ISSN No. 0976-5697

Volume 1, No. 2, July-August 2010

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

Fracture Extraction from Colored X-Ray Images

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Abstract: A fracture is a crack or break in the bone. This can be easily detected by taking an X-ray in that area. But sometimes these images lack sufficient details needed to diagnose. So these images can be enhanced by adding the color map. To add the RGB color to the Destination image, the reference image 'mood' color is taken. Although adding color to the gray scale has no much impact, but the human labor is much reduced. After adding color to the original image, it adds up details to the target image. In the second part of this paper, Bit-Plane slicing method is used to extract the details of a Colored X-Ray Image. This method produces different bit level images. In this paper Bit Level 6 is evaluated for RGB colors of the Original image and it is evaluated with the Bit level 6 of the original image. The result shows that the colored X-Ray image Bit level6 yield more details than the Bit level6 of gray scale X-Ray image.

Keywords: Color map, RGB Color Model Feature Extraction, Bit-Plane Slicing, Gray scale images.

I. INTRODUCTION

Bone fracture is crack or break in the bone. It is very common and most people fracture their bone at least once in their lifetime. The most common symptoms are: swelling around the injured area, loss of function in the injured area, bruising around the injured area, deformity of a limb. There are many types of fractures: simple, stress, comminuted, impacted, compound, complete and incomplete.

Bone fractures can be detected by taking an X-ray in defected area. An x-ray is a noninvasive medical test that helps physicians diagnose and treat medical conditions. Imaging with x-rays involves exposing a part of the body to a small dose of ionizing radiation to produce pictures of the inside of the body [4]. X-rays are the oldest and most frequently used form of medical imaging. A bone x-ray makes images of any bone in the body, including the hand, wrist, arm, foot, ankle, knee, leg or spine.

II. GRAY SCALE AND COLOR IMAGES

Gray scale images are made up of only one bit value. They lack the chromatic information. They are also called as monochromatic images. These image pixel value ranges from 0 to 255 [8]. It shows only the luminance information. Color models describe how colors are represented. There are different types of color models in image processing. They are RGB, CMYK, HSV, LAB, and HSL. In this paper, RGB color model is taken into account. This is very common type of color model for which the processing is done very easily.

The RGB Color Model is composed of three color components. They are Red, Green, and Blue. The RGB color model is an additive color model in which red, green, and blue light are added together in various ways to reproduce a broad array of colors [3].

The RGB is made up of 24 bit per pixel and is specified by three 8-bit unsigned integers to represent the three color models. It allows more than 16 million different color combinations and it is also called as true color.

Figure.1 Example of Gray Scale & RGB Color Image

III. COLOR CONVERSION

The process of color conversion includes adding color to the gray scale images. The algorithm for adding color to the gray scale images,

Step 1: Check whether the Original image is a gray scale image or not. If it is a color image, then convert it to a gray scale image.

Step 2: The Source image which taken for reference should be a color image.

Step 3: The size of the Original Image and the Source image should be taken.

Step 4: Convert the Original image and the Source image to ycbcr Color Space.

Step 5: Normalization process is done.

Step 6: Finally luminance is compared.

Step 7: After comparing the luminance the color mood is taken from the source image and added accordingly to the Original image to form the Destination image.

After this algorithm is processed the gray scale image is modified into a color image by the luminance effect of the Source image [2]. In Fig. 6 gray scale images are converted into RGB images by their respective Source images. In this paper, 20 X-Ray images are taken as samples. These images are processed and their running time is calculated. The running time of the algorithm for one image can range from 10 seconds to 2 minutes on a Pentium IV CPU using MATLAB code. Execution time will vary from one image to another, depending on the size of the image. The X-Ray image which is taken as an example in the Fig. 2 took a running time of 34,32,31 seconds depending on the source and reference Image.

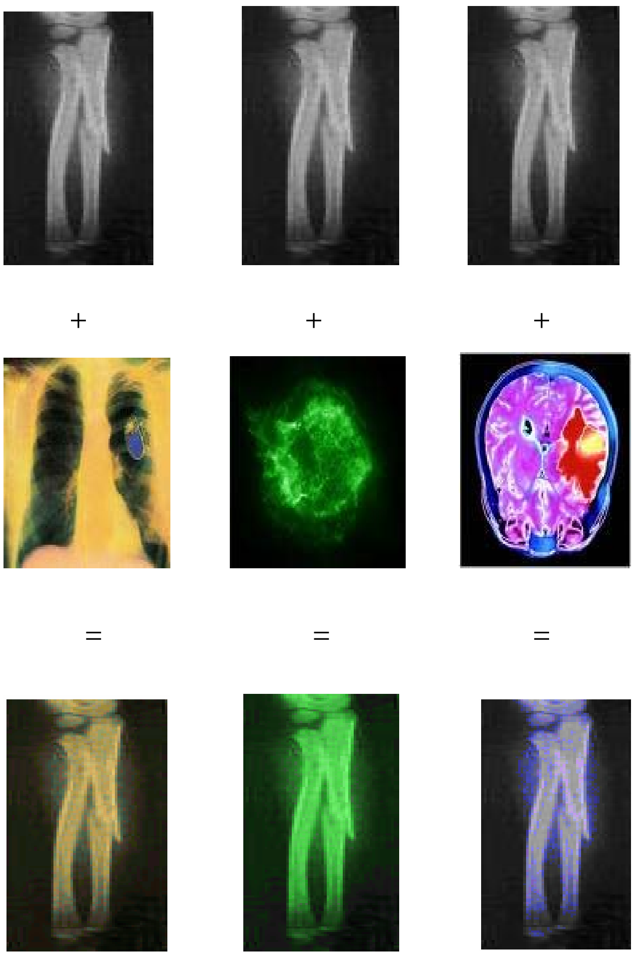

Figure 2. Results of conversion of gray scale to RGB Images using the Source image

IV. FEATURE XTRACTION

The goal in image analysis is to extract information useful for solving application based problems. After the image being analyzed, the next step is feature extraction. The primary function of this step is segmentation and transformation [8]. The Image segmentation provides the object features and image transformation provides features based on spatial frequency information.

After this function is performed, the image is modified from lowest level of pixel data to higher level representation [1]. The object features of interest include the geometric properties of binary objects, histogram features and color features.

When input data is given to a processor, the data which is fed will be consisting of redundant information [6]. The data should be converted into reduced set of features. This conversion of redundant data into features is called as Feature Extraction [5].

Feature extraction is a part of the data reduction process and is followed by feature analysis. The main aspect of feature analysis is to determine exactly which features are important [3]. So before doing appropriate feature analysis, the concept of Bit-Plane slicing is done. Once the features are extracted, and categorized according to the bit planes the next step is classification.

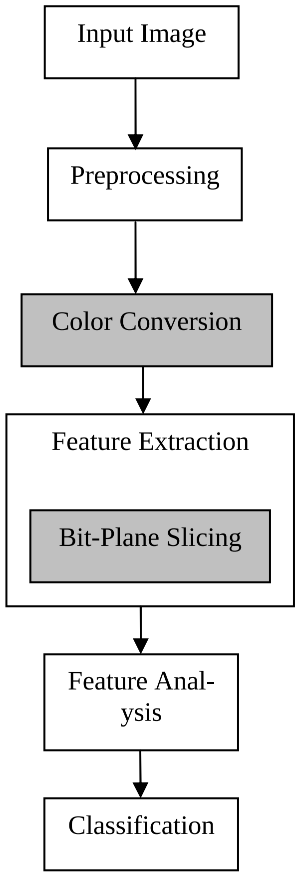

Figure 3. Basic steps

V. BIT-PLANE SLICING

Image enhancement is the method to enhance the image which is of low contrast. But the drawback in this method is that all the pixels in the image are brightened totally and this may not be suitable for some applications [9]. So to overcome this, Bit-Plane Slicing method is used.

Bit-Plane Slicing is a technique in which the image is sliced at different planes. It ranges from Bit level 0 which is the least significant bit (LSB) to Bit level 7 which is the most significant bit (MSB). The input to this method is an 8-bit per pixel image [3]. This is a very important method in Image Processing.

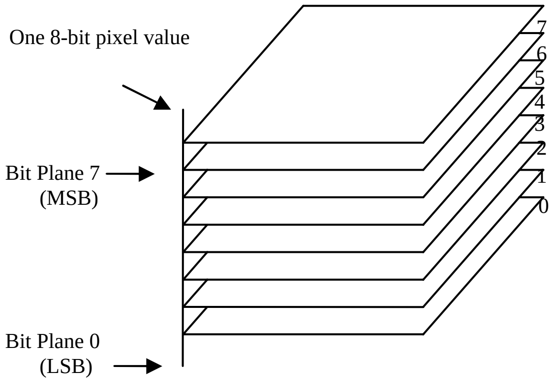

Figure 4. Bit-Plane Slicing

The advantage of doing this method is to get the relative importance played by each bit of the image. It highlights the contribution made by specific bits. In this method, only in last 4 higher order bits planes significant data is visualized [7]. The lower level bit plane does not give much detail because they are made up of lower contrast. The bit level in bit plane 7 is equivalent to the bit level of the original image.

The steps involved in Bit-Plane Slicing procedure is as follows,

1. Get the input image S.
2. Convert the input image S into gray scale image.
3. Generate random numbers by using rand function, ranging from the size of the image S.
4. Get the level of Bit-Plane from the user B.
5. Manipulate two loops, one for X coordinate and another for Y coordinate.
6. Inside the loop, bitand function should be evaluated, bitand H=(S(x, y), 2^B-1).
7. After the loops are completed, the resultant image H is displayed.

VI. RESULTS

The colorized X-Ray image is taken and its Features are extracted using Bit-Plane Slicing technique.

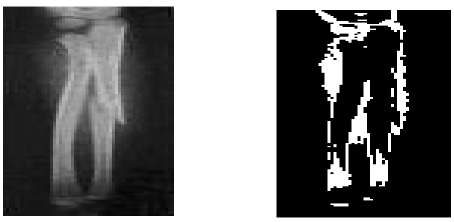

Figure 5(a). Original Image and its Bit- Plane 6

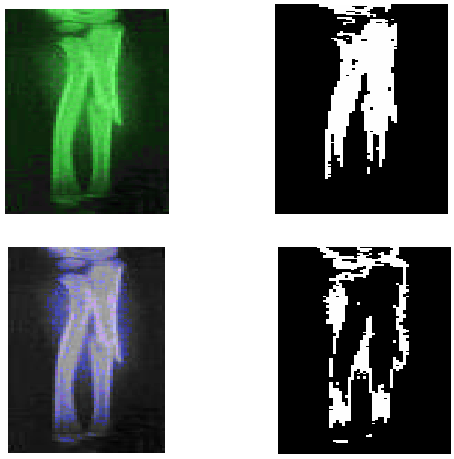

Figure 5 (b): Coloured Images and its Bit-Plane 6

The running time of the Bit-Plane algorithm for one image can range from 2 seconds to 1 minute on a Pentium IV CPU using MATLAB code. Execution time will vary from one image to another, depending on the size of the image. The bone X-Ray image which is taken as an example in the Fig. 5(a) took a running time of 4 seconds. The size of this bone X-Ray image is (133, 58).

Table I. SNR Value of Colored and Bit-Planed Images

Colour Image	***SNR Value***
Red Colour	1.0635
Green Colour	0.9242
Blue Colour	1.1367
Bit-Plane 6 of Colour Image	***SNR Value***
Red Colour	0.4605
Green Colour	0.5167
Blue Colour	0.4271

The SNR result is obtained from the formula applied in the matlab,

$$\textbf{SNR = Mean / Stand. Deviation} \quad (1)$$

The SNR value of the Original Image is 1.2291 and it Bit-Plane level 6 is 0.3857.

Table.II. PSNR & MSE Values of Original and RGB Bit Planed Images

Images	**PSNR Value**	**MSE Value**
Original Image & R Value	63.09dB	22.7974dB
Bit Level 6 of original and R Value	50.58dB	36.6039dB
Original Image & G Value	59.39dB	26.1975dB
Bit Level 6 of original and G Value	32.00dB	74.6714dB
Original Image & B Value	64.52dB	21.5302dB
Bit Level 6 of original and B Value	53.13dB	33.1986dB

When two images are identical Peak Signal to Noise Ratio increases and Mean Square Error decreases and it will be equal to zero. In Table 2, the first value of Original image and the Red color mapped X-Ray image is compared. As these two images are not equal, MSE value is 36.6039dB.

The second value compares the Bit Level 6 of the original Image and the Red color mapped X-Ray image. These two images are drastically not equal. So the PSNR value decreases to a low level and the MSE value increases a lot. The same process goes to the Green and Blue color Mapped X-Ray images.

V. CONCLUSION

In this paper, the X-Ray image is colorized by using RGB Color map. Then the Bit-Plane level 6 for the Original and the Color mapped image is computed. PSNR and MSE values for these Images are calculated and compared. Results shows that the MSE value for Bit plane 6 of Original and Color mapped images are very high. This concludes that the feature extraction in Color mapped X-Ray images yields more details than the gray scale X-Ray images.

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