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MORPHOLOGICAL BASED WATERSHED SEGMENTATION TO DETECT BRAIN BLOOD CLOT

J. Jennifer
Research scholar

Dr. K. Perumal
Assistant Professor, Department of Computer Applications, Madurai Kamaraj University

Abstract

During the impact of accident, traumatic brain injury (TBI) is sudden damage to the brain caused by a blow or jolt to the head. Injuries can range from mild concussions to severe permanent brain damage. This brain injury leads to blood clot in brain and it's medically detected by using MRI scan. In this paper segmentation of MRI Brain Blood clot is done and watershed segmentation is used to extract the blood clot features from MRI Brain image. Morphological operators are applied to separate the blood clot areas from the segmented image.

Keywords: *MRI, Brain Blood clot, Image segmentation, Watershed transform, Morphological operators.*

Introduction

Medical images like MRI, CT, and PET are essential to diagnose all the abnormalities in human body. MRI is one of the diagnostic tool to find abnormalities in a sensitive non-invasive way of seen the brain, spinal cord and other areas of the body. Brain MRI can diagnose the Brain tumour, Blood clot, stroke and other abnormalities.Nowadays MRI images are very effective for doctor's diagnosis. Especially MRI brain image is used to diagnose many diseases that affect the brain including Brain Blood clot, Brain tumour, stroke etc. Blood clots are collection of sticky blood cells that form when blood vessels are damaged. The brain blood clot are enhanced by using histogram equalization [1] and segmented by using the segmentation method called watershed segmentation [2,10] and the clot part is detected by applying morphological operators in the segmented image [4-10]. Area and perimeter of the morphological brain blood clot image are calculated [3].

Literature Survey

Many researchers proposed many methods to detect brain tumour , cysts, stroke etc. such as Mussarat Yasmin, Muhammad Sharif, Saleha Masood, Mudassar Raza and Sajjad, proposed a system called 'Brain Image Enhancement - A Survey' [1] and This paper provides a short overview of different methods presented in the prospect of brain image enhancement. VRUSHALI D. DHARMALE & P. A. TIJARE, proposed a system called 'Cyst Detection in MRI brain image'[2] . This paper presents the brain image has been considered to detect the cyst. A simple method of segmentation and edge detection will be applied for

the purpose of detection. The analysis will be performed using different structuring elements of the medical image.

DibyenduGoshal, PinakiPratimAcharjya, have presented the system called 'MRI Image Segmentation Using Watershed Transform' [3] and This paper presents a robust procedure for segmentation and edge detection of MRI images based on marker controlled watershed algorithm. The efficiency and accuracy of the algorithm is demonstrated by the experiments on the MRI brain images. Experimental results presented in this paper are obtained by using MATLAB.

Laura Gui , RadoslawLisowski , Tamara Faundez , Petra S. Hüppi , François Lazeyras , Michel Kocher developed the system called 'Morphology-driven automatic segmentation of MR images of the neonatal brain' [4] and they proposed a different approach for the segmentation of neonatal brain MRI, based on the infusion of high-level brain morphology knowledge, regarding relative tissue location, connectivity and structure.

Ahmad El ALLAOUI and M'barek NASRI proposed a system called, 'Medical image segmentation by Marker controlled and Mathematical Morphology' [4]in this paper, they proposed a method of segmentation watershed by markers and morphological operation. It is able to segment real medicals images. The markers are used to control the watershed to obtain good results.

Miss. Roopali R. Laddha , Dr.Siddharth A. Ladhake, developed a system called 'Brain Tumor Detection Using Morphological And Watershed Operators' [5] and Swe Zin Oo, Aung SoeKhaing, proposed a system called 'Brain tumor Detection and segmentation using Watershed segmentation and Morphological operation' [6] . In both papers they proposed watershed Segmentation is one of the best methods to group pixels of an image on the basis of their intensities. The purpose ofthe morphological operators is to separate the tumor part of the image.

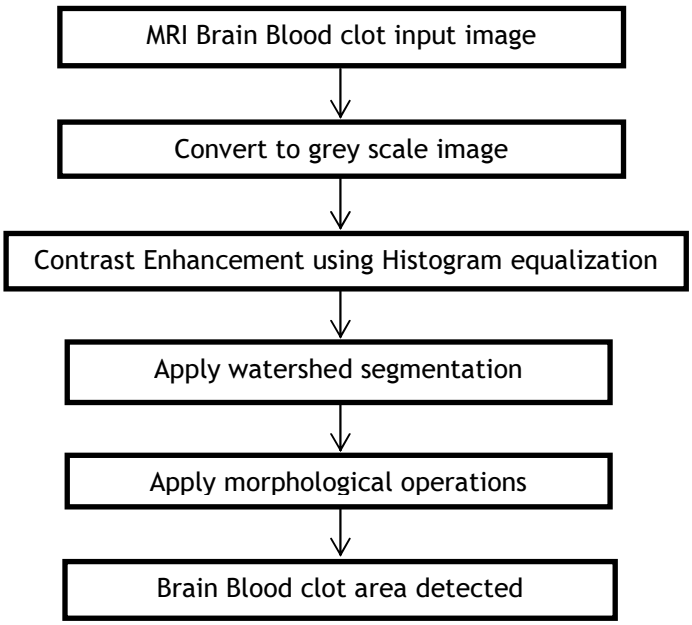
Vinay Parameshwarappa and Nandish S , have presented ' A Segmented Morphological Approach to Detect Tumour in Brain Images'[7] and Rohini Paul Joseph, C. Senthil Singh, M.Manikandan, proposed ' Brain Tumor MRI Image Segmentation and Detection in image processing' [8] and in these papers they usedimage enhancement techniques to enhance the contrast and normalize the pixel values in the image. after that some morphological operations to get the desired results.

Proposed Method

Image enhancement is a vast field in digital image processing. There exist many techniques to improve image quality. Histogram equalization is one of the techniques and equalizes the grey levels in digital image. This technique is essential for segmentation process. Each object is distinguished from the background by its up-lift edges. Morphological techniques probe an image with small shape or template called structuring element and all the morphological operators are based on this structuring element. These

operators are applied directly on watershed segmented image. The sequences of process involved in this paper are shown in block diagram.

1. **Block Diagram:**



2. **Pre-processing and Image Enhancement:**
   In this pre-processing process the input MRI brain image is converted into grey scale image and because segmentation and other process or based on gray scale values. Each pixel contains thevalue from 0 to 255 various intensity values such as black to white. resized for convenience. Histogram equalization method are one of the image enhancement method used to contrast the image. This is the process of equalizing all the grey levels in the digital image.
3. **Image Segmentation:**
   There are various ways to perform segmentation. Watershed segmentation method is used to segment the blood clot part from input MRI brain image. To overcome the over segmentation problem occur in watershed transform method marker controlled watershed segmentation is used.It can achieve one-pixel wide, connected, closed and exact location of outline. The basic concept of watershed is based on visualizing a gray level image into its topographic representation.
   Watershed segmentation Algorithm:
   - Step 1: Read the Image and Convert it to Grayscale
   - Step 2: Use the Gradient Magnitude

- Step 3: Mark the Foreground Objects
- Step 4: Mark the Background objects
- Step 5: Compute the Watershed Transform.
- Step 6: Visualize the Result

Watershed Transform

Watershed transform technique is applied on the gradient image. Three points should be identified for segmentation (i) points belong to regional minimum (ii) catchment basins of regional minimum (iii) watershed lines. The basic steps followed in this method are (a) select original image. (b) find out the gradient image of image (a). (c) watershed lines are obtained from image (b). (d) find out the connected regions (e) watershed lines are obtained from smoothed image (b).

Use of markers :

The over segmentation problem in watershed transform are solved by the use of markers. Internal markers are used to obtain watershed lines of gradient image which is to be segmented. The obtained watershed lines are refer as external markers. Therefore each region have external marker contains internal marker and its background. For this marker controlled segmentation sobel operator is used and its suitable for edge detection. The equation for marker controlled watershed segmentation is, M= (√Mx2 + My2).

Morphological operations :

Morphological operations are based on the structuring element. The structuring element is a small shape which positioned at all possible locations in the image and it is compared with the corresponding neighbourhood of pixels. Erosion and Dilation are the basic morphological operations which are applied on the segmented brain image. Dilation should be followed by erosion.

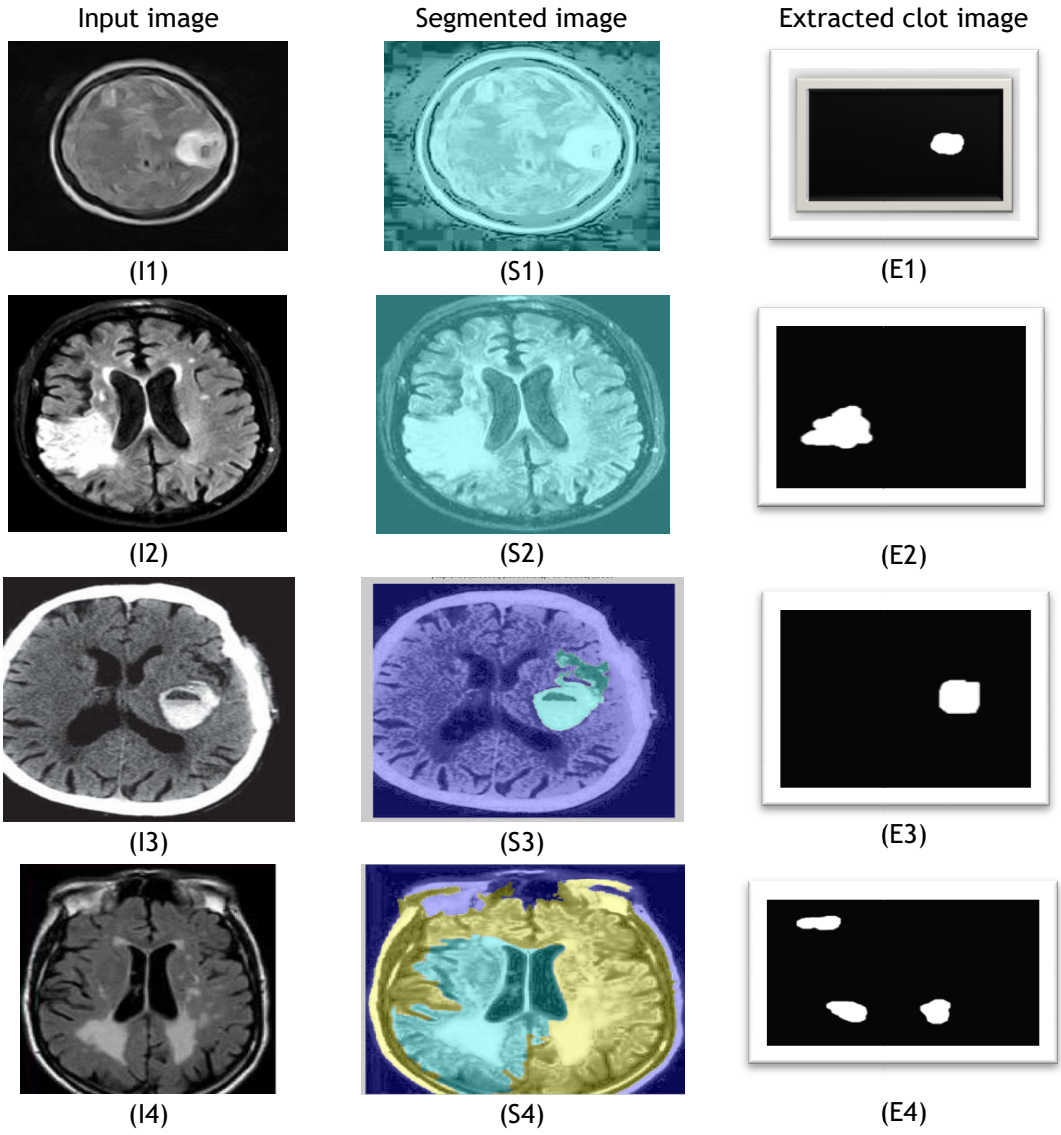
The erosion operator shrinks the image. The holes and gaps between different regions become larger, and small details are eliminated. The dilation operator grows the eroded image. Dilation and erosion are *dual* operations in that they have opposite effects. Both dilation and erosion operator denoted by g = f o s. Finally the area and perimeter of the dilated image are calculated.

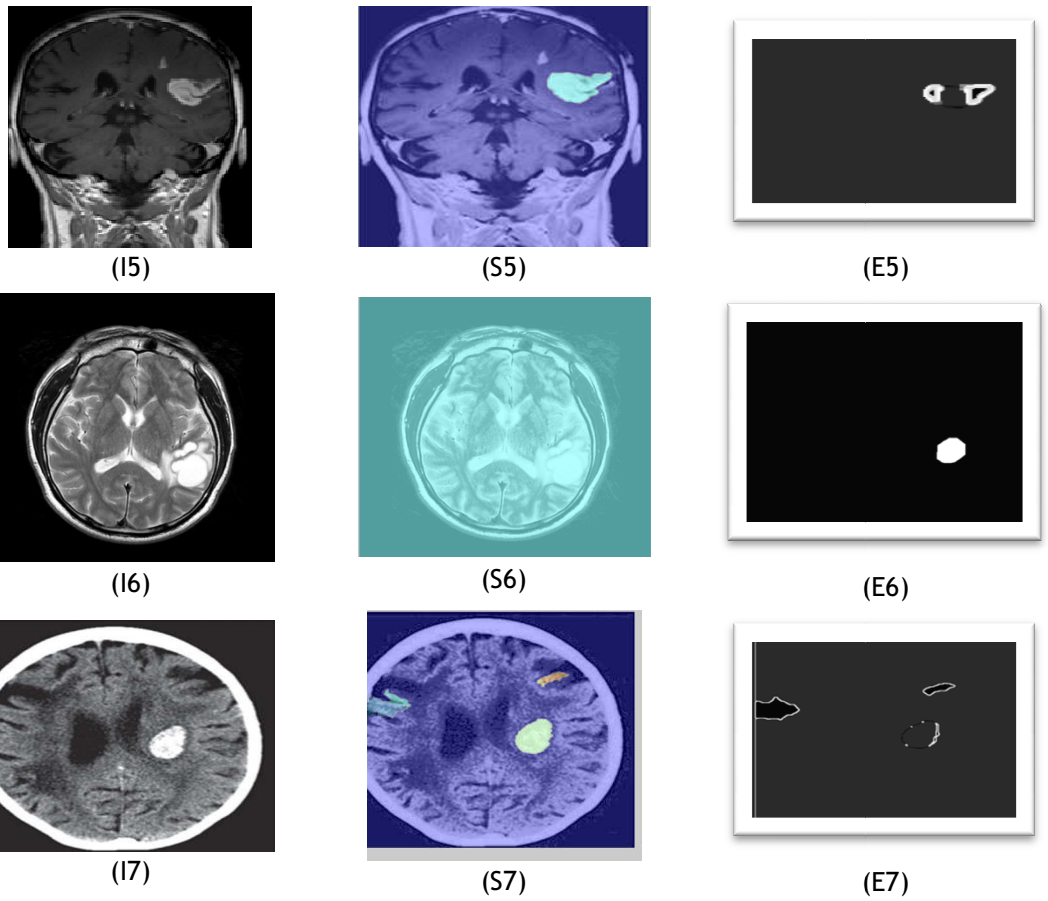
The area and perimeter morphological operator are used to find out area and perimeter of the dilated image. Finally the perimeter are merge into the original input image for highlight the blood clot part clearly.

Experimental Results and Discussions

The following are the results of seven sample MRI brain images. Detection and extraction of brain blood clot from MRI scan input image is done through the proposed

system. Blood clot is segmented and extracted from segmented image and its area is calculated and shown in the following figure.





In the above figure 4.13, the images I1 to I7 are the input image shown in the first column. The segmented images from S1 to S7 are shown in second column. This is the final segmented image of watershed segmentation. The extraction blood clot from the segmented image are from E1 to E7 are shown in third column. Morphological operation results are the extraction of blood clot from the segmented image.

If the input image is the RGB image then it should be converted into gray scale image. This is the first step in pre-processing. Contrast enhancement is applied after the conversion. Histogram equalization method is used to enhance the image and it looks brighter and the clot part is clearly visible now than the original input image. The watershed segmentation method is used to segment the enhanced image. Due to over segmentation in watershed transform method marker controlled segmentation is used for clot detection. After segmentation the erosion operator is applied to shrinks the clot part and by using dilation the eroded clot part is grows and the clot are clearly seen. In the last

process the area and perimeter are calculated and the perimeter outline is superimposed on the original image to show the blood clot part.

Conclusion

Blood clot detection from MRI Brain image are developed by using watershed segmentation technique and morphological operations. Both techniques are very useful to extract the abnormalities present in various images. Moreover, in future to develop a comparison of other segmentation methods and various morphological operators.

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