Region of Interest i.e. locate tumor, lesion and other abnormalities. The proposed approach is based on the information of anatomical structure of the healthy parts and compares it with the infected parts. It starts by allocating the anatomical structure of the healthy parts in a reference image of a normal candidate brain scan

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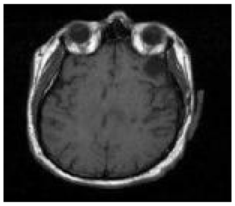
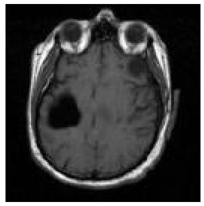


normal brain



abnormal brain

ENHANCEMENT AND SMOOTHING:

There are different types of noise encountered by different techniques, depending on the noise nature and characteristics, namely Gaussian noise and impulse noise. In this paper we assumed that the main image noise is additive and random; that is spurious and random signal, n(i, j), added to the true pixel value I(i, j):*II (i, j) = I (i, j) + n (i, j)* (1)In this algorithm the enhancement in spatial domain is based on direct manipulation of pixels in a small neighbourhood of pixels, it generally takes the form;*g (x , y) =T [f (x , y)]* (2)in which f(x, y) is the input image, g(x, y) is the processed image, and T is an operator on f, defined over some neighbour hood of (x, y). The filtered version of Iis given by the discrete convolution as follows:

(,) * (,) (,)

n m

A

h n k m
I i j I A A h k I i h j k
=− =−
= = Σ Σ − − (3)

Where i=1 to N and j=1 to M. This filter replaces the value I(i, j) with a weighted sum of I values in a neighbourhood of If all entries of A in Eq. (3) are non-negative, the filter performs average smoothing.Then the matrix of the abnormal brain scan image is subtracted from that of the normal brain image resulting in a matrix of the region of interest accompanied with some noise as illustrated in Fig. 3.

SMOOTHING USING GAUSSIAN FILTER

In this paper, the proposed Gaussian smoothing filter, Gf, is a nonnegative, real-valued column matrix defined by,

2 *f*
x y
G x y
*c*σ
(+ [[+]]) = | | | |

(4)

in which c is expressed as $c = 2\pi\sigma 2$.

However this type of filters enhanced the noise reduction level compared with the linear filters, it was observed that these smoothing and noise filters did not completely satisfy the noise removal level from the original image as shown in Fig. 4. Thus, for these applications a set of cascaded filters are recommended. We therefore proposed another stage of noise filtering by using an average filter. Figure 3: Applying Gaussian filter Figure 4: applying Average Filter Applying the average filter resulted in an acceptable noise reduction level for such applications. The conclusion from this part is cascaded filter array is recommended to reach an acceptable noise reduction levels brain tumor detection.

EDGE DETECTION

An edge is a property attached to an individual pixel andis calculated from the image function behaviour in aneighbourhood of the pixel. It is also considered as a vectorvariable (magnitude of the gradient, direction of an edge). The area of each related adjacent portion iscomputed and the irrelevant portions removed resulting in thedesired tumor region as shown in Fig. To enhance the results of the proposed edge detectionalgorithm we found that the most important criteria that affectthe edge detection performance are by reducing the rate errorof losing edges in an image and that edge points must be well localized.

A. GRAYSCALE IMAGING

MRI images are magnetic resonance images which can be acquired on computer when a patient is scanned by MRImachine. We can acquire MRI images of the part of the body which is under test or desired. Generally when we see MRI images on computer they looks like black and white images.In analog practice, gray scale imaging is sometimes called "black and white," but technically this is a misnomer. In true black and white, also known as halftone, the only possible shades are pure black and pure white. (for example, the image on a computer display), the brightness levels of the red (R), green (G) and blue (B) components are each represented as a number from decimal 0 to 255, or binary 00000000 to 11111111. For every pixel in a red-green-blue (RGB)grayscale 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. Because there are 8 bit s in the binary representation of the gray level, this imaging method is called 8-bit grayscale. Grayscale is a range of shades of gray without apparent color. The darkest possible shade is black, which is the total absence of transmitted or reflected light. The lightest possible shade is white, the total

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transmission or reflection of light at all visible wavelengths. So because of the above reasons first we convert our MRI image to be pre-processed in grayscale image.

B. HIGH PASS FILTER

After that image is given as an input to high pass filter.A high pass filter tends to retain the high frequency information within an image while reducing the low frequency information. The kernel of the high pass filter is designed to increase the brightness of the center pixel relative to neighboring pixels. The kernel array usually contains a single positive value at its center, which is completely surrounded by negative values.

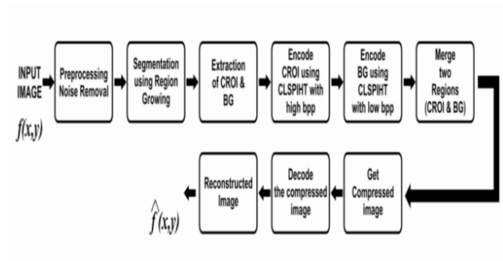
C. MEDIAN FILTER

In signal processing, it is often desirable to be able to perform some kind of noise reduction on an image or signal. The median filter is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors is called the "window", which slides, entry by entry, over the entire signal. For 1D signals, the most obvious window is just the first few preceding and following entries, whereas for 2D (or higher dimensional) signals such as images, more complex window patterns are possible (such as "box" or "cross" patterns). Note that if the window has an odd number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically. For an even number of entries, there is more than one possible median. This filter enhance the quality of the MRI image.

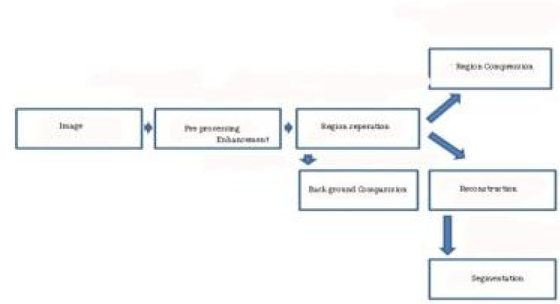
BENIGN TUMORS:

Benign brain tumors do not contain cancer cells, usually, benign tumors can be removed, and they seldom grow back. The border or edge of a benign brain tumor can be clearly seen. Cells from benign tumors do not invade tissues around them or spread to other parts of the body. However, benign tumors can press on sensitive areas of the brain and cause serious health problems. Unlike benign tumors in most other parts of the body, benign brain tumors are sometimes life
threatening. Very rarely, a benign brain tumor may become malignant.

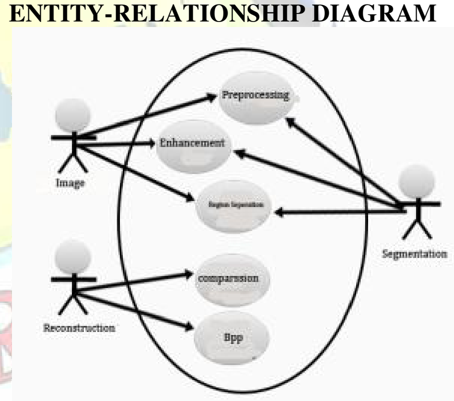
SYSTEM ARCHITECTURE:

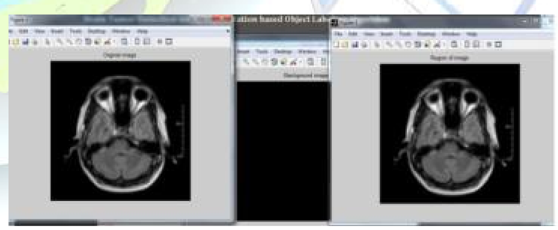


DATA FLOW DIAGRAM:



ENTITY-RELATIONSHIP DIAGRAM





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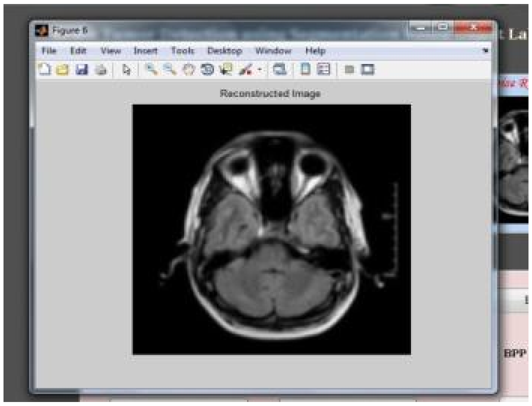

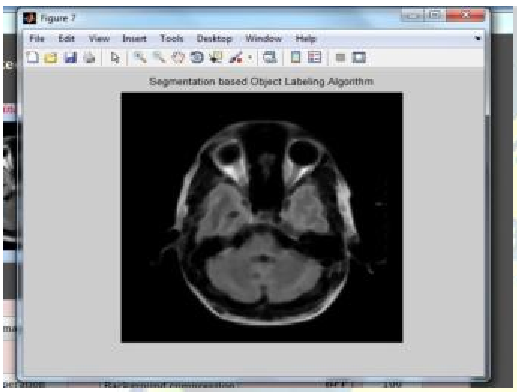

FUTURE WORK

In future this programme can be done more advanced so that tumour can be classified according to its type. Also tumour growth can be analysed by plotting graph which can be obtained by studying sequential images of tumour affected patient.

IV. CONCLUSION

In this proposed work we acquire an MRI image of the brain and perform a series of operations to enhance the quality of the image and then to segment the tumor within the brain. This algorithm is able to segment tumors clearly and able to outline the shape and location of the tumor. This in turn helps the physician or the doctor to analyze the tumor shape and size since the shape and size of the tumor plays a vital role in the treatment to the tumor. In the future we will address simple algorithms to calculate the area and the thinness of the Tumor. We will also use simple algorithms to calculate the location of the tumor

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