Brain Tumor Segmentation of MRI Images using Joint Techniques of Watershed and Morphological Operations

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ABSTRACT
Segmentation of brain tumor is an example of medical image segmentation that has grown as an emerging area of research in magnetic resonance imaging(MRI).In biomedical imaging, accurate detection of tumor is utmost important for proper clinical practice and treatment. Several techniques have been proposed for brain tumor segmentation, but there is no perfect algorithm proposed yet to enhance tumor. Brain tumor MRI images display complicated features in appearance and boundaries. To eradicate this problem,novel methods are proposed for accurately segmentating the brain image. This research paper focus on the segmentation and detection of brain tumor using watershed and morphological operations. Results are evaluated with the implementation of the work carried out in MATLAB.In the end, conclusion and future aspects are addressed regarding brain tumor segmentation.

Keywords
Brain tumor segmentation, MR images, Watershed algorithm, Close operation.

1. INTRODUCTION
Brain tumor is called as Intracranial Neoplasm in medical language. It arises due to abnormal development of brain tissues. Segmentation of brain tumor is one of the competitive tasks since tumor's characteristics are very difficult to visualize. Brain tumors are categorized as: [1]

1) Benign - This type of tumor is non- cancerous type, it is not a serious type and can be cured easily. It does not spread in a sudden way, thereby not affecting adjacent healthy tissues.

2) Pre-Malignant -It is a preliminary stage of cancer, which if not cured timely can even lead to death.

3) Malignant – It is a cancerous type and may also be termed as brain cancer. It is a life threatening type of tumor which grows over speedily. grades. This type of tumor is classified into four type's i.e. grade I to grade IV.
The death rate due to brain tumor has risen and studies show that about 90% of tumors are found to be glial tumors over 20 years[2].Tumors varies in various characteristics like location, shape ,size and image intensities.

Tissues segmentation of brain especially tumor and edema, is a difficult task because of artifacts in tumor, complex shape, heterogeneous intensity distribution [3].Medical imaging and soft computing have made progressive advancements in the field of brain tumor segmentation, but there is no perfect algorithm proposed yet to enhance tumor.

In this paper, proposed technique of watershed for segmentation of a brain tumor is used in conjunction with morphological operations.

The research paper is organized in the following manner: Section II deals with related work .Section III presents the summary of brain tumor segmentation methods. Section IV concludes the paper.

2. RELATED WORK
Extensive research work has been attempted for brain tumor segmentation. There are many proposed techniques for automatic and semi-automatic detection and segmentation of brain tumors.Atkins *et al*. [4] presents study on automatic image segmentation using thresholding technique, with the supposition that neighbourhood pixels whose gray level, color value or texture should lie within a certain range belong to the same class. Cheng *et al.* [5] proposed a method based on histogram thresholding which follows an idea that there is a homogeneous background and objects are as symetrically placed on it. But in this method evaluation is done for appropriate threshold between object and thereby, fulfilling the work of object identification. Saha *et al.* [6] developed asymmetric analysis method for tumor segmentation. It is based on the principle that asymmetry can be noticed if tumor appears in any one of the cerebral hemispheres.However; this analysis method is a challenging and difficult task when a tumor is located across the mid-sagittal plane or in any one of the cerebral hemispheres. Jiang et al. [7] presented Graph-based seeded segmentation which exhibits remarkable results, but manual seed selection in different tissues is a problematic task. In the study by Hamamci *et al.* [8], method called tumor-cut, needs the user to draw a largest line over the visible tumor diameter. Although it eliminates manual interaction but it may not include all tumor areas within the volume of interest thus results in tumor under segmentation.

3. PROPOSED METHODOLOGY
The proposed method consists of the following steps, i.e., 1)preprocessing(noise- removal), 2)applying morphological operations so as to remove the connections between brain and other tissues 3) tumor segmentation using watershed algorithm. The flowchart of the proposed method is illustrated Fig. 1.

3.1.1 Preprocessing
Noise is unwanted information that distorts an image. During acquisition noise may be introduced in an image. The very first step is the removal of noise while maintaining the quality of image. Gamma normalization is performed as a pre-processing step so as to normalized the intensity range to [0 1] range by dividing all intensity values to the maximum intensity value [9].

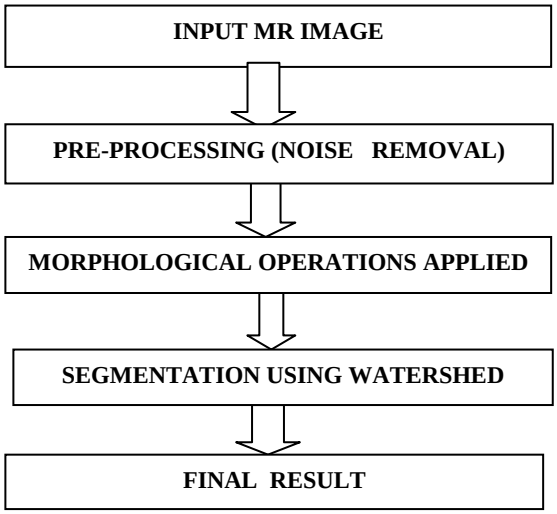

Fig 1: Proposed Flow Chart

3.1.2 Morphological Operations

Morphological operations are applied so as to remove the connections between brain and other tissues .The different operations under morphological operations used are dilation and erosion. Erosion and dilation is used to get the cleaned image. Skull stripped image can also be obtained using morphological operations.

3.1.3 Segmentation

Segmentation is performed using gradient based technique called watershed algorithm. Watershed algorithm imitates the natural process of water in landscape. In the landscape the mountains are like the ridge lines and valleys are the catchment basins. In an image, ridge lines generally denotes to high intensity values, whereas valley denotes to low intensity values[10].This algorithm results in complete contour of images. It is best technique which depends on edges rather than colour.It produces more stable segmentation results, including connected segmentation boundaries. Irrespective of its advantages, it experience over segmentation, so various pre or post processing methods have been developed for better segmentation results[11].

4. EXPERIMENTAL RESULTS

The experimental results are implemented on MATLAB R2010. Firstly, MRI image is taken as input image. Secondly, Gamma Normalization is performed and image is converted into double. In order to apply morphological operation (i.e. CLOSE) image is converted into black and white (BW) image as these operations can be applied only on BW image. After this, Finally for segmentation, watershed technique is applied and the required portion is segmented.

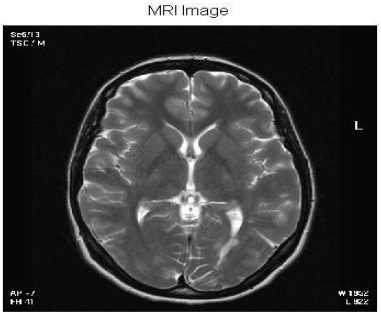

Fig 2 : MRI Image

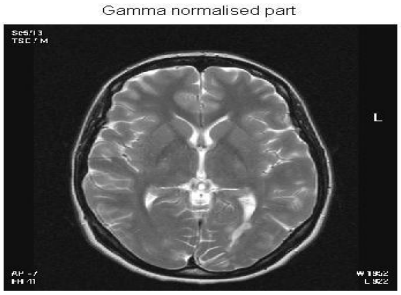

Fig 3 : Gamma Normalised part

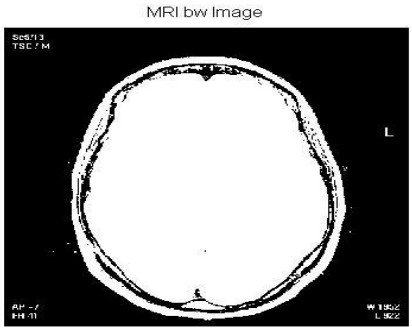

Fig 4 : MRI bw Image

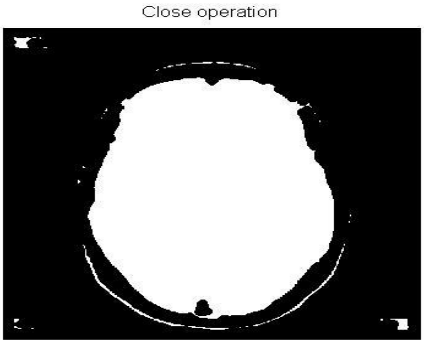

Fig 5: Morphological Close

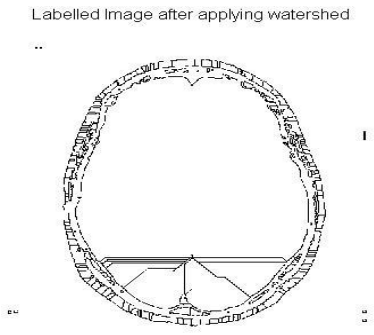

Fig 6 : Labelled image after watershed

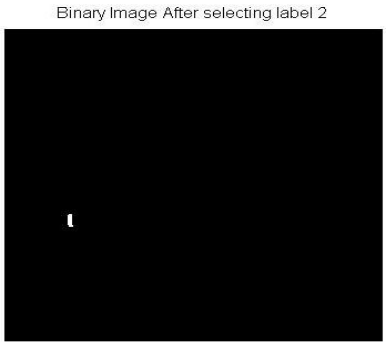

Fig 7 : Binary image after selecting label2

5. CONCLUSION & FUTURE ASPECTS

Segmentation has proved effectively in this particular research area. Medical image processing is an active and fast-growing field. Watershed segmentation gives better segmentation results, as it depends on edges rather than color .Watershed method reduces the computational cost to be implemented in hardware. Brain tumor segmentation techniques have proved itself in detecting and analyzing tumors in clinical images and it will continue into the future. The future work should focus on improving the accuracy by using additional features such as prior knowledge, shape and models [3].

6. REFERENCES

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