International Journal of Latest Trends in Engineering and Technology
Vol.(9)Issue(4), pp.203-207
DOI: http://dx.doi.org/10.21172/1.94.30
e-ISSN:2278-621X

DWT BASED CONTRAST AND RESOLUTION ENHANCEMENT APPROACH FOR MEDICAL COLOR IMAGES

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Abstract- Here, we propose an image resolution enhancement technique based on interpolation of high frequency sub-band images obtained by discrete wavelet transform (DWT) and the input image. DWT is applied in order to decompose an input image into different sub-bands. Then all these sub-bands are combined to generate a new high resolution image by using inverse DWT (IDWT). The quantitative and visual results show the superiority of the proposed technique over the conventional and state-of-art image resolution enhancement techniques. Many times we obtain a low contrast due to poor illumination or due to wrong setting of lens aperture. The idea behind contrast enhancement is to increase the contrast of image by making darker portions darker and brighter portions brighter. To achieve this we have to apply Histogram Equalization on high resolution, low contrast image.
Keywords – DWT, contrast enhancement, IDWT.

1. INTRODUCTION

Low contrast and poor quality are main problems in the production of medical images. By using the wavelet transforms with Haar transform followed by using the Laplacian operator we can obtain the sharpened image. First, a medical image is decomposed with wavelet transform. Secondly, all high-frequency sub-images were decomposed with Haar transform. Then, noise in the frequency field was reduced by the soft-threshold method. High frequency coefficients are enhanced by different weight values in different sub-images. The enhanced image is obtained through inverse wavelet transform and inverse Haar transform. Lastly, the filters are applied to sharpen the image; the resulting image is then subtracted from the original image. Experiments showed that this method can not only enhance an image as details but can also preserve its edge features effectively.

The parameters measured is PSNR which is satisfactory. Advanced image enhancement based on Wavelet and Histogram Equalization for medical images where image enhancement is used to produce high quality pictures like Medical images are present[2]. As the quality of the image is very much depend on environmental effects like light, weather or equipment that we used to capture the picture, images may loose important information which is required to enhance the quality of an image. Hence, we have many techniques to recover lost data to improve the quality of picture .Nonlinear enhancement technique is used to increase the contrast level of an image like wavelet transform and Histogram Equalization. In this experiment, it is found that this method enhance the contrast level of an image. Ganesh naga sai Prasad et. proposed an image enhancement using Wavelet transforms and SVD where resolution and contrast are the two important attributes of an image[3]. In this paper, we have developed a method to enhance the quality of the given image. The enhancement is done both with respect to resolution and contrast. The proposed technique uses DWT and SVD. To increase the resolution, proposed 4 methods uses DWT and SWT. These transforms decompose the given image into four sub-bands, out of which one is of low frequency and the rest are of high frequency. The HF components are interpolated using conventional interpolation techniques. Then we use IDWT to combine the interpolated high frequency and low frequency components. To increase the contrast, we use SVD and DWT. The experimental results show that proposed technique gives good results over conventional methods. Anamika Bhardwaj et. all proposed “A Novel approach of medical image enhancement based on Wavelet transform” where, by using the wavelet transform and Haar transform[4].

First, a medical image is decomposed with Haar transform. Then again high frequency sub images were decomposed. Then noise in the frequency field was reduced by the soft threshold method. Then high frequency coefficients are enhanced by different weight values in different sub images. Enhanced image is obtained through the inverse Haar transform. The image contrast is adjusted by nonlinear contrast enhancement approaches. Experiments showed that this method can not only enhance an image as details but can also preserve its edge to increase human visibility.

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2. PROPOSED ALGORITHM

Our main aim is to enhance all the parameters of an image and along with bring out detail that is obscured, or simply to highlight certain features of interest in an image. For that purpose we are going to develop an automated system for image enhancement & to develop image processing algorithm for achieving better accuracy of image. Finally to get high resolution and contrast of image. Image enhancement process consist of a collection techniques that seek to improve the visual appearance of an image or an image to convert the image to a form better suited for analysis by a human or machine. The principal objective of image enhancement is to modify attributes of an image to make it more suitable for a given task and specific observer. This can be explained with the help of following methodology.

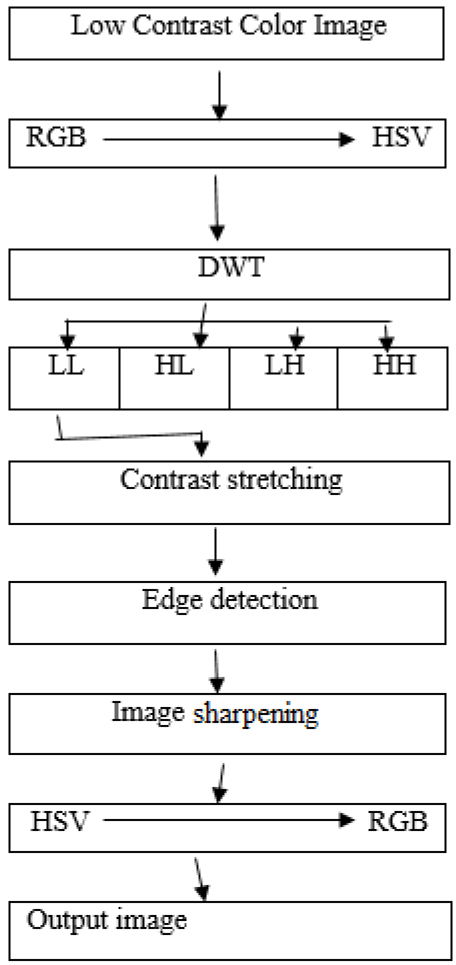

Figure 1. Methodology

2.1 HSV Image

HSV is so named for three values namely Hue, Saturation and Value(Brightness). This color space describes colors (hue or tint) in terms of their shade (saturation or amount of gray) and their brightness value.The HSV color wheel is depicted as a cone or cylinder.Some color pickers use the acronym HSI, which substitutes the term ”Intensity” for value, but HSV and HSI are the same color model. Photoshop uses HSI. Hue is expressed as a number from 0 to 360 degrees representing hues of red (which start at 0), yellow (starting at 60), green (starting at 120), cyan (starting at 180), blue (starting at 240) and magenta (starting at 300). Saturation is the amount of gray from zero percent to 100 percent in the color. Value (or brightness) works in conjunction with saturation and describes the brightness or intensity of the color from zero percent to 100 percent. The HSV color space is used because HSV better represents how people relate to colors than does the RGB color space. The HSV color wheel is used to generate high quality graphics. Selecting an HSV color begins with picking one of the available hues, which is how most humans relate to color, and then adjusting the shade and brightness value. RGB to HSV conversion color vision can be processed using RGB color space or HSV color space. RGB color space describes colors in terms of the amount of red, green, and blue present. HSV color space describes colors in terms of the Hue, Saturation, and Value. In situations where color description plays an integral role, the HSV color model is often preferred over the RGB model. RGB defines color in terms of a combination of primary colors R,G and B but the HSV model describes colors similarly to how the human eye tends to perceive color.[1]

2.2 Discrete Wavelet Transform

The 2-D wavelet decomposition of an image is performed by applying the 1-D discrete wavelet transform (DWT) along the rows of the image first,and then the results are decomposed along the columns.This operation results in four decomposed sub-band images referred to low-low(LL),low-high(LH),high-low (HL),and high-high(HH).The frequency components of those sub-bands cover the full frequency spectrum of the original image.[3] Low resolution image can be obtained by passing the high resolution image through a low pass _lter in wavelet domain,which implicitly means that the LL sub-band is the low resolution of the original image.

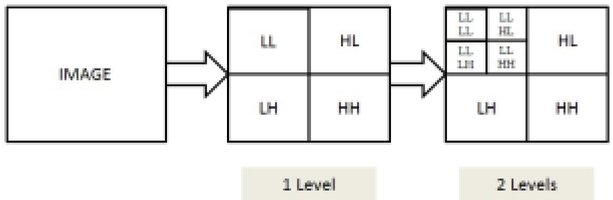

Figure 2. 1-D DWT of image

2.3 Contrast Stretching

Contrast enhancement is frequently referred to as one of the most important issues in an image processing.Contrast is created by the difference in luminance reected from two adjacent surfaces.In visual perception,contrast is determined by the difference in the color and brightness of an object with other objects. Our visual system is more sensitive to contrast than absolute luminance; therefore,we can perceive the world similarly regardless of the considerable changes in illumination conditions.If the contrast of an image is highly concentrated on a specific range,the information may be lost in those areas which are excessively and uniformly concentrated.The problem is to optimize the contrast of an image in order to represent all the information in the input image.Sometimes during image acquisition low contrast may be result due to one of the following reasons: poor illumination, lack of dynamic range in the image sensor and wrong setting of the lens aperture. The idea behind contrast stretching is to increase the dynamic range of gray levels in the image being processed. Linear and nonlinear digital techniques are two widely practiced methods of increasing the contrast of an image[2]. There have been several techniques to overcome this issue,some are listed below:

(i) Linear Contrast enhancement
(ii) Decorrelation Stretching
(iii) General histogram equalization and Local histogram equalization
(iv) Multi-wavelets and singular value decomposition(SVD)

2.4 Edge Detection

Edge detection includes a variety of mathematical methods that aims at identifying points in digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges.The same problem of finding discontinuities in one-dimensional signals is known as step detection and the problem of finding signal discontinuities over time is known as change detection. Edge detection is a fundamental tool in image processing, machine vision and computer vision, particularly in the areas of feature detection and feature extraction.The purpose of detecting sharp changes in image brightness is to capture important events and changes in properties of the world. It can be shown that under rather general assumptions for an image formation model, discontinuities in image brightness are likely to correspond to: discontinuities in depth, discontinuities in surface orientation,changes in material properties and variations in scene illumination. In the ideal case, the result of applying an edge detector to an image may lead to a set of connected curves that indicate the boundaries of objects, the boundaries of surface markings as well as curves that correspond to discontinuities in surface orientation. Thus, applying an edge detection algorithm to an image may significantly reduce the amount of data to be processed and may therefore alter out information that may be regarded as less relevant, while preserving the important structural properties of an image.

If the edge detection step is successful, the subsequent task of interpreting the information contents in the original image may therefore be substantially simplified. However, it is not always possible to obtain such ideal edges from real life images of moderate complexity. Edges extracted from non trivial images are often hampered by fragmentation, meaning that the edge curves are not connected, missing edge segments as well as false edges not corresponding to interesting phenomena in the image a thus complicating the subsequent task of interpreting the image data. Edge detection is one of the fundamental steps in image processing, image analysis, image pattern recognition, and computer vision techniques.The edges extracted from a two-dimensional image of a three-dimensional scene can be classified as either viewpoint dependent or viewpoint independent. A viewpoint independent edge typically reects inherent properties of the three-dimensional objects, such as surface markings and surface shape. A viewpoint dependent edge may change as the viewpoint changes, and typically reects the geometry of the scene, such as objects occluding one another.

A typical edge might for instance be the border between a block of red color and a block of yellow. In contrast a line (as can be extracted by a ridge detector) can be a small number of pixels of a dfferent color on an otherwise unchanging background. For a line, there may therefore usually be one edge on each side of the line. Image Sharpening Sharpness is a combination of two factors: resolution and acutance. Resolution is straight- forward and not subjective. It's just the size, in pixels, of the image file. All other factors equal, the higher the resolution of the image^athe more pixels it has athe sharper it can be. Acutance is a little more complicated. It as a subjective measure of the contrast at an edge. For example, if a subject eyelashes are an indistinct black blur they won't appear sharp. If, on the other hand, you can pick out each one then most people will consider the image sharp. Sharpening is a technique for increasing the apparent sharpness of an image. Once an image is captured, Photoshop can add magically any more details: the actual resolution remains fixed. You can increase the file as size but the algorithms any image editor uses to do so will decrease the sharpness of the details. In other words, the only way to increase apparent sharpness is by increasing acutance.

If you want your image to look sharper, you need to add edge contrast. Here are three main reasons to sharpen your image: to overcome blurring introduced by camera equipment, to draw attention to certain areas and to increase legibility. RAW files from any modern camera are always slightly unsharp. Every step of the image capturing process introduces blur. As the light passes through the lens elements no matter how well made some definition is lost. When the sensor processes the photons falling on it, the sharpest transitions are averaged out and slightly blurred. When the three different colour channels are interpolated to create the final image, again, a small amount of blur is introduced. Second, human eyes are attracted to contrast. When we look at a photo, we are drawn to the sharpest details. If you are trying to direct a viewer, selective sharpening is one of the best ways to do it. Finally, sharpening an image makes it easier to see important details.

Text becomes easier to read, individual leaves stand out and faces in a crowd become more distinct The new approach enhancement model in this research begins with brightness enhancement. The algorithm of this technique was processed according to the sharpening model, which on the first stage, the color information of the digital image are transformed into grayscale image. Then, linear contrast stretch approaches to enhance the brightness of the image. The image is then edge detected by finding the second derivative of the Laplacian operator. Finally, increase the sharpness of the image by subtracting the result with the original image. This step subtracts the edge detection output from original image and hence gives the enhanced image.

3. EXPERIMENT AND RESULT

The test set for this evaluation experiment image for crack & brain is randomly selected from the internet. Matlab 7.0 software platform is use to perform the experiment. The PC for experiment is equipped with an Intel P4 2.4GHz Personal laptop and 2GB memory.

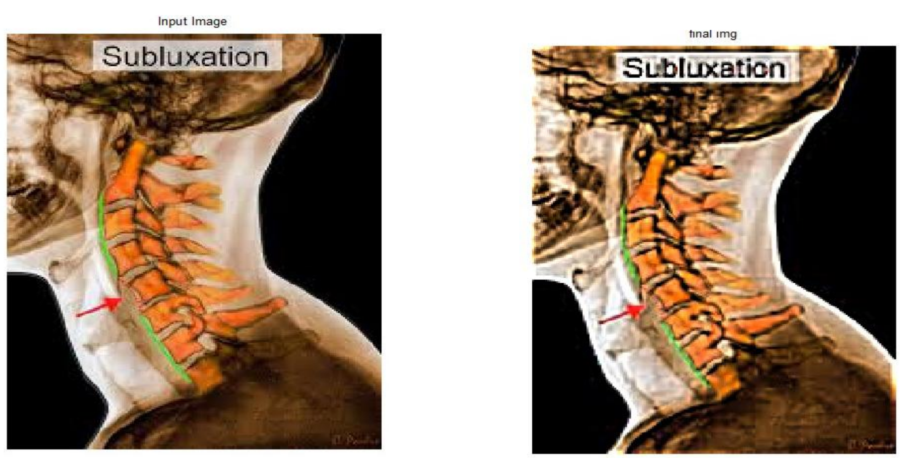

Figure 3 (a) Input image for Crack (b) Output image for Crack

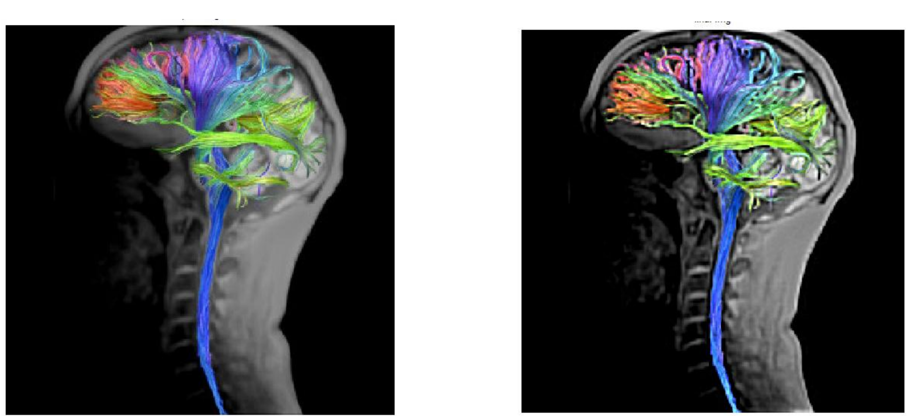

Figure 4 (a) Input image for Brain (b) Output image for Brain

Table -1 Experiment Result

Image	RMSE1	PSNR
Crack	1.1766	47.4244
Brain	1.0240	48.0276

Table 1 shows results of experiments that the algorithm not only can enhance an image as contrast, but also can preserve the original image as edge property effectively. We used two level DWT to decompose an image.

4. CONCLUSION

An important problem of medical image enhancement based on wavelet transform is how to extract high-frequency information. DWT is used to decompose the high-frequency sub-images of wavelets in this algorithm. This helped us to extract high-frequency information effectively. Different enhancement weight coefficients in different sub-images and Edge sharpening are used in the process of medical image enhancement. They can also helped us to enhance a medical image effectively. The sharpening method procedure was experimented with additional steps. We must transformed the image from RGB image into HSV image, then applied DWT transform and extracted the LL sub band. Then we applied linear contrast stretching and edge detecting with Laplacian technique. The edge detected image is then subtracted from the original image. The output image after enhancement was converted back to RGB image which was of high quality. In our project we intentionally damaged one image and used it as an input to our program and output of that image was compared with original one. The output was somewhat similar to original image.

5. REFERENCES

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