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A Segmented Morphological Approach to Detect Tumour in Brain Images

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Abstract— Image processing techniques are been widely used in medical imaging research. These techniques are useful for visualization, enhancements, segmentation and many more operations which are useful for processing medical images which maybe MRI, CT or any other images obtained through one of the imaging modality. One of the benefits of using these techniques is to detect any abnormality in the medical images. Some of these abnormalities include tumor, blocked vessels or sometimes broken joints. In this paper we are detecting one such abnormality observed in brain images. Using some of the classical image processing tools we are able to detect and segment tumors in the brain. The segmentation of brain tumors helps in knowing the exact size and shape of the tumor and the location. Firstly we have used some image enhancement techniques to enhance the contrast and normalize the pixel values in the image. Then we apply Fast Fourier Transform after that we have applied some morphological operations to get the desired results. The algorithm is been used on different images of the brain detected with tumor and has always given us the correct desired output.

Keywords— Visualization; Enhancement; Segmentation; Morphological Operations; Fast Fourier Transform.

I. INTRODUCTION

When a patient is been diagnosed with brain tumor it will be the beginning of a journey that nobody would like to undertake. The reason behind this is any brain tumor is inherently serious and life threatening. In the United States alone in the year 2013 there has been 23,130 cases of brain tumor detection and 14,080 deaths due to brain tumors. Brain tumor's are caused by the abnormal formation of cells within the brain. These cells may include the neurons or the glial cells which are the astrocytes and the ependymal cells. Sometimes they may be caused by cancers primarily located in other organs which are called as primary tumor. The different kinds of primary tumors are gliomas which are the most common type, secondly the meningiomas thirdly the pituitary adenomas and lastly nerve sheath tumors. Brain tumors are classified as bengin which are also referred to as non-cancerous or malignant which are referred as cancerous. The detection of brain tumor depends upon two important factors firstly the tumor size and secondly the tumor location. The symptom starts with the development of the neoplasm which mainly depends on the nature of the tumor. Sometimes in many cases it is also related to the change of the neoplasm from bengin to malignant. Some of the other common symptoms include headache, optic disc in the eye, behavioural impairment, vomiting and sometimes in children the changes in the diameter of the skull. Recently the world health organization as declared the use of cell phones also to the cause of brain tumors but there is no record for this cause [11].

Treatments such as the chemotherapy, radiotherapy and also surgery are carried out against brain tumor. When a brain tumor is diagnosed a medical team is formed to asses the condition and treatments to the patients. Before a final decision is been taken on the brain tumor the surgeons look carefully at the evolution of the neoplasm and the various treatments which may depend on the neoplasm type and location. In these cases imaging plays a crucial role in the treatment of brain tumor. Imaging gives an extraordinary view of the presences of the brain tumor to the physicians or the surgeons [11].

In this paper we have developed an algorithm which is able to detect the tumor within the brain in images which are obtained through magnetic imaging resonance (MRI) or computed tomography (CT). The images which are obtained through these modalities are in a standard format that is digital imaging and communication for medicine (DICOM). This is a standard format for all the medical images. It was developed by the national electronic manufactures association. This standard format is mainly used for storing, printing and transmitting information in medical imaging. These images are taken and converted into grayscale images for pre-processing which include some of the imaging enhancement techniques and later on post processing which include morphological operations. Morphological operations here play the central part in the detection of the tumor. In image processing morphological operations are used for analyzing and segmentation of different patterns in an image. Therefore by using this algorithm we are able to segment the tumors and also we are able to clearly observe the shape of the tumors.

II. LITERATURE SURVEY

Brain tumors are well known from the beginning of the 18th century. From then on being a period on researching on the various aspects of brain tumors. A lot of treatments are known to come and go from that period onwards. Later in the 19th century lot of societies and research institutes where set up in order to find imaging and treatment methods. Societies like The Brain Tumor Research Centre set up by Charles Wilson are doing various researches on tumor

detection and treatments. Automatic segmentation algorithms are been developed recently to detect tumors within the brain. The images that are obtained through Magnetic Resonance Imaging or the Computed Tomography are taken to analyze the brain tumor. Some of the effects that are observed in these images which are taken either through MRI or CT may have artifacts, low contrast making the detection of brain tumor uneasy or noise present in those images. Hence it can be said that imaging here plays a central role in the segmentation or detection of brain tumor.

Many imaging techniques are been used to detect tumors within the image. Algorithms like K-clustering or fuzzy are been used to segment brain tumors. The existing method is based on thresholding and region growing. When these methods were applied there are few disadvantages such as the thresholding method ignored spatial characteristics which are important for malignant tumor detection. Whereas in the region based segmentation it needed more user interaction for the selection of seed. Due to these drawbacks these techniques are not been widely adopted [2].

(a) (b)

Figure 1: (a) Original Image (b) Image after threshold technique

III. METHODOLOGY

The below figure 1 shows the proposed methodology involved in tumor detection.

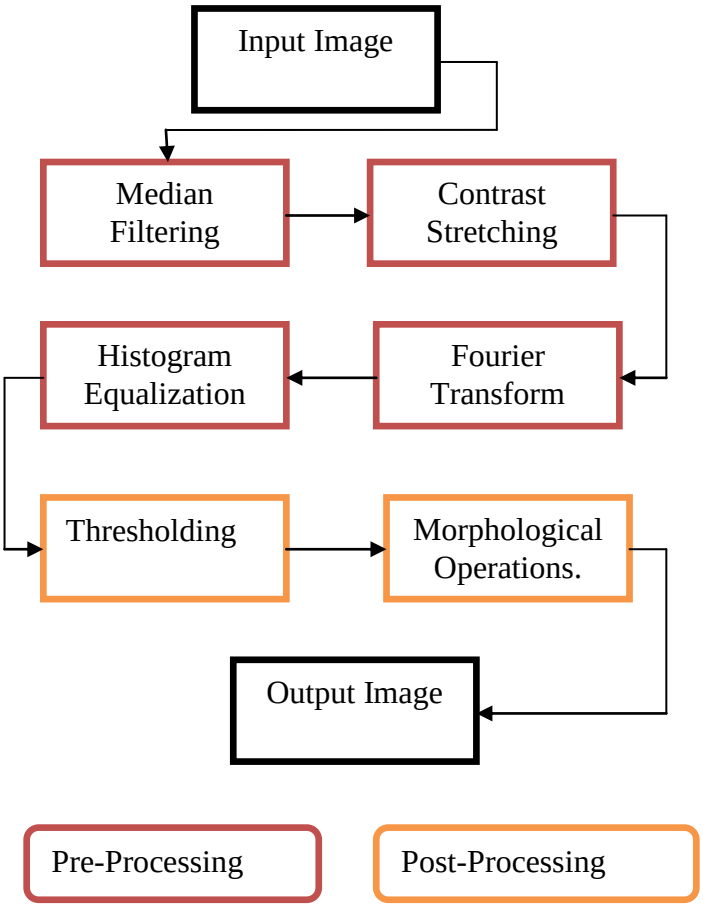

Figure 1 Flowchart of the proposed algorithm

Image processing has been one of the useful tools for processing of medical images and its use and benefits are rapidly growing in this advanced technical world. Using some of the image processing techniques we are able to develop an algorithm which is useful for detecting abnormal formation of the cells in the brain. Here we present an approach that detects the tumor within the brain. In this proposed algorithm we have applied a series of operation first some image enhancement techniques and then morphological techniques to detect the tumor in the brain. Firstly we have taken an image and enhance its contrast. Most of the medical imaging processing algorithm begin with enhancing the contrast of the image. This helps us to normalize the pixel values, removing noise and some artefacts which are sometimes observed in medical images. Here in this paper we have used some contrast stretching techniques. This improves the interpretability of information in images for human viewers. Image enhancement techniques are been classified into two broad categories which are the spatial domain and frequency domain methods. In spatial domain processing, all the pixels composing in the image are considered and different procedures are applied on the image. Some of the procedures that are involved in spatial domain method include point processing, image subtraction, image averaging and spatial filtering. Frequency domain method operates on the Fourier transform of an image. Some of the Fourier domain methods include low pass filter, high pass filter, pseudo colour image processing[1][6][9].

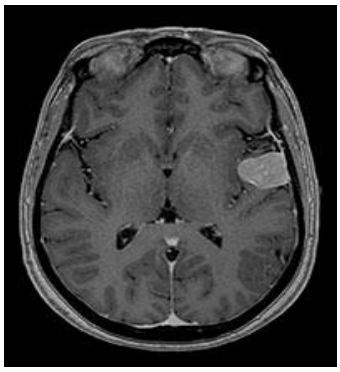

Figure 2 MRI brain image- Input Grayscale Images

For enhancement first we apply a non linear filter (median filter). Median filter is a popular non linear filter and it works by sorting the pixel values within the neighbourhood, finding the median value and replacing the original pixel value with the median of that neighbourhood. Then we use contrast stretching method to adjust the intensity values in an image [1][4][6].

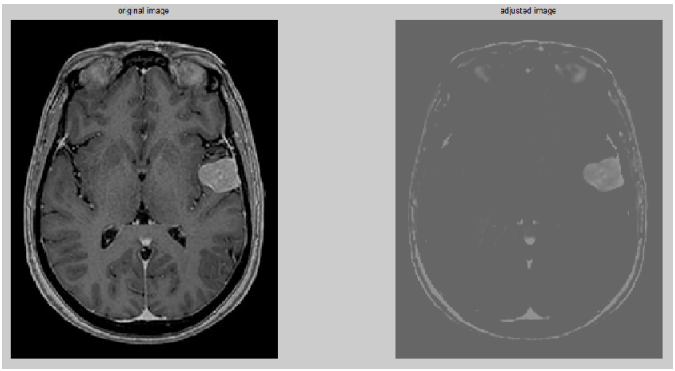

Figure 3(a) Image after applying median filter, (b) Image after contrast stretching.

After image enhancement using median filtering and contrast stretching, resultant image is transformed into frequency domain using fast Fourier transformation. Now we apply a Gaussian high pass filtering using distance matrix to the enhanced image. The use of high pass filtering in our algorithm is used for preserving or emphasizing its high frequency components, that is to highlight the transitions in intensity within the image[6][9].

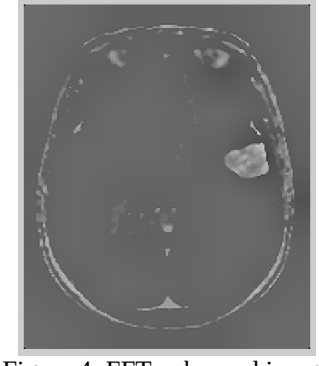

Figure 4: FFT enhanced image

After the application of frequency domain method we then apply histogram enhancement technique. This is the technique that can be used to improve the visual appearance in an image. We have applied the histogram enhancement technique to the FFT image with the objective to have a uniform intensity throughout [1][8].

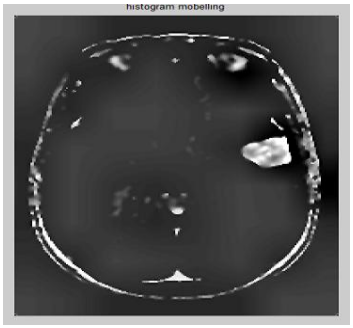

Figure 5: Histogram Enhanced Image

After we have got the uniform intensity values throughout the image by using histogram techniques the next step in our proposed methodology is image thresholding. Thresholding is a common technique in image processing on images in which they are relatively fewer objects of interest whose shape is more important than surface properties. Here we using thresholding as a segmentation algorithm to segment the image's desired part, in this case the tumor we want to segment. Here we first analyze the histogram of the image obtained after histogram enhancement technique. After analyzing the image histogram we select an appropriate value for T , threshold value. We then apply the selected value to the image [5][6][7].

Figure 6:Image after Threshold

After segmentation of abnormal regions using thresholding we then apply a series of morphological operations. Morphological operation is a branch of image processing which is used for representing, describing and analyzing shapes in the images. The basic neighborhood structure that is associated with the morphological operations is the structuring element. In morphological operations structuring elements plays vital role in the result. They shape and size impacts the results of applying a certain morphological operator to an image. In the algorithm first we apply Erosion, whose effect is to shrink or thin objects. This operation is controlled by the size and the shape of the structuring element. Then we apply dilation, whose effect is to grow or thicken objects. The structuring element plays a central role in this operation too. Then we apply the operations which are made by the combination of these basic operations (erosion and dilation) such as opening and closing operations [3][8].

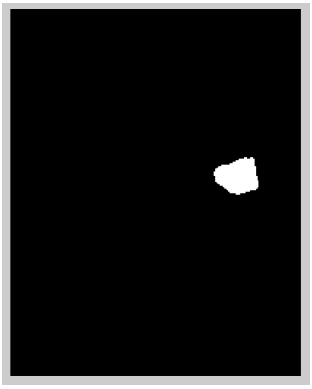

Figure 7: Output image

After the application of these morphological operators we are able to clearly distinguish the tumor within the brain. The output image clearly shows the tumor and its shape is clearly outlined.

IV. CONCLUSIONS

In this proposed work we acquire an MRI image of the brain and perform a series of operations to enhance the quality of the image and then to segment the tumor within the brain. This algorithm is able to segment tumors clearly and able to outline the shape and location of the tumor. This in turn helps the physician or the doctor to analyze the tumor shape and size since the shape and size of the tumor plays a vital role in the treatment to the tumor. In the future we will address simple algorithms to calculate the area and the thinness of the Tumor. We will also use simple algorithms to calculate the location of the tumor

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