Segmentation of Brain Stroke Image

Abdulrahman Alhawaimil

Biomedical Engineering Department, University of Bridgeport, Bridgeport, CT, USA

Abstract: Stroke is the 4th leading cause of death in the US, with one person dying every 4 minutes as a result. Approximately 800,000 people have a stroke each year; about one every 4 seconds. Strokes occur due to problems with the blood supply to the brain; either the blood supply is blocked or a blood vessel within the brain ruptures. Due to the increase in misdiagnosis in medical for example misdiagnosis of stroke in brain. This Led to make correct medical diagnosis through many ways. However, it is not easy to correctly diagnose the stroke. In this paper our aim to present a foundational approach to assisting physicians when making medical diagnose for brain stroke. Brain stroke has been detected using image segmentation. The researcher use Matlab image processing software to analyze brain stroke image captured from magnetic resonance imaging (MRI).

Keywords: Stroke, Brain, Image Processing, Matlab and Segmentation.

I. BACKGROUND

The human brain is composed of 40% gray and 60% white matter. The gray matter is made up of about 100 billion neurons that gather and transmit signals while the white matter is made of dendrites and axons that the neurons use to transmit signals. There are different ways of dividing the brain anatomically into regions. The common method and divide the brain into three main regions based on embryonic development: the forebrain, midbrain, and hindbrain. It controls thoughts, memory, speech, and movement. It regulates the function of many organs. When the brain is healthy, it works quickly and automatically [1]. However, when problems occur, the results can be devastating. Brain diseases come in different forms: Infections, trauma, stroke, seizures, and tumors are some of the major categories of brain diseases.

A stroke is a sudden interruption in the blood supply of the brain. Most strokes are caused by an abrupt blockage of arteries leading to the brain (ischemic stroke). Other strokes are caused by bleeding into brain tissue when a blood vessel bursts (hemorrhagic stroke). Because stroke occurs rapidly and requires immediate treatment, stroke is also called a brain attack [2].

MRI is useful for imaging soft tissues such as the brain because it shows great details. It can detect minute differences, even between areas that are similar (unlike CT scans, which are useful in imaging bone and soft tissue, but with less detail). MRI can often demonstrate brain abnormalities which are too small or located in regions of the brain that cannot be seen well by CT scans.

There are many methods and programs used to segment medical image to help doctors to diagnostic the diseases. The most effective method to let the doctors analyze the disease or unmoral tissue is Image segmentation by using Matlab. Image segmentation is the identification and isolation of an image into regions that, one hope, correspond to structural units. The MRI brain image one of the most complex organs in the body, so the segmentation of brain is complicated task that can face the

expert [3]. Biomedical Images reveals the body structure which is contained soft tissues, organs and bones. Doctors cannot decide whether the disease has been growth or not with a normal biomedical image. Therefore, biomedical image analysis by image processing is so important to let the doctors know more details about the disease or abnormal growth. There are many different types to segment medical images by using matlab software such as thresholding and morphological [4]. Pixel-based and mropholigical method are types of image segmentation and they work in some kind of brain stroke. The most straightforward and common of the pixel-based methods is thresholding in which all pixels having intensity values above or below some level are classified as part of the segment. Morphological operations have to do with processing shapes. It has two basic morphological operations are dilation and erosion. In dilation, the center or active pixel is set to the maximum of its neighbors and in erosion it is set to the minimum of its neighbors. Both operations are nonlinear. They are not invertible transformations. One followed by the other will not generally result in the original image. From Erosion to dilation (Opening) is used to remove back ground artifacts. But dilatio to erosion is used to fill small holes and smoothens the object outline by filling up small gaps [5] [6].

II. METHODOLOGY

More than fifteen MRI images with brain stroke are analyzed using Matlab software. The images have same dimensions (256*256), width (256 pixels), height (265 pixels), horizontal and vertical resolution (96 dpi), and bit depth (24). The main and first process is pre-processing which is used to remove some features and to enhance the quality of image to make the next step which is segmentation easier. After pre-processing the images, the researcher did the segmentation by applying thresholding, and morphological method [7]. Finally, the researcher did post-processing for the images. Figure 1 explains the main steps of our project.
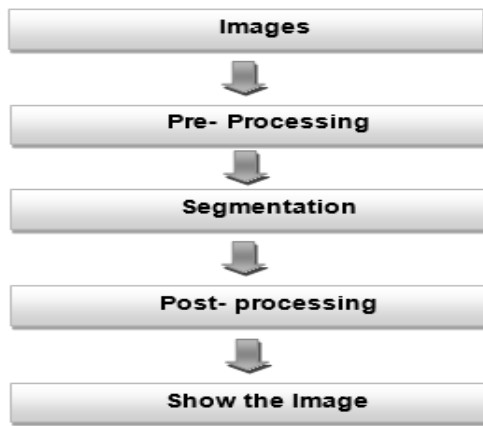
Fig. 1. Main Steps

III. PRE-PROCESSING

First, the researcher started with adjust image intensity values and contract enhancement by multiply image by constant which is 1.3. Before the researcher start segmentation processes, the researcher has to work to improve the quality of the image and remove the noise. Median filter is working fine to remove salt and pepper noise. Because it is less sensitive than linear techniques and it can remove salt and pepper noise without affecting of the sharpness of an image [8].

Pre-processing sequences had improved the image quality and the histogram as shown in figure 2.
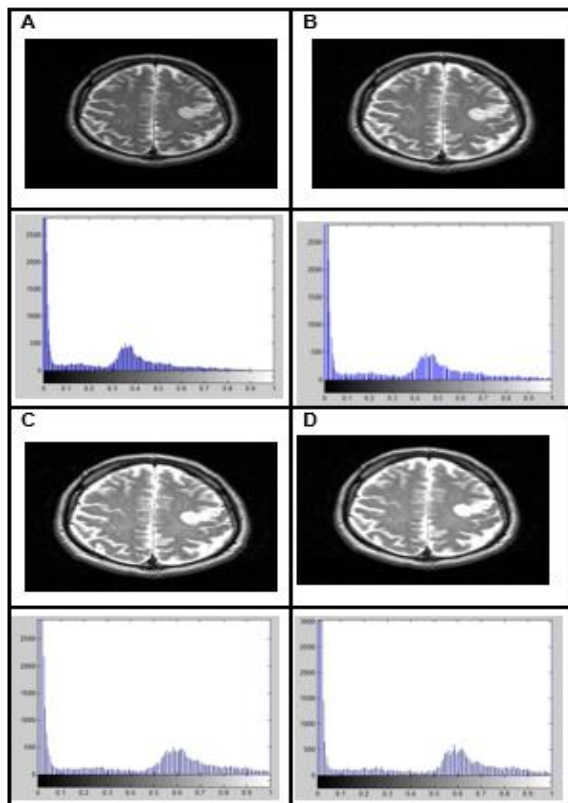
Fig. 2. A represented original image, B represented adjusted image, C represented enhanced image, and D represented Filter image

IV. SEGMENTATION PROCESS

1) Global Thresholding

There are many segmentation methods but thresholding is one of the most popular methods in which all pixels having intensity values above or below some level are classified as part of the segment. Also, in thresholding the image is changed from an intensity image to a binary image. The researcher sated threshold value to isolate the background and the stroke as figure 3. Most of the unwanted tissues or normal tissues are removed but there were some tissues and frames did not isolate. Therefore, the researcher have to apply another segmentation method on the images [9].
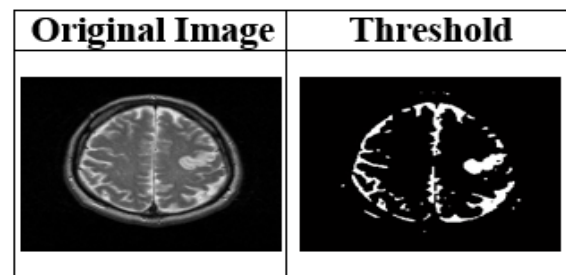

Fig. 3. Threshold value to isolate the background and the stroke

2) Morphological Operations

Morphological operations have to do with processing shapes as what you have. It has two basic operations dilation and erosion. In dilation, the center or active pixel is set to the maximum of its neighbors and in erosion it is set to the minimum of its neighbors. Erosion to dilation it is called Opening used to remove back ground artifacts but dilation to erosion it is called Closing used to fill small holes and smoothens the object outline by filling up small gaps [10]. Therefore the researcher decided to use closing method to fill small holes and smoothens the image as figure 4.
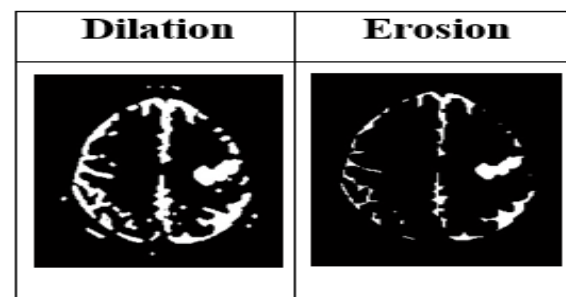

Fig. 4. Closing method, dilation then erosion

Most of the holes were filled but still some holes did not fill, so the researcher tried to use imfill which lead to filling holes in the image. It changes connected background pixels (0s) to front pixels (1s).

V. RESULTS

This project is designed to detect brain stroke by using Matlab program. The brain stroke detection has to with several steps started with post processing passing through segmentation methods and post processing.

In the pre-processing image adjustment (imadjust) is the first step to Adjust image intensity values. Image enhancement (immultiply) should be apply before applying any filter to decide which filter can be used in this segmentation sequences. Median filtering is a common image enhancement technique for removing salt and pepper noise. Because this filtering is less sensitive than linear techniques to extreme changes in pixel values, it can remove salt and pepper noise without significantly reducing the sharpness of an image (Ref). See figure 2-D.

 After the images were improved or in other word prepared to segment, thresholding is the first segmentation method that was applied to segment brain stroke. It is used to extract an object from its background by assigning an intensity value T (threshold) for each pixel such that each pixel is either classified as an object point or a background point. (Figure 3) shows the image after applying threshold. Another segmentation method has to apply to complete the segmentation sequence. Therefore, morphological operations are the best choice for our project. There are small holes needed to fill and the image needs to be more smoothens. Therefore, closing method which is dilation followed by erosion is the method that will help to fell small holes and smoothens the image (Figure 4). Moreover, the researcher applied imfill to filling holes in the images.

There are small objects are not related to the stroke, so the researcher used (bwareaopen) to remove them from a binary image all connected components (objects) that have fewer than P pixels, and producing another binary image. This operation is known as an area opening (Figure 5).
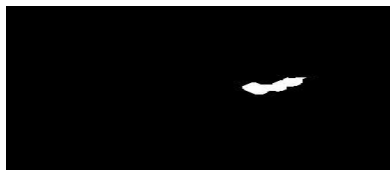

Fig. 5. Region of interest

VI. POST- PROCESSING

In post-processing the researcher calculated the brain stroke area in some of our MRI brain stroke images. This calculation let the doctors know more about the stroke size figure 6.
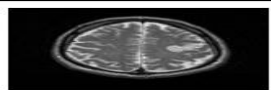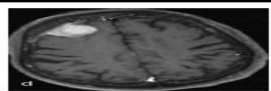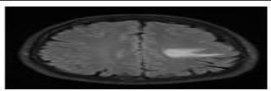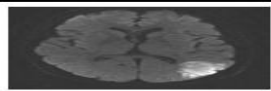

Image	Stroke Area
	427
	1500
	456.5
	1.8948e+003

Fig. 6. Stroke size

VII. CONCLUSION

This study presented a procedure for the segmentation of medical brain stroke images consisting of stroke. Brain stroke segmentation is a complicated process which consists of many different steps for segmentation process, including Pixel-Based and Morphological. MRI images are the best choice to study stroke in Matlab program because MRI device provides clear images with more details for the brain. These methods are able to detect several kinds of strokes in several positions in the brain. The researcher hope this project helps physician to detect the brain strokes in MRI images. Figure 7 shows the whole segmentation process.
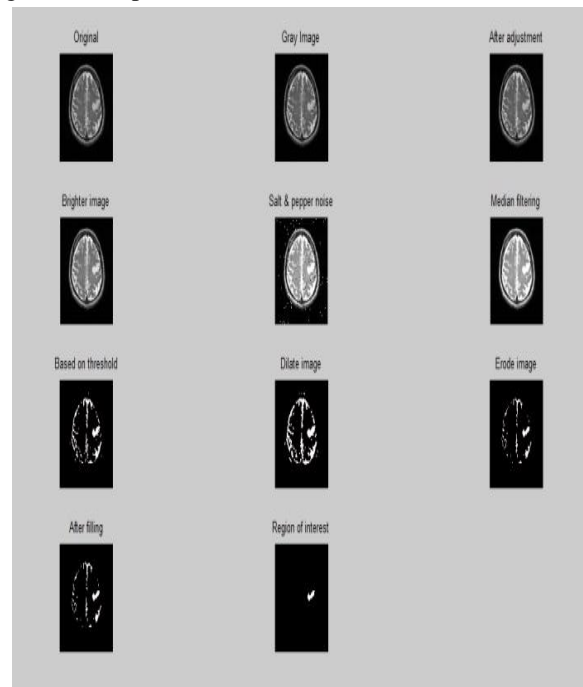

Fig. 7. Whole segmentation process

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BIOGRAPHY

Abdulrahman Alhawaimil got his BS, in 2008, from KSU, Riyadh, Saudi Arabia in Biotechnology and Bioinstrumentation. From October 2009 till December 2011 he worked for Philips Health care group as a field Engineer. He was in charge in maintenance team for CT scan systems. Abdulrahman Alhawaimil is MS student at University of Bridgeport, USA.