Research Paper Medical Science

Brain Tumor Detection from Clinical Ct and Mri Using Wavelet Based Image Fusion Technique

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ABSTRACT

Accurate detection of size and location of brain tumor plays a vital role in the diagnosis of tumor. This is essential as it helps the surgeon to plan the course of treatment. Segmentation and detection of specific regions of brain containing the tumor cells is considered to be the fundamental problem in image analysis related to tumor detection. Use of medical imaging techniques such as image fusion is one step towards the solution of this issue. In this paper, we propose an efficient wavelet based algorithm for tumor detection which utilizes the complementary and redundant information from the Computed Tomography (CT) image and Magnetic Resonance Imaging (MRI) images. Hence this algorithm effectively uses the information provided by the CT image and MRI images there by providing a resultant fused image which increases the efficiency of tumor detection. The main features taken into account for detection of brain tumor are location of tumor and size of the tumor.

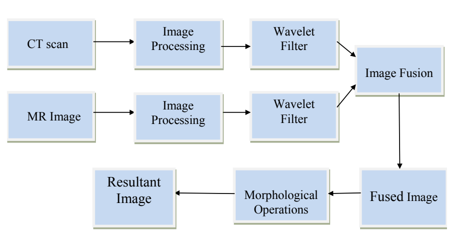
KEYWORDS Tumor detection , Segmentation, Morphological Operations , Wavelet Transform.

Introduction

Main aim of all image processing techniques is to recognize the image or object under consideration easier visually. The main emphasis of the latest developments in medical imaging is to develop more reliable and capable algorithms which can be used in real time diagnosis of tumors. Brain tumor is caused due to uncontrolled growth of a mass of tissue, which can be fatal among children and adults. Depending on the origin and growth, brain tumor can be classified into two types: 1) primary brain tumor is developed at the original site of the tumor 2) secondary brain tumor is the cancer which spreads to the other parts of the body. The detection of brain tissue and tumor in MR images and CT scan images has been an active research area. Segmenting and detection of specific regions of brain containing the tumor cells is considered to be the fundamental problem in image analysis related to tumor detection. This method seeks to bring out the advantages of segmentation of CT scan images and MR images through image fusion. Image fusion is one of the most commonly used methods in medical diagnosis.It merges the multimodal images to provide additional information. Medical imaging image fusion, usually involves combining information of multi modalities such as magnetic resonance image (MRI), computed tomography (CT), positron emission tomography (PET), and single photon emission computed tomography (SPECT). Image fusion is more general solution to a number of applications in image processing where high spatial and spectral information are required in a single image. Wavelet transforms is a new area of technology, replacing the Fourier transform in different fields of application like image processing, heart-rate and ECG analysis , DNA analysis, protein analysis , climatology , speech recognition , computer graphics and Multi fractal analysis . The proposed method utilizes wavelet analysis based image fusion to enhance the efficiency of brain tumor detection. Wavelet transform allows the components of a non-stationary signal to be analysed whereas Fourier Transform fails to analyse a non-stationary signal. Wavelets allow complex information such as speech signals, images and patterns to be decomposed into elementary forms at different positions and scales and subsequently reconstructed with high precision.

In this method, the MRI and CT image are processed using wavelet analysis. Image Fusion is applied by merging multiple images resulting into precise information about the size, shape and location of the tumor. Before applying image fusion, the source images must be pre-processed through various Image enhancement techniques. The Image enhancement techniques involve point operations, mask operations, and global operations which sharpen image features for efficient analysis. In this paper various results are obtained by changing the wavelet used for decomposition. The paper further discusses the variation in result on changing the parameters of wavelet transforms used for the decomposition.

The block diagram represents the entire process.



Literature Survey

1. Huaxun Zhang, Xu Cao[5] has introduced a way of medical image fusion based on wavelet theory. Medical image fusion have three steps, they are image processing, image registration and image fusion. In the paper, image processing get across multi resolution characteristics of wavelet to de-noise, image registration pass the wavelet analysis to gain biggish change point and receive image edge to achieve quick and nice superposable, image fusion use disassemble image to different frequency sub band to save all information to have a perfect fusion. Simulation experiment proved it has advantages of simply calculation, fast superposition and perfect fusion in medical image fusion.

2. Tariq A. Alshawi, Fathi E. Abd El-Samie, Saleh A. Alshebeili[6] in their paper have explored image fusion using Empirical Mode Decomposition (EMD) for medical imaging purposes. In particular, Bidimensional Empirical Mode Decomposition (BEMD) is used to analyze Magnetic Resonance (MRI) and Computed Tomography (CT) Images and the generated Bidimensional Intrinsic Mode Functions (BIMFs) are fused using simple fusion rules. Results of BEMD-based fusion are reported and compared with two other fusion techniques: Curvelet Fusion and Wavelet Fusion. Performance of BEMD is evaluated using perceived quality as well as using three popular image fusion quality metrics; namely, Peak Signal-to-noise Ratio (PSNR), Structure Similarity Index Metric (SSIM), and Mutual Information parameter (MI).

3. Mostafa Amin Naji, Ali Aghagolzadeh[7] in their work has proposed an efficient and simple image fusion method using improved variance criteria. The proposed method uses sharpened input images to make a larger difference between the variance of the corresponding input image's blocks. In addition, by adjusting two threshold values for recognizing the corresponding blocks which have close variance values, the quality of the output image is enhanced significantly. The results of conducting the proposed algorithm with gray-scale multi-focus images and evaluating the performance of the proposed method in comparison with the well-known methods are done. Finally, they demonstrate the simplicity of applying method proposed on color multi-focus images.

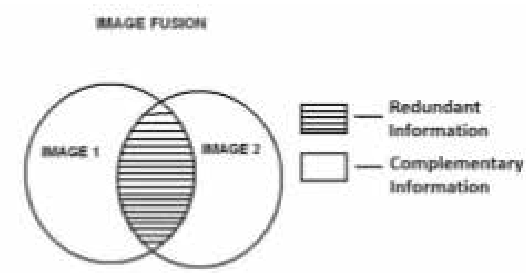
4. Yoonsuk Choi*, Ershad Sharifahmadian, Shahram Latifi[8] in their work has analyze and compare the performance of fusion methods based on four different transforms: i) wavelet transform, ii) curvelet transform, iii) contourlet transform and iv) non sub-sampled contour let transform. Fusion framework and scheme are explained in detail, and two different sets of images are used in experiments. Furthermore, eight different performance metrics are adopted to comparatively analyze the fusion results. The comparison results show that the non-subsampled contourlet transform method performs better than the other three methods, both spatially and spectrally.

5. Yong Yang, Shuying Huang developed the algorithm[9] by modifying the objective function of the standard FCM algorithm with a penalty term that takes into account the influence of the neighbouring pixels on the centre pixels. The penalty term acts as a regularizer in this algorithm, which is inspired from the neighbourhood expectation maximization algorithm and is modified in order to satisfy the criterion of the FCM algorithm. The performance of algorithm is discussed and compared to those of many derivatives of FCM algorithm. Experimental results on segmentation of synthetic and real images demonstrate that the proposed algorithm is effective and robust.

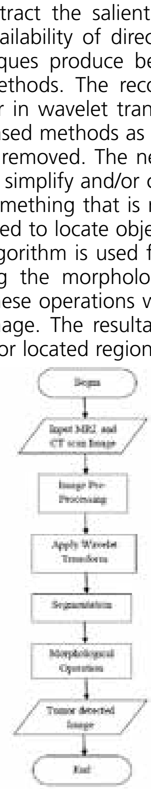
PROPOSED METHOD

In this paper, the CT and MRI images are fused to detect tumour. Fused images can be created by combining information from multiple modalities, such as magnetic resonance image (MRI) and computed tomography (CT). Both types of images play specific important roles in medical image processing. CT images are used more often to ascertain differences in tissue density depending upon their ability to block X-rays while MRI provides good contrast between the different soft tissues of the body, which make it especially useful in detecting brain tissues, and cancers.

In the first step, Image pre-processing techniques are applied on the source images i.e. MR image and CT scan image to increase the contrast, brightness. This involves de-noising of the images. It is done by using wiener filter that removes salt and pepper noise. Main aim of image de-noising is noise reduction and feature preservation. In the next step, wavelet transform is further applied on these images by passing the processed images through the respective wavelet filters. In wavelet transform the image signal is divided into wavelets representing each pixel of the original image as co-efficients. The wavelet transform is applied on the source images with different wavelets such as Daubechies, Symlets, and Coiflets in order to try and obtain optimum results. Image signals are broken down layer by layer decomposition process.4 subbands are obtained at 1st level. Low-Low, Low-High, High-Low, High-High. Once the decomposition is done, the two images are fused. Fusion can be performed either by taking the average of the coefficients either the minimum of the coefficients or maximum of the coefficients. In this paper, fusion is performed by taking the absolute maximum of the coefficients as the larger Coefficients correspond to sharper brightness changes thus making the salient features visible. Thus fusion takes place in all resolution levels and the prominent features at each scale are preserved. The resultant image is formed by performing inverse wavelet transform. The wavelet transform technique of image fusion allows us to effectively



extract the salient features of the input images due to the availability of directional information. Thus the wavelet techniques produce better results than Laplacian pyramid based methods. The reconstruction of the final image is also better in wavelet transform technique than in Laplacian Pyramid based methods as errors such as blocking effects are effectively removed. The next step is Segmentation, where the goal is to simplify and/or change the representation of the image into something that is more meaningful and easier to analyse. It is used to locate objects and boundaries in an image. Watershed algorithm is used for segmentation. The final step is performing the morphological operations like erosion and dilation. These operations will remove any imperfections present in the image. The resultant obtained will be the most probable Tumor located region.



CONCLUSION

In this paper we propose a new segmentation method to identify and locate the tumor in the human brain from clinical images, especially from MRI and CT images. Medical imaging helps us to learn more about neurobiology and other human behavior. This method will segment the clinical MRI and CT image even in presence of noise.

RESULTS

First, we take the inputs i.e CT Scan and MRI and Pre-process these images (as shown in fig 5.1).

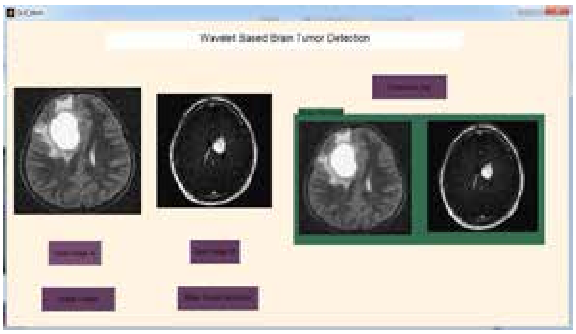


Fig 5.1

Next, we perform the image fusion where one image is placed over the other (as shown in fig 5.2).

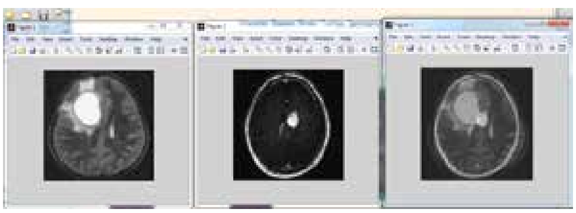


Fig 5.2

The fused image is converted to binary and the segmentation is performed (as shown in fig 5.3).

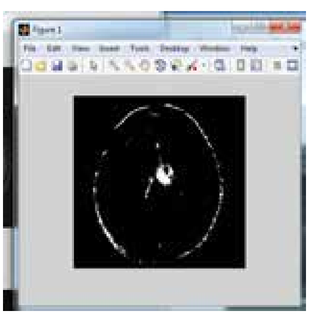


Fig 5.3

Based on the intensity of the pixels the tumor region is detected (as shown in fig 5.4).

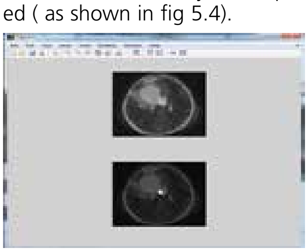


Fig 5.4

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