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Pre-Processing and Post-Processing Enhancement of MRI Image using Filters

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Abstract: In biomedical, there are various techniques to detect the problem in an image. Magnetic resonance images (MRI) are popular for identification of tumour in brain images. This paper introduces an approach to enhance an image with filtering technique. Filter is used to remove the noise from an image. So far 'image enhancement with filter' has been classified in two sections viz. Pre-processing filter and post-processing filter. This paper while making a classification of filters also helps in raising the visual perception property of an image. This classification consists of Median, Gaussain, Bilateral, Wiener, Gabor and Kalman filters. The use of MRI image enhancement and filtering in different procedure are described. Here a brief review of different filter applied on brain tumor from MRI has been discussed.

Keywords: Magnetic resonance images, Image enhancement, Noise removal, Pre-processing filter and Post processing filter**.**

I. INTRODUCTION

The impact of digital image processing is increasing by the day for its use in the medical and research areas. For example, brain tumors are nonthreatening and can be detected before having a chance to grow or spread. Approximately 40 per cent of all, detected at primary stage, are successfully treated with surgery and, in some cases using radiation therapy. [1].

Magnetic resonance imaging (MRI) has become a widely used method of high quality medical imaging, especially brain imaging where MRI's soft tissue contrast and non-invasiveness is a clear advantage. MRI provides a matchless view inside the human body. The level of details that we can see is extraordinary on being compared with any other imaging modality. Proper, reliable and fast detection of brain cancer is of major technical and economic importance for the doctors. Common practices based on specialized techniques are slow, and possess a degree of subjectivity which is hard to quantify [2].

The aim of de-noising technique is removal of noises from an image and thus becomes the first step in image processing. The technology for removal of noise should be applied carefully; otherwise noise removal introduces artifacts which cause blurring of the image [3].

Filtering is a preliminary operation performed on biomedical images before any other subsequent segmentation or registration techniques are applied on them. It reduces the noise level and improves the Quality of an image. Many methods have been proposed for noise removal [4]. Depending on their property and functioning, they are used in various stages of enhancing an image.

In this paper, filters are classified according to their property and functioning in pre-processing and post processing steps of image enhancement. Thus here short introduction with MRI image, denoising and filtering technique discussed.

In this section 2 describe the pre-processing and post – processing technique and filter are classified in them. Section 3 describes the comparison of filter. In section 4 there is conclusion and section 5 consists of reference.

II. LITERATURE SURVEY

In general, any kind of magnetic resonance image analysis starts with an image enhancement process. The choice of enhancement technique has a direct impact on the final result, since the image quality has great impact on subsequent analysis. In the literature, however, relatively little attention has been given to the classification of filter in pre-processing and post processing steps. In the following, we briefly discuss various filtering techniques.

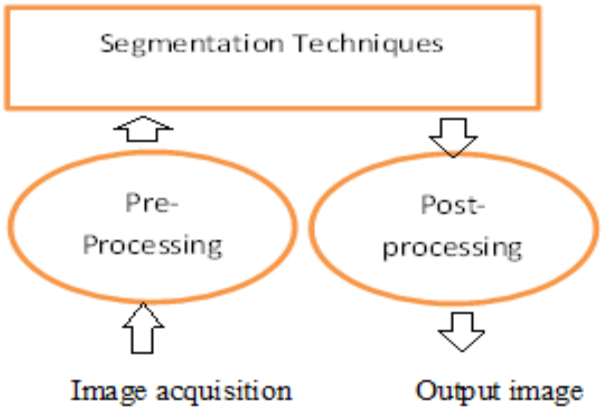

Figure 1: Basic Enhancement step

A. Image acquisition:

Pre-processing and enhancement techniques are used to improve the detection of the suspicious region from magnetic resonance image (MRI). These techniques are applied to all types of scan images like MRI images of head, body and knee. The images used are digital and 256 x 256 pixels in size. The gray scale has been quantized into 12 bits, which allowed 4096 different pixel intensities.

B. Pre-processing:

Pre-processing techniques are used to improve the detection of the suspicious region from magnetic resonance image (MRI). Aim of pre-processing step is to remove the

artifacts from the image and enhance it. It includes that operation whose main goal is to analysis and extraction of the desired information [6]. This stage provides correction in irregularities of data and removes unwanted atmospheric noise thus making the data corrected and ready for use in next stages. Image processing and enhancement stage is the simplest category of medical image processing. This stage is used for decreasing image noise, highlighting important portion and edges, or displaying images. After applying pre-processing the medical image is converted into standard form. The steps carried out in this stage of image processing are:

a) Read an image (.) extension.

b) Applying filter on them in pre-processing stage to remove component.

c) Move to further steps of image processing (such as region growing/ thresholding /edge detection).

There are some more techniques that employ medical image processing of coherent echo signals prior to image cohort. The enhancement phase includes resolution and contrast enhancement and are used to overwhelm noise and imaging done in ranged parameters. After applying this stage the medical images are converted into standard images without noise, film artifacts and labels [5]. This section of technique presents the median, gaussain, bilateral and wiener filter.

a. Median filter:

Median filtering [7][8] is similar to using an averaging filter, where each pixel is set to an average of the pixel values in the neighbourhood of the corresponding input pixels. In case of median filtering, the value of an output pixel is determined by the median of the neighbourhood input pixels, rather than the mean. It is much less sensitive than the two extreme values. Median filtering is well able to remove the outlier without reducing the sharpness of the image. It is one of the order rank filter.

Families of median filter include centre weighted median filter, min-max median filter, adaptive median filter, and progressive switching median filter. Min-max median filter contains test pixel and centre pixel which are replaced by median value of the neighbour. This pixel value should be in between the minimum and maximum of pixel. In centre weighted median filter centre pixel are used as test pixel and their value should be minimum of all pixel present with in the window and maximum to all the pixel in rest of the window and centre pixel value are corrupted. In adaptive median filter, if the test and centre pixel value is within minimum and maximum limit then it is taken for observation otherwise the pixel is corrupted. If proper pixel are not observed then window size increases. And in progressive switching median filter, test pixel value which ranges in maximum and minimum limit are corrupted and not taken thus window size is increased to get tested pixel value [6]

For median and its families consider window size of 3-by-3, the smoothing process depends on the window size used. To denoise images, we chose to use the window size of 3-by-3 neighborhood. Larger values of m-by-n cause's edges to disappear hence are unable to determine the exact frame of each brain structure. If we run the process using smaller windows, noise is still retained in the images [9].

In some cases, the median filtered image is passed through high pass filter. The mask of 3-by-3 is used to detect the edges of image when filtered by median filter [10].

b. Gaussian filter:

A smoothing filter, defined by a gaussain kernel [11], shows lower blurring effects compared to simpler averaging filters. The key feature of gaussain filter contains not only to correct the spectral coefficient of interest, but also all the amplitude spectrum coefficients that lies within the filter window. Generally gaussain low-pass filters compute a weighted average of pixel values in the neighbourhood, in which the weights decrease with distance from the neighbourhood centre. The degree of smoothing is determined by the standard deviation of the gaussain, where larger standard deviation requires larger convolution kernels in order to be accurately represented [9].

Gaussian filters use a matrix of m-by-n with a standard deviation in order to smooth the area. By choosing the standard deviation value wisely, the degree of blurring can be adjusted accordingly. With the observation combined from with previous research work, larger standard deviations tend to make the processed image more blur [9].

c. Bilateral filter:

Bilateral filtering [9] is a non-iterative and local approach to edge-preserving smoothing. The bilateral filtering is to do in the range of an image what traditional filters do in their domain. In short, it combines both domain and range filtering. However, according to [7], bilateral filtering is a non-iterative method only if a wide spatial window is used, which may over-smooth sharp ridges and gutters in the image. Therefore, it is necessary to strike a balance between the size of the spatial window and the number of iterations that need to be used.

The desired parameters of bilateral filters are its simplicity, local and non-iterative scheme. It combines gray levels based on both their geometric closeness and their photometric similarity. Bilateral filters depend on two sigma values. The degree of denoising depends on sigma 1 (spatial-domain) and sigma 2 (intensity-domain). But, sigma 2 is less than preferred in experiment as compared to sigma 1. The time taken for the bilateral filter depend on window size, where longer time taken for a larger window size [9].

d. Wiener filter:

Wiener filtering [9] is known to be the optimal estimator for the true underlying image. It can be represented by

$G(u, v) = f(u, v) \times h(u, v)$

Where f is the Fourier transform of an ideal version of the given image, h is the blurring function and g is the processed image. (u, v) refer to the pixel position. Its main advantage is the short computational time it takes to find a satisfactory solution. A family of wiener filter i.e. Adaptive wiener filter with fast lifting wavelet transform is applied on thresholding process.

The process of adaptive wiener is carried out in two steps (1) noisy image is converted into the wavelet domain with fast lifting wavelet transform technique. After that the thresholding technique is applied over them with wavelet domain using visual shrink and bayes shrink thresholding techniques. (2) After performing suitable thresholding technique, lifting based adaptive wiener filter is applied to

all sub-band images. Thus adaptive wiener filter is applied on small section of image and for improved quality of the image.

C. Post processing:

In this technique, we apply post processing method such as segmentation like edge detector region growing and thresholding on standard image. The basic purpose of the operations is to show only that part of the image which has the tumor that is the part of the image having more intensity and more area some image enhancement processes allow filter to be applied in pre-processing step while in some cases filter is applied next after the segmentation step [10]. To detect the ailing part in body filters are applied along with segmentation of an image. To locate the position of ailing part divide the pixel on basis of symmetry and clearly.

The steps carried out in post processing filter are:

a) Read an image (.) Extension.

b) Pre-processed filter may or may not be applied on it.

c) Post processed filter are applied with segmentation technique to give better result.

Different filters are combined with various segmentation techniques to provide the result. Some of the filters that are applied are Gabor filter and kalman filter.

a. Gabor filter:

Gabor filtering [12] method is popularly used for extracting spatially localized spectral feature of an image. It is exploited to extract the edge and contours of the image. As well as functional structure changes in object position, scale and orientation which can be detected in the gabor feature space. Frequency and orientation representations of gabor filters are similar to those of the human visual system, and they have been found to be particularly appropriate for texture representation and discrimination. Fourier analysis has proven to be one of the most powerful tools in signal processing. However, a key problem with Fourier analysis is that spectral features from different parts of the image are mixed together. Many image analysis applications require spatially localized features. Gabor filter is a popular tool for this task for extracting spatially localized spectral features.

A gabor function in the spatial domain is a sinusoidal modulated gaussain. The complex gabor function in space domain is given by

G (x, y) = s (x, y) war (x, y)

Where s(x, y) is a complex sinusoid, known as the carrier, and war (x, y) is a 2-d gaussain-shaped function, known as the envelop.

b. Kalman filter:

A kalman filter is an optimal estimator - i.e. Infers parameters of interest from indirect, inaccurate and uncertain observations. It is recursive so that new measurements can be processed as they arrive. Kalman filter is able to formulate a smoothed state estimation which rejects the symmetric regions as noisy observations [13]. For injury detection, the state variable of kalman filter is changed to the properties discriminating injury and non-injury. A 3d filtering approach based on kalman filter is applied to extract the injury regions from mri scans. The use of kalman filter is to smoothing the noisy data and provide estimate of parameter of interest [14].It provide good result due to optimality and structure and hence used for online real time processing. Smoothing of an image work on parameter selected. Selection of parameter is made from observation that is randomly made on an image.

III. COMPARISON AND ANALYSIS

The aim of filtering is to produce an image free from noise and have better visual perception. Steps of image enhancement sometime adopt different techniques of filtering depending on different condition. The pre-processing filters are used to remove noise and other artifacts from and the images. After applying suitable segmentation, thresholding and edge detection technique on noise free image, filter is often applied along with them to clearly visualize the edge, content based, texture, features of an image. So they are called as post processing filters which provide better perception of an enhanced image. Table: 1 & 2 provides various features of filters .the classification trend of filter is features of filters .the classification trend of filter is done on the basis of smoothing ,making it noise free detection of pixel position classifying the symmetry and non-symmetry of an image pixel. The entire factor is used for filtering of an image.

Table No 1: Pre-Processing Filter

Filter Name	**Remark**
Median	Low frequency image is generated and the mammogram images are enhanced using median filter; pectoral muscle region is removed and the border of the mammogram is detected for both left and right images from the binary image
Gaussian	Enhances image boundaries, smoothen an image.
Bilateral	It allows intensity values to be Remapped by a range filter to avoid the loss of details from occurring and hence preserve overall shading
Wiener	It gives the optimal way of tapering off the noisy components

Table No: 2 Post Processing Filter

Filter Name	**Remark**
Gabor	HTD (homogeneous texture descriptor) is extracted
Kalman	It is highly efficient tracker and smoother as well as robustness to noisy observations

IV. CONCLUSION

In this survey various filtering methods on brain tumor detection through mri have been studied and compared. This is used to focus on future development of medical image processing in biomedical field. We have described and discussed the properties and requirement of various filtering technique in brain tumor detection. This paper thus gives more information about when and at what phase filtering technique has to be applied. It is a milestone for analyzing all technique relevant for enhancing an image by applying suitable filter on it. This helps digital image processing to improve visual perception of tumor detection.

We have discussed different approach which resorts to suitable image filtering technique. Both techniques are considered to provide the better result to move to next step.

V. REFERENCES

[1]. Rajesh C. Patil and A. S. Bhalchandra, "Brain Tumour extraction from Mri Images", International Journal of Electronics Communication &Soft Computing Science and Engineering, ISSN: 2277-9477, Volume 2, Issue 1, and April2012.

[2]. Dipali M. Joshi, N. K. Rana and V. M. Misra, "Classification of Brain Cancer using Artificial Neural Network" 2010 2nd International Conference on Electronic Computer Technology (ICECT 2010)

[3]. B.Thamotharan, M.Menaka, Sandhya Vaidyanathan, and Sowmya Ravikumar, "Survey on Image Processing in the field of De-Noising Techniques and Edge Detection Techniques on Radiographic Images" Journal of Theoretical and Applied Information Technology 15 July 2012. Vol. 41 No.1

[4]. Swetha Danda and Tim McGraw, "A Comparison of the Bilateral Filter and Tv-Norm minimization for Image Denoising" IEEE 2007.

[5]. Suneetha Bobbillapati1 and A. Jhansi Rani, "Automatic Detection of Brain Tumor through Magnetic Resonance Image" International Journal of Scientific and Research Publications, Volume 3, Issue 11, November 2013 1 ISSN 2250-3153

[6]. Sudipta Roy, Sanjay Nag, Indra Kanta Maitra and Prof. Samir Kumar Bandyopadhyay, "A Review on Automated Brain Tumor Detection and Segmentation from Mri of Brain"

[7]. Bhausaheb Shinde and A.R. Dani, "Noise Detection and Removal Filtering Techniques in Medical Images" International Journal of Engineering Research and Applications, Vol. 2, Issue 4, July-August 2012, Pp.311-316.

[8]. Gajanand Gupta, "Algorithm For Image Processing using Improved Median Filter and Comparison of Mean, Median and improved Median filter" (IJSCE) Issn: 2231-2307,Volume-1, Issue-5, November 2011.

[9]. N.F Ishak, Mj Gangeh and R Logeswaran, "Comparison of Denoising Techniques applied on Low-Field Mri Brain Images" Fifth International Conference on Computer Graphics, Imaging and Visualization.

[10]. M. Usman Akram and Anam Usman, "Computer Aided System for Brain Tumor Detection and Segmentation" 2011 IEEE

[11]. R. Gonzales and R. Woods, Digital Image Processing, 3rd Ed. Pearson Education International, 2010

[12]. Jeena R S and Sukesh Kumar, "A Comparative analysis of Mri and CT Brain Images for Stroke Diagnosis", International Conference on microelectronics, communication and renewable energy (ICMICR-2013).

[13]. Y.U.Sun and Bhanu Bir, "3d filtering for injury detection in Brain Mri" 2010 International conference on Pattern Recognition.

[14]. Kleeman Lindsay, "Understanding and applying Kalman filtering" Department of electrical and computer Systems engineering monash university, Clayton