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Performance Analysis of Image Enhancement Techniques for Brain Tumor Images

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Abstract- The reconstruction of the medical images of the brain tumor is very helpful for the radiologist to diagnose the tumor efficiently, other biological research and surgical planning. The research paper is about the analysis of performance of the various image enhancement techniques for MRI of brain tumor. This research finds the best enhancement technique out of Weiner filter, Blind convolution method and Median filter so that tumor can be detected properly. In the process, the image is acquired from the external device than the preprocessing of the MR image and various image enhancement techniques are applied to obtain an image with improved quality which may give best results on getting diagnosed. The best technique is chosen based on peak signal to noise ratio (PSNR) factor. The filter which gives highest PSNR value is chosen as the best filter for enhancement.

Index Terms- 3D medical image enhancement; brain tumor detection; enhancement techniques.

1. INTRODUCTION

A tumor is a mass of tissue that multiplicatively grows out of the normal forces that regulates growth. Proper detection of the tumor area is very essential for proper treatment of tumor as tumor is serious and life threatening disease because of its invasive and infiltrative character. MRI is the commonly used image modality for non invasive analysis of the brain tumor. MRI uses radio waves and magnetic fields to acquire a set of cross sectional images of the brain. 2D images cannot accurately convey the complexities and thus we need to represent the 2D image as 3D image. 3D visualization enables better understanding of the topology and shape of the tumor Brain tissues consist of white matter (WM), grey matter (GM) and cerebrospinal fluid (CSF). In MRI image, the white matter appears white and the grey matter and the cerebrospinal fluid appears dark grey color. In the MRI image of brain tumor, there are extra portions of the brain such as artifacts that needs to be excluded while analysis of the image. Various enhancement techniques are applied to remove the artifacts from the MRI image so that the white matter gets highlighted and helps in better analysis of tumor detection.

2. LITERATURE SURVEY

In spite of the presence of substantial number of image enhancement methods, accurate removal of noise from MRI image is a challenge. In non-local method, the redundant information in images is exploited. The pixel values are replaced by taking weighted average of locality similar to the neighborhood surrounding of the image. MRI image consists of non repeated details due to noise, complex structures, smear in acquisition and the partial volume effect originating from the low sensor resolution that is abolished by this type of method.In frequency domain, wavelet based methods are used for de-noising and preserving the actual signal. Application of wavelet based methods on MRI images makes the wavelet and scaling coefficients biased. This problem is solved by squaring the MRI image by non central chi-square distribution method. These make the scaling coefficients independent of the signal and thus can be easily removed. In case of low SNR images, finer details are not preserved. In [1], they introduced an efficient technique for detection of brain tumor from cerebral MRI images. The methodology consisted of three steps: Enhancement, Segmentation and Classification. For enhancing the image they applied Mean filter and Gaussian filter. They also applied histogram equalization techniques. For segmentation they used Mathematical Morphology and Wavelet Transform. And then finally they applied K-means technique for classification of the image. In [2], they proposed a novel approach for the MRI image enhancement which was based on Modified Tracking Algorithm, Histogram Equalization and

Center Weighted Median filter. Center Weighted Median filter gives more weight only to the central value of each window. In [3], they introduced a technique in which they applied preprocessing steps to the low-field MR brain images for improving quality of the image. The image enhancement is done using three steps: first, the MRI image is acquired, second, the removal of film artificates such as labels and marks on the MRI image and finally the high frequency components are removed. Weighted Median filtering is also applied to the image. In [4], they presented a technique for 2D and 3D wavelet domain medical image resolution enhancement method. The proposed approach is based on the interpolation of the low resolution input image and the derived high frequency sub-band images obtained using Discrete Wavelet Transform (DWT). They have compared two techniques: first is DWT based resolution technique and second is image resolution enhancement by using DWT and Stationary Wavelet Transform (SWT). After applying both the methodologies they found that the second one provides better result in terms of Peak Signal To Noise Ratio (PSNR).

3. PROPOSED SOLUTION METHODOLOGY

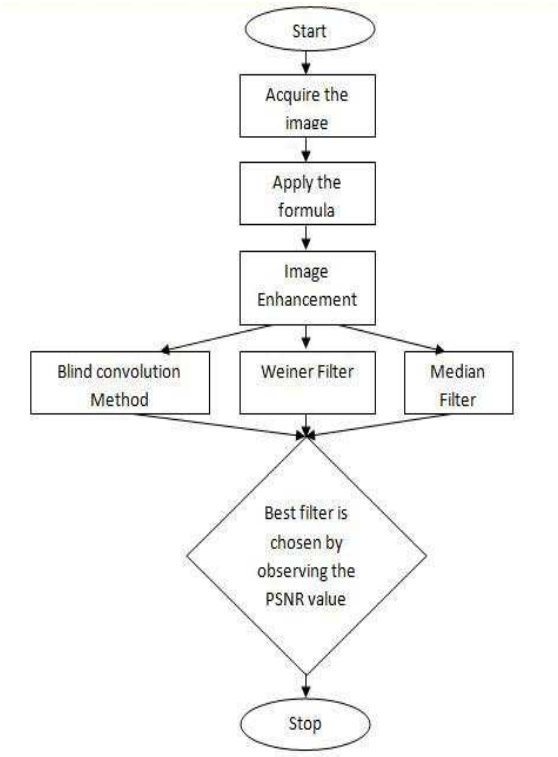

Fig 1. Flowchart of the image enhancement technique used

3.1. Image Acquisition

A digital image is produced by one or several image sensors, which, besides various types of light-sensitive cameras, include range sensors, tomography devices, radar, ultrasonic cameras etc. Image acquisition can be defined as the action of retrieving an image from some source, usually a hardware based source, so it can be passed through the enhancement process. Performing image acquisition in image, processing is always the first step in the workflow sequence because, without an image, no processing is possible. The acquired image is completely unprocessed and is the result of whatever hardware was used to generate it. One of the ultimate goal of this process is to have a source of input that operates within such controlled and measured guidelines that the same image can, if necessary, be nearly perfectly reproduced under the same conditions so that anomalous factors are easier to locate and eliminate.

3.2. Formula Used

Peak Signal to Noise Ratio (PSNR) is used to measure the quality of reconstruction of lossy compression codecs. The signal in this case is the original data, and the noise is the error introduced by compression. Higher PSNR indicates that the reconstruction is of higher quality. PSNR is most easily defined via the Mean Square Error (MSE). Given a noise free m*n monochrome image I and its noisy approximation K, MSE is defined as Eq(1):

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$

The PSNR is defined as Eq(2):

$$PSNR = 10 * \log_{10}(\frac{MAX_I^2}{MSE})$$

Here, MAX_I is the maximum possible pixel value of the image.

3.3. ***Image Enhancement*** This research is to analyse best enhancement results among three filters i.e. Blind Convolution Method, Weiner Filter and Median Filter. Using Point Spread Function (PSF), image enhancement is done and based on that, PSNR value is calculated which helps us to choose best enhancement method. Initially the value of SPF is taken as [1, 1] and Blind Convolution Method is applied on it. Blind Convolution Method returns actual SPF value, which is further given as argument in the other two filters.

4. EXPERIMENTAL RESULTS

After enhancing the image, the PSNR values of all the enhanced images, obtained after applying different filtration techniques, are compared, to

obtain the best results. The filter which gives the highest PSNR value is the best filter.

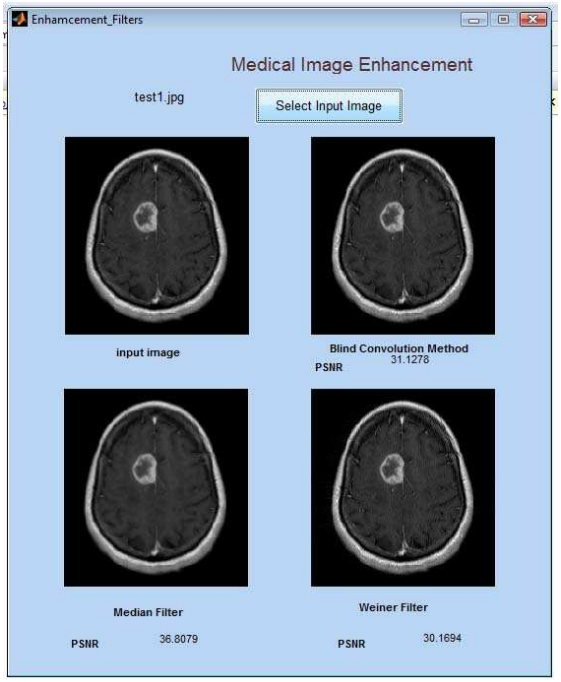

Fig 2. Showing result of 1st test image

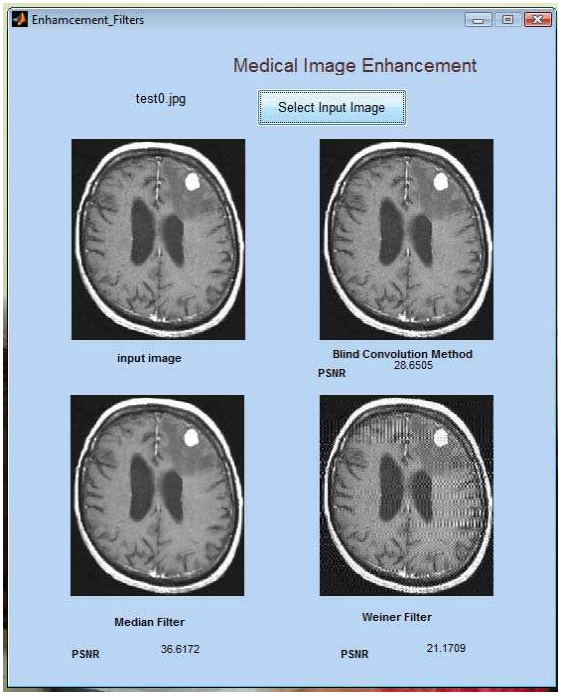

Fig 3. Showing result of 2nd test image

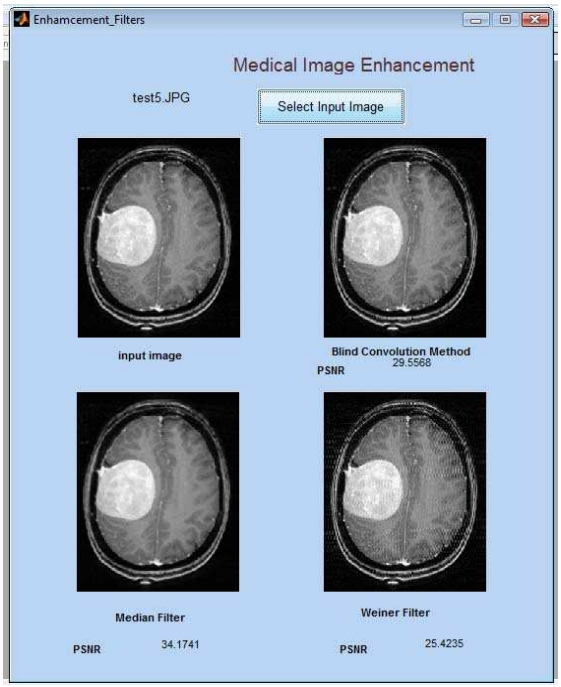

Fig 4. Showing result of 3rd test image

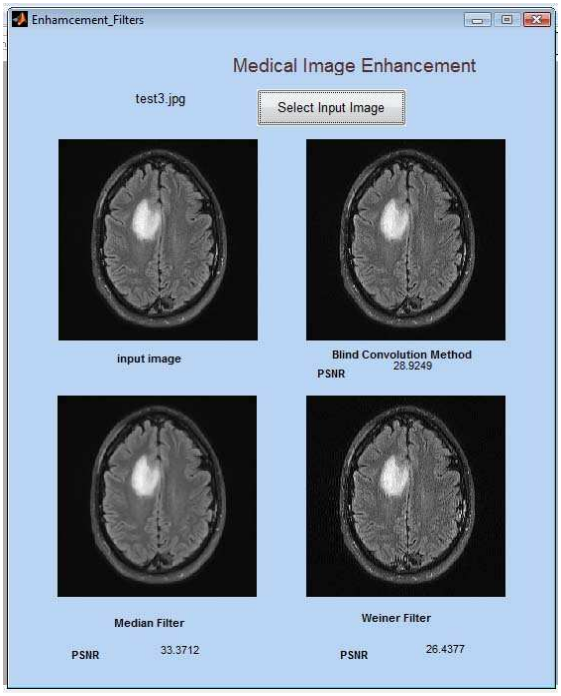

Fig 5. Showing result of 4th test image

From the above test images we can observe that PSNR obtained from median filter is greatest, so Median filter is chosen as the best filter.

5. CONCLUSION

We had applied the algorithm on various test images. Three filtration techniques i.e. Blind Convolution method, Median filter and Weiner filter, have been applied to the test images. By calculating the PSNR values in each filtration technique, we have observed that with most of the images, median filter gives the best results.

6. FUTURE SCOPE

This research can be carried further to use the enhanced medical images for detection of tumors in other parts of the body and many other medical issues related to any medical image.

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