Detection of Brain Tumor and EDEMA using Image Segmentation

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***Abstract*— Advanced techniques of medical image processing and analysis find widespread use in medicine. Various imaging modalities like CT scan, MRI, and ultrasound are being used for imaging brain tumors. In recent years, MRI has emerged as the best for clear identification of cancer and other anomalies in breast, prostate, liver, brain etc. The tumor detection becomes more complicated for the huge image database especially when edema is present with the tumor. So a software approach is needed to aid the accurate, faster clinical diagnosis. Here we detect the tumor and edema Segment them and the final image having clear boundary between edema and tumor is superimposed on the original image to highlight the tumor and edema boundaries.**

Keywords—Edema, MRI images, co-resemblance, histogram equalization, segmentation, Sobel edge detection filter, image superimposition.

1 . INTRODUCTION

Brain is the central processing unit of world's most complicated machinery, that is, human being. Brain acts as the in charge of human thoughts, feelings, speech, and memory and also plays a pivotal role in controlling muscle movements. Brain helps in the interpretation of sensory information. A tumor is an abnormal new mass of tissue that serves no purpose. By using this process we can get: (1) our study aims to help the physician for surgical planning.(2)The co-resemblance between tumor part and edema will be reduced.(3)The feature extraction of brain tumor part and edema in an easy to use. This software based approach aims to introduce an algorithm for detecting and segmenting the brain tumor and edema from normal brain using basic image processing operations like preprocessing, enhancement, segmentation, morphological operations, feature extraction we fallow in this project.

1.1 COMMON TYPES OF BRAIN TUMOR:

There are two categories of brain tumors depending on its location of origin.

A. Benign:

Benign tumors are non-cancerous mass of cells that grows slowly in the brain. It usually stays in one place and does not spread. These tumors can be removed and they seldom grow back.

B. Malignant:

A malignant brain tumor is a rapidly growing cancer that spreads to other areas of the brain and spine. Most of the malignant brain tumors are secondary but can be primary too.

1.2 EDEMA

Edema is commonly known as brain swelling which can occur in specific location in vicinity of the brain tumor or throughout the brain. It is the "extra fluid" within the tissue of the brain.

1.2 DIAGNOSIS OF BRAIN TUMOR AND EDEMA

One or more of the following methods may be used to detect the presence of a brain tumor having edema and if it has spread-

- Biopsy.
- Stereotactic Biopsy.
- Surgery.
- Lumbar Puncture.

A. Imaging methods

- Computed Tomography (CT) scan.
- Magnetic Resonance Imaging (MRI).
- Positron Emission Tomography (PET) scans.
- Diffusion Tensor Imaging (DTI).

2 PROBLEM FORMULATIONS

Detection of brain tumor having edema as its most prominent feature is a serious issue in imaging science. The brain tumors having edema is done by doctors by simply viewing the image scans which is a very difficult task due to very minute variations. The problem of manual detection becomes more severe when the database is too large. An important step in analysis of MRI brain images is to extract

the boundary of the tumor part which becomes more complicated when tumor have edema in its vicinity.

To solve the problem, the proposed work describes the strategy for detection, segmentation and feature extraction of brain tumor part and edema in an easy to use, inexpensive format using MATLAB software. This software based approach aims to introduce an algorithm for detecting and segmenting the brain tumor and edema.

3 METHODOLOGY

The proposed algorithm follows the following sequence of steps.

A. Image Acquisition

Image acquisition in image processing can be broadly defined as the action of retrieving an image from source, usually a hardware based source. Image acquisition is the first step in the proposed workflow sequence. MRI brain images are used in the proposed system. MRI uses magnetic field and radio waves to provide detailed information about brain tumor with edema.

B. Preprocessing

Preprocessing is the initial step for detecting brain tumor with edema. Basically, this process involves DE noising the image and increasing the signal to noise ratio using different filtering techniques. MRI images are bound to have some noise in them and white noise is one of the most common problems in processing MRI images. So to overcome the drawbacks of LPF, HPF and above stated problems, the following preprocessing methods are used in the present study.

C. Median Filtering

It is done for smoothening of MRI brain image. Median filtering is very effective for removing "salt and pepper" noise (random occurrences of black and white pixels). It is somewhat like mean filter. The median filter does not create new unrealistic pixel values when the filter straddles an edge in the image. For this reason, the median filter is much better at preserving sharp edges than other filters. The fallowing figure shows the impact of "salt and pepper" noise on the grayscale image.

D. Image Enhancement

Image enhancement brings out the details that are obscured and highlight certain features of interest in an image. The fundamental enhancement needed in the MRI images is the contrast enhancement. Contrast is the main reason for the co-resemblance between the tumor part and edema. The Contrast between the brain, tumor part and edema may be present in the MRI image but below the threshold of human perception we are fallowing two methods.

D.1. Arithmetic Operations

Arithmetic operations are performed on a pixel by pixel basis between two or more images. In the present paper, subtraction operation is performed between the Grayscale and the double class MRI brain image. The subtraction operation is expressed as

$$G(x, y) = F(x, y) - H(x, y)$$

And the difference is obtained by computing the difference between all pairs of corresponding pixels From F and H.

D.2 Histogram Equalization

Histogram equalization is a technique for adjusting image intensities to enhance contrast of an image. Better contrast is obtained via the histogram of the image, then using histogram equalization that allows the areas with low contrast to gain higher contrast by spreading out the most frequent intensity values. Histogram equalization is a three step process

- Formation of histogram.
- Calculation of new intensity values for each intensity level of image.
- Replace the previous intensity values of the image with new calculated intensity values.

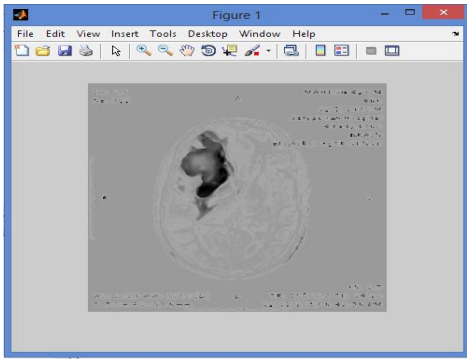


Fig: histogram equalization

E. Image Segmentation

It is the division of an image into meaningful structures. Segmentation subdivides an image into its constituents regions or objects and it is an essential step in image analysis, object representation, visualization and many other image processing tasks. A great number of segmentation methods has been employed in the past decades for brain tumor segmentation like clustering methods, fuzzy logic approach, neuro-fuzzy approach, watershed segmentation, random walk etc. but these all methods produces unsatisfactory results due to unsharp edge boundaries and more time consumed to produce desired result. Moreover, these methods can only segment the tumor region but edema present in the vicinity of tumor region cannot be distinguished from the tumor part. In the present paper, we are using a filter to segment the tumor region and edema from the normal brain. Sobel operator applies gradient filter which average the image perpendicular in gradient direction. The main advantages of using sobel operator over other methods used till now are

- Errors in magnitude and angle are smaller than with discrete differences.
- Smaller anisotropy.
- Clear segment tumor part from edema which proves helpful in tumor excisions during surgery.

Fig: sobel filter equalized image

F. Morphological operations

Morphological processing deals with the tools for extracting image components that are useful in the representation and description of shape. Basically, these operations are the linear operations related to the shape of features in an image. These operations process images based on shapes by applying a structuring element to the input image, creating an output image of the same size. In a morphological operation, 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. The morphological operations used in the present paper are dilation. Dilation and erosion depends on size and shape of the structuring element used to process the image.

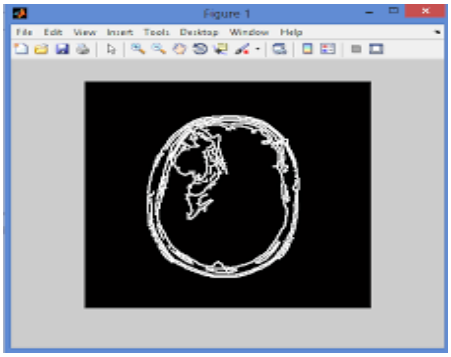
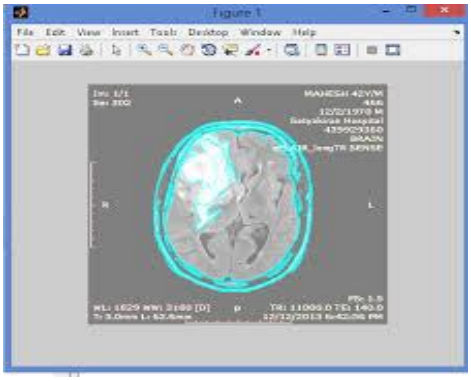


Fig: UN wanted boundaries removed

G. Image superimposition

The final segmented image is then superimposed on the original image which clearly distinguish between tumor and edema and the boundaries are detected which becomes more visible when superimposed on the anatomical structure of brain MRI image.



The above diagram shows the summarize the developed method, the operations are performed on gray scale image of brain and then enhancement is done followed by segmentation and final superimposition of output image on original image.

FUTURE WORK

The proposed system can be extended for some other imaging modality like CT, PET-CT, DTI etc., for different organs of human such as lungs, liver, breast and so on. This proposed work finds its wide applications in the Medical Imaging Sciences and other related research areas.

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