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An Automatic Brain Tumor Segmentation and Classification using MRI Image

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Abstract—*The aim of the project is to detect and classify the brain tumor from MRI image. This project involves mainly 6 stages namely Input Image, Preprocessing, Segmentation, Post Processing, Feature Extraction and Classification. In this phase, 4 stages are implemented, Input image, preprocessing, segmentation and post processing. Input image reads the MRI brain image. Preprocessing mainly includes image smoothing and image enhancement. Image smoothing can be accomplished by using Median Filter and which is followed by Image Enhancement technique which can be achieved by Sobel edge detect technique. The third stage is segmentation. In this project, brain tumor is segmented using Pillar K-Means algorithm. Pillar K- Means algorithm includes selection of pillar pixels for useful segmentation. The experimental results shows that the proposed algorithm can effectively segments the tumors from MRI. Post processing operations are applied on the image to clearly locate the tumor part in the brain.*

Keywords*: Brain Tumor Detection, Image Segmentation, Wavelet Transform, Feature Extraction.*

1. INTRODUCTION

Information can be well interpreted through images. Basically machine learning focuses on bringing out information from an image and after extraction again those valuable information are applied to deal with other tasks. Few examples can clarify the point such as images used for robots to navigate through some patterns, extraction of spoiled tissues from body scan etc. The first step which counts in direction of understanding images is segmentation and finding out variety of different components in those images. With the recent rapid growth of the technological advancements, medical science has also improved. But medical science is dependable on the current improvement of technologies. With this technological improvement it has reached to certain esteem where it can diagnose any diseases in a very less time with full accuracy. Most tumor victims are children and adults in their prime of life. So multi-disciplinary approach must be taken to resolve such diseases. There are many approaches to detect brain tumor. Brain tumor segmentation in MR images has been recent area of research in the field of automated medical diagnosis as the death rate is higher among humans due to brain tumor. In automated medical diagnostic systems, MRI (Magnetic Resonance Imaging) gives better results than computed tomography as MRI provides greater contrast between different soft tissues of human body. Hence MRI is much more effective in brain and cancer imaging.

Detection of brain tumor requires brain image segmentation Manual brain MR images segmentation is a difficult task. It requires plenty of time, non-repeatable task, non-Uniform Segmentation and also segmentation results may vary from expert to expert. So computer aided system is useful in this context. An automated brain tumor detection system should take less time and should classify the brain MR image as normal or tumorous accurately it should be consistent and should provide a system to radiologist which is self-explanatory and easy to operate. Automatic brain tumor detection and segmentation faces many issues and challenges. It is a difficult task to segment brain tumor in an automatic computerized system as it involves pathology, physics related to MRI along with intensity and shape analysis of MRI image. The major issue with brain tumor segmentation is that the tumor varies in form of shape, size, location and image intensities. Manual segmentation of brain tumor requires human experts and it takes a lot of time, which makes a computer aided system for brain tumor detection and segmentation a desirable method.

1.1 OBJECTIVE

The aim of the project is tumor identification in brain MR images. The main reason for detection of brain tumors is to provide aid to clinical diagnosis. The aim is to provide an algorithm that guarantees the presence of a tumor by combining several procedures to provide a foolproof method of tumor detection in MR brain images. The methods utilized are filtering, contrast adjustment, negation of an image, image subtraction, erosion, dilation, threshold, and outlining of the tumor.

1.2 MOTIVATION

A brain tumor is defined as abnormal growth of cells within the brain or central spinal canal. Some tumors can be cancerous thus they need to be detected and cured in time. The exact cause of brain tumors is not clear and neither is exact set of symptoms defined, thus, people may be suffering from it without realizing the danger. Primary brain tumors can be either malignant (contain cancer cells) or benign (do not contain cancer cells).

Brain tumor occurred when the cells were dividing and growing abnormally. It is appear to be a solid mass when it diagnosed with diagnostic medical imaging techniques. There are two types of brain tumor which is primary brain tumor and metastatic brain tumor. Primary brain tumor is the condition when the tumor is formed in the brain and tended to stay there while the metastatic brain tumor is the tumor that is formed elsewhere in the body and spread through the brain.

The symptom having of brain tumor depends on the location, size and type of the tumor. It occurs when the tumor compressing the surrounding cells and gives out pressure. Besides, it is also occurs when the tumor block the fluid that flows throughout the brain. The common symptoms are having headache, nausea and vomiting, and having problem in balancing and walking. Brain tumor can be detected by the diagnostic imaging modalities such as MR scan and MRI. Both of the modalities have advantages in detecting depending on the location type and the purpose of examination needed. In this paper, we prefer to use the MR images because it is easy to examine and gives out accurate calcification and foreign mass location.

The MR image acquired from the MRI machine give two dimension cross sectional of brain. However, the image acquired did not extract the tumor from the image. Thus, the image processing is needed to determine the severity of the tumor depends on the size [4].

The focus of this project is MRI brain image's tumor extraction and its representation in simpler form such that it is understandable by everyone. Humans tend to understand colored images better than black and white images, thus, we are using colors to make the representation simpler enough to be understood by the patient along with the medical staff. Contour plot and c-label of tumor and its boundary is programmed to give 3D visualization from 2D image using different colors for different levels of intensity. A user-friendly GUI is also created which helps medical staff to attain the above objective without getting into the code.

1.3 PROBLEM STATEMENT

Brain tumor segmentation in MR images has been recent area of research in the field of automated medical diagnosis as the death rate is higher among humans due to brain tumor. Magnetic resonance (MR) images are a very useful tool to detect the tumor growth in brain but precise brain image segmentation is a difficult and time consuming process.

1.4 PROBLEM SOLUTION

The algorithm is a set of image processing fundamental procedures. A set of noise-removal functions accompanied with morphological operations that result in clear image of tumor after passing through high pass filter is the basic idea behind the proposed algorithm. The set of morphological operations used will decide the clarity and quality of the tumor image.

A GUI is created in the MATLAB offering the proposed application of extracting the tumor from selected brain image and its visualization using contour plot. Without having to deal with the code, medical staff can select the CT image and study the extracted tumor along with its boundary from contour and c-label options. The GUI also contains options for zoom-in, zoom-out, data cursor for co-ordinates, and prints the selected image.

2. EXISTING SYSTEM

Image Segmentation is an important and challenging factor in the field of medical sciences. It is widely used for the detection of tumors. This paper deals with detection of brain tumor from MR images of the brain. The brain is the anterior most part of the nervous system. Tumor is a rapid uncontrolled growth of cells. Magnetic Resonance Imaging (MRI) is the device required to diagnose brain tumor. The normal MR images are not that suitable for fine analysis, so segmentation is an important process required for efficiently analyzing the tumor images. Clustering is suitable for biomedical image segmentation as it uses unsupervised learning. This paper work uses K-Means clustering where the detected tumor shows some abnormality which is then rectified by the use of morphological operators along with basic image processing techniques to meet the goal of separating the tumor cells from the normal cells [1].

Malignant is the rapid growing tumor which is invasive and life threatening. Magnetic Resonance Imaging (MRI) is the device required to diagnose brain tumor. The normal MR images are not that suitable for fine analysis, so segmentation is an important process required for efficiently analyzing the tumor images. It is also called as brain cancer since the malignant contains cancerous cells that able to destroy any nearby cell However, manually detecting and segmenting brain tumors in today's brain MRI, where a large number of MRI scans taken for each patient, is tedious and subjected to inter and intra observer detection and segmentation variability [2].

The paper by Natrajan states that Primary brain tumors include any tumor that starts in the brain. Primary brain tumors can start from brain cells, the membranes around the brain (meninges), nerves, or glands. Tumors can directly destroy brain cells. They can also damage cells by producing inflammation, placing pressure on other parts of the brain, and increasing pressure within the skull. Accurate segmentation of MRI image is important for the diagnosis of brain tumor by computer aided clinical tool. After appropriate segmentation of brain MR images, tumor is classified to malignant and benign, which is a difficult task due to complexity and variation in tumor tissue characteristics like its shape, size, gray level intensities and location. The rapid growing tumor which is invasive and life threatening [3].

Brain tumor detection and segmentation is one of the most challenging and time consuming task in medical image processing. MRI (Magnetic Resonance Imaging) is a medical technique, mainly used by the radiologist for visualization of internal structure of the human body without any surgery. MRI provides plentiful information about the human soft tissue, which helps in the diagnosis of brain tumor. Accurate segmentation of MRI image is important for the diagnosis of brain tumor by computer aided clinical tool. After appropriate segmentation of brain MR images, tumor is classified to malignant and benign, which is a difficult task due to complexity and variation in tumor tissue characteristics like its shape, size, gray level intensities and location. Taking in to account the aforesaid challenges, this research is focused towards highlighting the strength and limitations of earlier proposed classification techniques discussed in the contemporary literature. Besides summarizing the literature, the paper also provides a critical evaluation of the surveyed literature which reveals new facets of research [4].

Mohamed Gouskir has presented a new approach that allows the detection and segmentation of brain tumors automatically. The approach is based on covariance and geodesic distance. The detection of central coordinates of abnormal tissues is based on the covariance method. These coordinates are used to segment the brain tumor area using geodesic distance for Tl and T2 weighted magnetic resonance images (MRI). The ultimate objective is to retrieve the attributes of the tumor observed on the image to use them in the step of segmentation and classification. The present methods are tested on images of Tl and T2 weighted MR and have shown a better performance in the analysis of biomedical images [5].

In brain tumor diagnosis, clinicians integrate their medical knowledge and brain magnetic resonance imaging (MRI) scans to obtain the nature and pathological characteristics of brain tumors and to decide on treatment options. However, manually detecting and segmenting brain tumors in today's brain MRI, where a large number of MRI scans taken for each patient, is tedious and subjected to inter and intra observer detection and segmentation variability. As result a number of methods have been proposed in recent years to fill this gap, but still there is no commonly accepted automated technique by clinicians to be used in clinical floor due to accuracy and robustness issues. In our approach, an automatic brain tumor detection and segmentation framework that consists of techniques from skull stripping to detection and segmentation of brain tumors is proposed with fuzzy Hopfield neural network as its final tumor segmentation technique. Through preprocessing, image fusion and initial tumorous slice classification, the final hybrid intelligent fuzzy Hopfield neural network algorithm based tumor segmentation, and tumor region detection and extraction is achieved. The performance of the proposed framework is evaluated on various MR images including simulated and real, normal and tumorous. Quantitatively the method is validated against available ground truth using commonly used validation metrics. The final segmentation mean and standard deviation result in Jaccard similarity index, Dice similarity score, sensitivity and specificity are 0.8569+/-0.0896, 0.9186+/-0.0638, 0.9480+/-0.0402 and 0.9917+/-0.0387 respectively. Quantitative and qualitative segmentation result indicates the potential of the proposed framework [6].

Brain tumor extraction and its analysis are challenging tasks in medical image processing because brain image and its structure is complicated that can be analyzed only by expert radiologists. Segmentation plays an important role in the processing of medical images. MRI (magnetic resonance imaging) has become a particularly useful medical diagnostic tool for diagnosis of brain and other medical images. This paper presents a comparative study of three segmentation methods implemented for tumor detection. The methods include k-means clustering with watershed segmentation algorithm, optimized k-means clustering with genetic algorithm and optimized c- means clustering with genetic algorithm. Traditional k-means algorithm is sensitive to the initial cluster centers. Genetic c - means and k-means clustering techniques are used to detect tumor in MRI of brain images. At the end of process the tumor is extracted from the MR image and its exact position and the shape are determined. The experimental results indicate that genetic c-means not only eliminate the over segmentation problem, but also provide fast and efficient clustering results [7].

Glioma is a type of brain tumor, originates from glial cells. Approximately 80% of them are malignant. Based on pathological evolution of tumor, they can be classified into two types of tumor - high grade & low grade glioma. In this paper, the segmented area obtained from the conventional region-growing approach is automatically selected as the the initial contour to the iterative distance regularized level set evolution method thus removing the need of selecting the initial region of interest by the user. Therefore, a computer aided fully automated technique is developed to detect glioma from multimodal MRI images & segment the tumor region from whole image. The proposed method is capable of improving the overall detection and segmentation performance of tumor for different glioma cases of BRATS 2012 publicly available database [8].

The MRI or CT scan images are primary follow up diagnostic tools when a neurologic exam indicates a possibility of a primary or metastatic brain tumor existence. The tumor tissue mainly appears in brighter colors than the rest of the regions in the brain. Based on this observation, an automated algorithm for brain tumor detection and medical doctors' assistance in facilitated and accelerated diagnosis procedure has been developed and initially tested on images obtained from the patients with diagnosed tumors and healthy subjects [9].

The brain tumor is abnormal growth of cells inside skull which causes damage of the other cells necessary for functioning human brain. The brain tumor detection is challenging task due to complex structure of human brain. MRI images generated from MRI scanners using strong magnetic fields and radio waves to form images of the body which helps for medical diagnosis. This paper gives the overview of the various techniques used to detect the tumor in human brain using MRI images [10].

3. SYSTEM DESIGN

Given a brain MR image, the first step enhances the image, the second step is preprocessing, the third step segments the brain tumor image and in the fourth step post processing using morphological operations and windowing technique takes place, the fifth step does feature extraction which describes a large set of data accurately and the final step is classification which is considered as an instance of supervised learning. As a result of these steps, we get a final brain tumor detected image.

The Fig. 3.1 shows the block diagram of brain tumor detection.

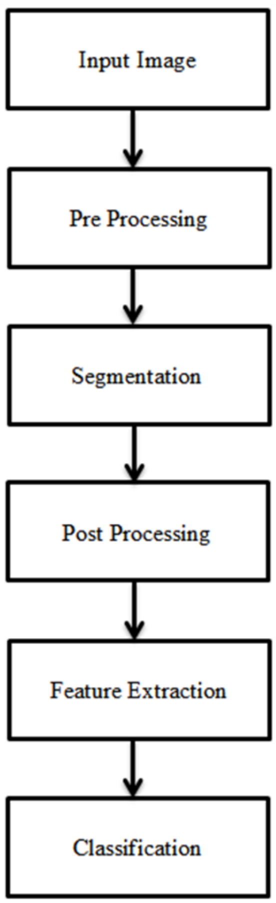

Fig. 3.1: Block Diagram of Brain Tumor Detection

3.1 PREPROCESSING

Preprocessing of brain MR image is the first step in our proposed technique. Preprocessing of an image is done to reduce the noise and to enhance the brain MR image for further processing. The purpose of these steps is basically to improve the image and the image quality to get more surety and ease in detecting the tumor. Steps for preprocessing are as follows:

- Image is converted to gray scale.
- A 3x3 median filter is applied on brain MR image in order to remove the noise.
- The obtained image is then passed through a high pass filter to detect edges.
- The edge detected image is added to the original image in order to obtain the enhanced image.

Preprocessing of an image is done to reduce the noise and to enhance the brain MR image for further processing. The purpose of these steps is basically to better the image and the image quality to get more surety and ease in detecting the tumor. Steps for preprocessing are as shown in Fig. 3.2.

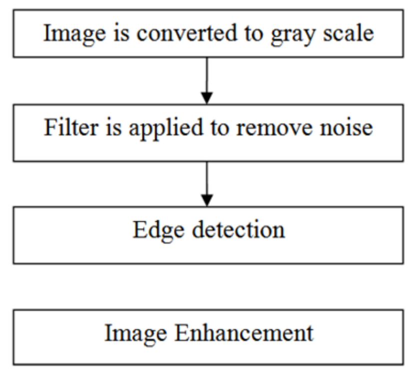

Fig. 3.2: Preprocessing Steps

RGB TO GRAY SCALE CONVERSION

A gray scale digital image is an image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this sort, also known as black-and-white,are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest.

3X3 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.

Nonlinear spatial filters are Order statistic filters whose response is based on ordering or ranking the pixels contained in the image area encompassed by the filter and then replacing the value of the central pixel with the value determined by the ranking result. The median filter, as its name implies, replaces the value of a pixel by the median of the intensity values in the neighborhood of that pixel. Median filters are quite popular because, for certain types of random noise, they provide excellent noise reduction capabilities, with considerably less blurring .Median filters are particularly effective in the presence of impulse noise, also called salt and pepper noise because of its appearance as white and black dots superimposed on an image.

The median $ of a set of values is such that half the values in the set are less than or equal to $, and half are greater than or equal to $.In order to perform median filtering at a point in an image, we first sort the values of the pixel in the neighborhood, determine their median, and assign that value to the corresponding pixel in the filtered image. When several values in a neighborhood are the same all equal values are grouped.

The principal function of median filter is to force points with distinct intensity levels to be more like their neighbors. In fact, isolated clusters of pixels that are light or dark with respect to their neighbors, and whose area is less than *m*^2/2 are eliminated by an *m*m* median filter, that means forced to the median intensity of the neighbor. Larger clusters are affected considerably less.

EDGE DETECTION

The obtained image is then passed through a high pass filter to detect edges. The high pass filter mask is given in matrix,

$$\begin{bmatrix} -1 & 2 & -1 \\ 0 & 0 & 0 \\ 1 & -2 & 1 \end{bmatrix}$$

Edges are significant local changes of intensity in an image. Edges typically occur on the boundary between two different regions in an image. Edge detection refers to the process of identifying and locating sharp discontinuities in an image. The discontinuities are abrupt changes in pixel intensity which characterize boundaries of objects in a scene. Classical methods of edge detection involve convolving the image with an operator (a 2D filter), which is constructed to be sensitive to large gradients in the image while returning values of zero in uniform regions.

There are an extremely large number of edge detection operators available, each designed to be sensitive to certain types of edges. Variables involved in the selection of an edge detection operator include Edge orientation, Noise environment and Edge structure. The geometry of the operator determines a characteristic direction in which it is most sensitive to edges. Operators can be optimized to look for horizontal, vertical, or diagonal edges. Edge detection is difficult in noisy images, since both the noise and the edges contain high frequency content. Attempts to reduce the noise result in blurred and distorted edges. Operators used on noisy images are typically larger in scope, so they can average enough data to discount localized noisy pixels. This results in less accurate localization of the detected edges. Not all edges involve a step change in intensity. Effects such as refraction or poor focus can result in objects with boundaries defined by a gradual change in intensity .The operator needs to be chosen to be responsive to such a gradual change in those cases. So, there are problems of false edge detection, missing true edges, edge localization, high computational time and problems due to noise etc. Therefore, the objective is to do the comparison of various edge detection techniques and analyze the performance of the various techniques in different conditions.

There are many ways to perform edge detection. Gradient based Edge Detection is one of the useful methods. The gradient method detects the edges by looking for the maximum and minimum in the first derivative of the image. The four steps of edge detection are

(1) Smoothing: suppress as much noise as possible, without destroying the true edges.

(2) Enhancement: apply a filter to enhance the quality of the edges in the image.

(3) Detection: determine which edge pixels should be discarded as noise and which should be retained.

(4) Localization: determine the exact location of an edge.

EDGE DETECTION USING SOBEL OPERATOR

The operator consists of a pair of 3×3 convolution kernels as shown in Fig. 3.1.3.1. One kernel is simply the other rotated by 90°.

$$G_x = \begin{bmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{bmatrix} \qquad G_y = \begin{bmatrix} 1 & 2 & 1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$

These kernels are designed to respond maximally to edges running vertically and horizontally relative to the pixel grid, one kernel for each of the two perpendicular orientations. The kernels can be applied separately to the input image, to produce separate measurements of the gradient component in each orientation (call these *Gx* and *Gy*). These can then be combined together to find the absolute magnitude of the gradient at each point and the orientation of that gradient .The gradient magnitude is given by:

$$G = Gx + Gy$$

Typically, an approximate magnitude is computed using:

$$G = Gx + Gy$$

This is much faster to compute. The angle of orientation of the edge (relative to the pixel grid) giving rise to the spatial gradient is given by:

$$q = \arctan(Gy/Gx)$$

ENHANCED IMAGE:

Image enhancement is the process of manipulating an image so that the result is more suitable than the original image for a specific application. The edge detected image is added to the original image in order to obtain the enhanced image.

SKULL STRIPPING:

After consummating the de-noising process of the brain MRI, the brain portion is extracted from the skull by utilizing skull stripping technique. The skull is surrounded at outer part of the brain, that is, the abstraction of its non-cerebral tissues. Segmentation of the non-cerebral and the intracranial tissues are the main quandary in skull-stripping due to their homogeneity intensities. Consequently, the contrast adjusted image is cropped for the tumor part of the brain image and it is converted to binary by using low threshold value in which the morphological operation is applied to 'thicken' the binary image once. The process flow of mathematical morphology for skull stripping is shown in Fig. 4.7 .

3.2 SEGMENTATION

After enhancing the brain MR image, the next step of our proposed technique is to segment the brain tumor MR image. Segmentation is done to separate the image foreground from its background. Segmenting an image also saves the processing time for further operations which has to be applied to the image.

Segmentation is done to separate the image foreground from its background. Segmenting an image also saves the processing time for further operations which has to be applied to the image. Segmentation algorithms are based on one of two basic properties of intensity values discontinuity and similarity. First category is to partition an image based on abrupt changes in intensity, such as edges in an image. Second category is based on partitioning an image into regions that are similar according to predefined criteria. Histogram Threshold approach falls under this category. This paper taken the study the second category (threshold techniques) in this case there are more studies take this subject can be give some of these studies briefly. Threshold segmentation techniques can be grouped in three different classes: First Local techniques are based on the local properties of the pixels and their neighborhoods. Second Global techniques segment an image on the basis of information obtain globally (e.g. by using image histogram; global texture properties). Third Split, merge and growing techniques use both the notions of homogeneity and geometrical proximity in order to obtain good segmentation results. Finally image segmentation, a field of image analysis, is used to group pixels into regions to determine an image's composition.

Threshold techniques can be categorized into two classes: global threshold and local (adaptive) threshold. In the global threshold, single threshold value is used in the whole image. In the local threshold, a threshold value is assigned to each pixel to determine whether it belongs to the foreground or the background pixel using local information around the pixel. Because of the advantage of simple and easy implementation, the global threshold has been a popular technique in many years.

Pillar K-Means Algorithm

The K means clustering algorithm can also be used for segmentation. The average distance from each data point to its associated cluster centroid ensures the overall quality of clustering. The proposed research is inspired by the performance of the Euclidean distance and its uses; hence adaptive pillar K-means algorithm uses Euclidean distance to determine the distance between an object and its cluster centroid.

3.3 POST PROCESSING

Post processing after segmenting the brain MR image, several post processing operations are applied on the image to clearly locate the tumor part in the brain. The basic purpose of the operations is to show only that part of the image which has the tumor that is the part of the image having more intensity and more area. These post processing operations include morphological operations and windowing technique.

After segmenting the brain MR image, several post processing operations are applied on the image to clearly locate the tumor part in the brain. The basic purpose of the operations is to show only that part of the image which has the tumor that is the part of the image having more intensity and more area. These post processing operations include morphological operations and windowing technique.

Mathematical morphology is a tool for extracting image components that are useful in the representation and description of region shape, such as boundaries, skeletons and convex hull. The language of mathematical morphology is set theory. Sets in mathematical morphology represent objects in an image. In binary images sets are members of the 2-D integer space Z^2, where each element in a set is a duple (2-D vector) whose coordinates are (x, y) coordinates of a white (or black, depending on convention) pixel in the image.

Erosion and dilation are two basic operations used in morphology. In order to explain about erosion and dilation we need structuring elements. Structuring elements are Small sets or sub images are used to probe an image under study for properties of interest. Structuring elements with a variety of shapes and sizes are available e.g. Diamond, Disk, Line, Square etc.

EROSION

Erosion shrinks or thins objects in a binary image. The manner and extent of shrinking is controlled by a structuring element. Erosion is a process of translating the structuring element through out the domain of image.

Let A is a set of original image and B is a set of structuring element. Mathematically erosion can be represented as

$$A \ominus B = \{z \mid (B)_z \subseteq A\}$$

This equation indicates that erosion A by B is the set of all points z such that B, translated by z, is contained in A.

One of the simplest uses of erosion is for eliminating irrelevant details from binary image. Erosion is a morphological filtering operation in which image details smaller than structuring element are filtered from original image. The structuring element overlap only ‘1’ valued pixels of the input image (fore ground of image). The output image has a value of ‘1’ at each location of the origin of the structuring element.

DILATION

Dilation is an operation that grows or thickens objects in binary image. The manner and extent of shrinking is controlled by a structuring element. Dilation is a process of translating the structuring element through out the domain of image.

Let A is a set of original image and B is a set of structuring element .Mathematically dilation can be represented as

$$A \oplus B = \{z \mid [(\hat{B})_z \cap A] \subseteq A\}.$$

This equation indicates that dilation A by B is the set of all displacements, z, such that $B^{\wedge}$ and A overlap by at least one element. It is processes that translate the origin of the structuring element throughout the domain of the image and check where it overlaps with ‘1’ valued pixels. Translation of structuring element in dilation is similar to that of convolution. One of the simplest applications of dilation is for bridging gaps.

OPENING AND CLOSING

In image processing applications, dilation and erosion are used in various combinations. The most common combination are opening and closing. Opening and closing contains series of dilations and/or erosions using same or different structuring element.

Morphological opening remove completely regions of an object that cannot contain the structuring element, smooth object contours, break thin connections and remove thin protrusions. The Opening of set A by structuring element B is the erosion of A by B, followed by dilation of the result. Morphological closing tends to smooth the contours of object. It generally joint narrow break, fills gap smaller than structuring element.

3.4 FEATURE EXTRACTION

Feature extraction involves simplifying the amount of resources required to describe a large set of data accurately. When performing analysis of complex data one of the major problems stems from the number of variables involved. Analysis with a large number of variables generally requires a large amount of memory and computation power or a classification algorithm which over fits the training sample and generalizes poorly to new samples. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy.

3.5 CLASSIFICATION

Classification is considered an instance of supervised learning, i.e. learning where a training set of correctly-identified observations is available. The corresponding unsupervised procedure is known as clustering (or cluster analysis) and involves grouping data into categories based on some measure of inherent similarity (e.g. the distance between instances, considered as vectors in a multi-dimensional space in feature classification steps are classified as normal or tumor using the selected features).

4. RESULTS

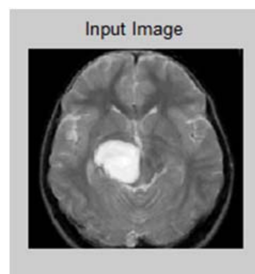

Fig. 4.1: The Input Tumor Image

Fig. 4.1 shows an Input MRI image of human brain Tumor which is converted into Gray scale image.

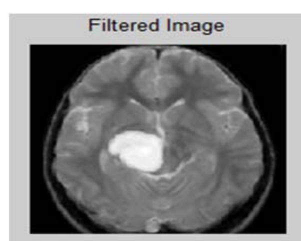

Fig. 4.2: The Median Filtered Output Image

Fig. 4.2 shows the Median Filtered Output Image which is applied on brain MR image in order to remove the noise.

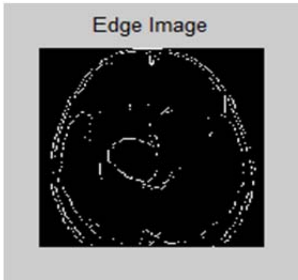

Fig. 4.3: The Sobel Edge Detected Image

Fig. 4.3 shows the edge detected image using sobel operator.

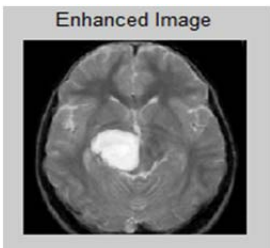

Fig. 4.4: The Enhanced Image

Fig. 4.4 shows the enhanced image.

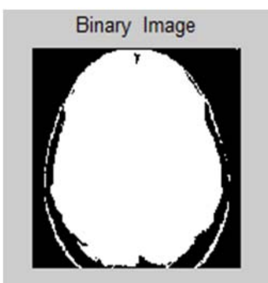

Fig. 4.5: The Binary Image

Fig. 4.5 shows the binary image.

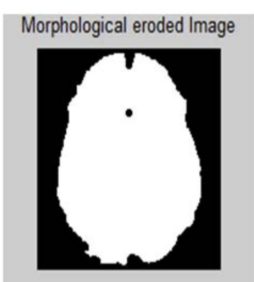

Fig. 4.6: Morphological Eroded Image

Fig. 4.6 shows the morphological eroded image.

Fig. 4.7: Skull Removal Image

Fig. 4.7 shows the skull removal image.

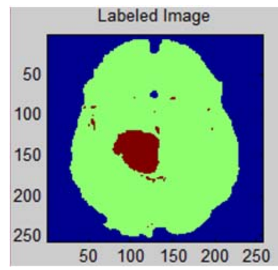

Fig. 4.8: Labeled Image

Fig. 4.8 shows Labeled Image.

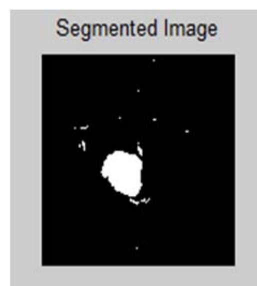

Fig. 4.9: Segmented Image

Fig. 4.9 shows the segmented image.

5. ADVANTAGES

- Fast: Segmentation using K-Means and associated ground truth can be pre computed and stored, and assigned to new data sets.
- Simple to use: Extensive hand-labeling of images by experts to generate training data is not necessary.
- Avoids manual work, processing speed is fast.

6. APPLICATIONS

- In brain tumor detection, the information can be retrieved, such as large number of patient information stored in MRI medical images in the hospitals, which can be extracted by using segmentation algorithms.
- The brain tumor detection using MRI can be applied for searching large data set of information and extracting the information.
- Brain tumor using MRI can be used in PHR (Personal Health Record) which hides the patient information inside the MRI tumor.

7. CONCLUSION

In this project, the two stages are implemented namely preprocessing and segmentation. Segmentation involves efficient clustering algorithms such as pillar k means. The preprocessing steps includes median filtering, edge detection and image enhancement techniques. An input image is filtered using 3x3 median filter to remove the noise, it is then passed through a high pass filter to detect the edges. Edge detection refers to the process of identifying and locating sharp discontinuities in an image. The discontinuities are abrupt changes in pixel intensity which characterize boundaries of objects in a scene. The edge detected image is added to the original image in order to obtain the enhanced image. Image enhancement is the process of manipulating an image so that the result is more suitable than the original image for a specific application. The experiment is conducted for different MRI images. The result shows that the brain tumors are segmented effectively from the MRI images.

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