Detection of Brain Tumour by Image Fusion Based on Discreet Wavelet Transform

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ABSTRACT

For the past few years, Image processing has evolved into various dimensions especially in the medical field. We utilize the multi scale decomposition of brain image which is done by discreet wavelet transform for fusing the images in its frequency domain. It decomposes an image into two different components like structural and textural information. It doesn't down sample the image while transforming into frequency domain. So it preserves the edge texture details while reconstructing image from its frequency domain. It is used to reduce the problems like blocking, ringing artifacts occurs because of DWT. The low frequency sub band coefficients are fused by selecting coefficient having maximum spatial frequency. It indicates the overall active level of an image. The high frequency sub band coefficients are fused by selecting coefficients having maximum code value. Where as in brain tumor detection using wavelet transform both CT scan and MRI scan is used, where CT refers to "Computed Tomography" which uses different X-ray images taken from different angles of an specific part of an human body and also provides the detailed information about the internal structure of an human body and MRI scan refers to "Magnetic Resonance Imaging" use strong magnetic fields, radio waves and field gradients to generate images of the inner human body. Finally, fussing two varied frequency sub bands are taken inverse transformation to reconstruct the fused image. The system performance will be evaluated by using the parameters such as Peak signal to noise ratio, correlation and entropy. To finally segment the tumor part by applying Fuzzy C-Means Clustering.

KEY WORDS -Brain tumour, discreet wavelet transform, Inverse discreet wavelet transform, Contrast based image fusion, Spatial domain based fusion, Fuzzy c-means clustering.

1. INTRODUCTION

Brain tumor is a mass of abnormal cells in your brain. Skull is a part which encloses the brain it is very rigid. Growth inside those regions can cause any serious problems. Brain tumors can be of two types cancerous (malignant) or non-cancerous (benign). When benign or malignant they cause pressure inside your brain. This leads to brain cancer and leads to damage in brain.

Brain tumors are categorized as primary or secondary. Most of the brain tumor which are primary are said to be Benign. A secondary brain tumor which is also known as a metastatic brain tumor, this happens when cancer cells from other organ (such as your lung or breast) gets accumulated in your brain. Image processing is a method which is used for performing several operations on an image, for acquiring an enhanced image or to acquire some useful information. We use image processing to detect brain tumor along with the discreet wavelet transformation. Image processing is a signal processing type in an image is taken as input and output may be image or characteristics/features associated with that image. Here we have a database which consists of Brain image of MRI and CT scans of both normal and abnormal brain (affected by tumor). Currently, image processing is one of the rapidly growing technologies. It is an important research area in computer science and engineering.
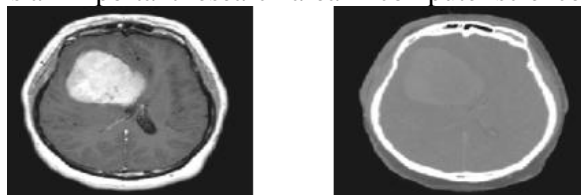

Figure.1. Sample MRI and CT images

The need for fusing the images of MRI and CT scan is that the image which is fused provides more complete information. This is more useful for understanding for both humans and for machines. The final image will be more informative than any other images.

Techniques used:

Discreet wavelet transform: Discreet wavelet transformation is a local transformation from the time domain and frequency domain. It generates different resolution images very easily. It decomposes or divides the main image into 4 different sub bands namely, LL, LH, HL and HH. The High Frequency sub band contains the clear and exact edge information of the input image and LL sub band contains the clear information of the image.

Fuzzy c-means: Fuzzy c-means (FCM) is a clustering method which allows one piece of a data to belong to one or more clusters apparently. This method is also used in pattern recognition also. We use Fuzzy C-Means technique to segregate the brain details into 4 different co-ordinates namely, Tumor cells, cancer cells, Tissues and Noise.

Inverse discrete wavelet transform: The inverse Discrete Wavelet Transform decodes an image into the spatial domain from a representation of the data better suited to compaction. IDWT-based decoding forms the basis for current image and video decompression standards

Contrast based fusion method: Wavelet multi-resolution expression maps the image into various level of pyramid structure of wavelet coefficient which is based of scale and direction. To implement this scheme, we have to first construct the wavelet coefficient pyramid for the two input images that are chosen. Next is to consolidate the coefficient information of the corresponding level. At last, apply inverse wavelet transform using the fused coefficient.

Spatial domain based fusion: Spatial domain based fusion techniques are based on grey level mappings, depending on the criterion chosen for enhancement the type of mapping is fixed. For an example, consider the problem of enhancing the contrast of an image. Let a and b represent any grey level in the originally taken image and the enhanced image. The spatial domain is the normal image space; here if we change the position in the image it changes the position in the scene also. This also includes the pixel difference corresponding to the real and the scene. We use this concept in frequency with which even the values of the images change. One would refer to the number of pixels over which a pattern repeats (its periodicity) in the spatial domain.

2. RELATED WORK

For the past few years, we have been observed a rapid growth in medical image processing. We use this rapidly growing technology in the cerebral region to detect Brain Tumor Cells. Several methods are used for efficient detection of brain tumor from cerebral MRI and CT images. We have listed out our observations from various paper's we referred (Ahmed Kharrat, 2009). The basic phenomenon includes three main steps: Enhancement, segmentation and classification. The major reason behind the enhancement phase is to reduce the risk of two different regions getting fused. At times Mathematical morphology is used to increase the contrast in MRI images so that we can acquire more details. Then various transformation techniques are used to decompose MRI images which also include the process of segmentation. This is used to separate the tumor cells, tissues, cancer cells and noise. Finally several algorithms are used eg:K-means classification is used to extract the affected tumor region accurately (Bhakti Potdukhe, 2016). Wavelet transformation is a technique used in deducting the brain tumor along with Gabor wavelet transform. Gabor filters transform is an excellent resolution approach which represents the character of an image in an effective way using multiple direction and scales. It has a spatial characteristic that is similar to human perceptual vision, hence it provides researchers a good chance to use it in DIP (Dina Aboul Dahab, 2012). At times the main issues is to identify the tumor cells. In order to overcome that issue an approach is used. It is related to an integrated set of image processing algorithms, the other is based on improved method known as probabilistic artificial neural networks structure. Here they also use the image processing algorithm this is based on a modified canny edge detection algorithm. Simulation using this algorithm accurately detect and identify the contour of the tumor. But its computational time and accuracy is less when compared to other corresponding algorithms (Eman Abdel, 2015). When it comes to medical diagnosis, the best ever imaging technique is currently CT and MRI. MRI is the is a effective image model used to diagnose brain tumor. The MRI is more informative than CT scan for the brain tumor better than CT. On the other hand, K-mean algorithm can detect a brain tumor faster than Fuzzy C-means, but Fuzzy C-means can predict tumor cells accurately. The quantitative comparative analysis of the performances are based on using 5 different measures of effectiveness. These metrics were based on measuring information content, Fusion Methods Total Probability Density Function (TPE) Principal Component Analysis (PCA) Laplacian Pyramid Filter-Subtract-Decimate Hierarchical Pyramid (FSD) Ratio Pyramid Gradient Pyramid Discrete Wavelet Transform (DWT) Shift Invariant Discrete Wavelet Transform (SIDWT) Contrast Pyramid Morphological Pyramid Bio-inspired measures of contrast. (Jorge Nunez, 1999) Additive wavelet-based methods have fetched best results for image merging better than any other standard techniques based on component substitution (Mohammad Bagher Akbari Haghighat, 2011). DCT based fusion technique for multi-focus images were proposed. Variance is considered as a proper contrast measure in multi-focus images, which leads to better quality of the fused image. Various experiments have been conducted and the fusion performance were analysed. The results show that the proposed method outperforms the previous DCT based methods both in quality and complexity reduction (Pandey, 2014). In the field of digital image processing, the algorithm has two stages to follow, first stage is the pre-processing of the given MRI image and then segmentation and then morphological operations (Pratibha Sharma, 2012). Yet another method includes the following steps, it starts with the acquisition of the MRI scan of brain and then the digital imaging techniques are applied to exactly locate the size of tumor. To increase the image quality, Pre-processing of MRI images is the primary step which perform image enhancement and noise reduction techniques (Roopali Laddha, 2014). The quality of the image can be improved by removing noise in the image, researches were held to detect brain tumor by medical imaging techniques. The main technique used was Text Noise Removal & segmentation (Selvaraj Damodharan, 2015). In this work, an even more efficient NN based brain tumor deduction method is used with the MRI images of brain (Sonali Wadgure, 2014). It is already proved that the output of the K-Means algorithm is based on the initial seeds number as well as the final clusters number. In order to avoid issues K-Means based

FCM clustering is suggested (Swapnali Sawakare, 2014). In 1990, Donald F. Speech, proposed a method to formulate the weighted-neighbor method in the form of a neural network. He called this a "Probabilistic Neural Network" (Varsha Kshirsagar, 2014). Automation of brain tumor detection and segmentation from brain MRI images is the most important research area. There are so many researches being conducted in this field for past few years (Vipin Borole, 2015). Image segmentation is the process in which a digital image is partitioned into multiple segments. Image Segmentation is typically used in MRI images are best suitable for brain tumor detection. The can segment the tumor part separately from the normal brain part. Digital Image Processing Techniques are important for brain tumor detection by MRI images. The preprocessing techniques include different methods like Filtering, Contrast enhancement, Edge detection is used for image smoothing. The preprocessed images are used for post processing operations like; threshold, histogram, segmentation and morphological, which is used to enhance the images (Vishal Shinde, 2014). Segmentation of brain image is the final stage. It segregates the tumor part from the brain region. It is imperative in surgical planning and treatment planning in the field of medicine.

Proposed Method: In this paper, we have proposed a method to detect brain tumor by multi focus image fusion using discrete wavelet transform (DWT), inverse DWT (IDWT) and to segment the tumor part we use Fuzzy C-means clustering. Image fusion is the process of selecting the useful and accurate information from the individual source images. It is important to preserve the quality of the source images. Preserving the quality plays a major role in the image fusion technique. In this paper, we will enhance the source images before fusion, to enhance the source images we will use the wavelet transform.
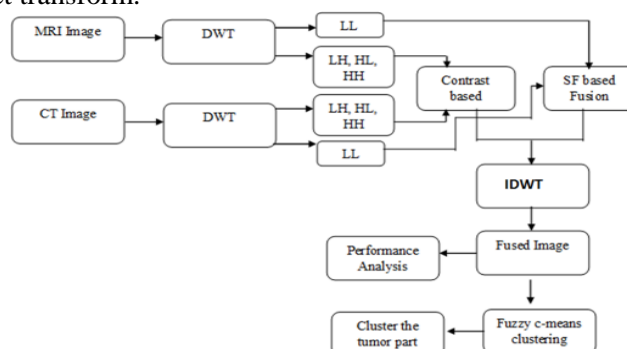
Figure.2. Block diagram for proposed system

Explanation for the block diagram: The MRI and CT scan of a person who is affected by a brain tumor is taken from the database. The DWT technique is applied to both the MRI and CT scan images, DWT technique splits the scan images into four side-bands namely low-low, low-high, high-low, high-high (LL, LH, HL, HH). The spatial frequency image fusion method is applied to LL bands. In spatial frequency, we can use two techniques namely "maximization" and "averaging". In the maximization process, highest frequency of two images (i.e. MRI and CT) is compared and the highest frequency is taken as output for further processing. In the averaging process, lowest frequency of two images (i.e. MRI and CT) is taken and average operation is performed and can be used for further analysis. For LH, HL, HH bands, we are using contrast based technique. In the contrast based technique we will generate histogram graph for each frequencies of two images (MRI and CT) and fuse two LH, HL, HH bands. The IDWT is used to fuse the images from both spatial frequency and contrast based image fusion techniques. Performance analysis is made to detect and remove noises in the fused image. Finally Fuzzy c-means clustering is applied to segment the tumor part separately.

2. CONCLUSION

Though there are various methods for Deduction of brain tumor using MRI and CT image samples of patients. It is more comfortable, accurate and informative when it comes to our proposed method. The fusion of both the MRI and CT image of a patient makes it easier to exactly locate the tumor cells of the patient. This is made possible by the discreet wavelet transformation. This technique makes it possible to fuse the images and MAT Lab image processing tool box is use for further implementation work.

Conflict of interest: The author declares having no competing interests.

3. ACKNOWLEDGEMENT

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