Pseudocoloring Of Medical Images: A Research

Selvapriya B, Raghu B

ABSTRACT--- *A color mapping is a process by which we transfer the particular range of colors from source to the target image. This paper says about a novel method for medical images using pseudocolor by pre existence of color mapping. Conversion of grey scale image to color has no exact way or approach, direct way to colorize is tedious by which the entire range of colors can be changed, but in color mapping the conversion is done by converting the whole black and white image into color. This novel method presents black and white image to various colors. By the creation of color map that color map is applied for colorizing the medical grey scale images. This approach can be used for grey scale medical images irrespective of size and shape such that the intensity and aspect of the image can be improved.*

Keywords: Color mapping, pseudocoloring, color, medical images

I INTRODUCTION

Pseudocolor image processing transforms black and white images into colored one which can be done by process known as pseudocolor. By colorization of image certain features can be perceived easily by our vision because our human eye can identify various color shades easily instead of few gray shades. This can be done by color mapping. Those black and white images are used by doctors for examination of the biological structure of the humans. Those medical images produced are with less luminance. So there is a need of converting those grey scale images to colored one by which the perception of image is clear and can be diagnosed clearly.

Any defects or damage to our internal body parts cannot be seen by our eyes so we are using medical imaging. The various imaging techniques used in medical field are X-rays, Computed Tomography (CT scan), magnetic resonance imaging (MRI) and ultrasound. Each imaging techniques uses various technology for creating medical images [14]. Those images produced by imaging techniques are in grey shades where luminance is less. So we are in need of colorization such that the visual perception of those images can be enhanced.

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In this paper we are using jet color map for medical images because jet uses multicolored one such that many colors are shown such that the tissues, bones and inner parts of the body can be seen clearly and the defects in those parts can be identified easily so colorization of images is done.

II. RELATED WORK

Jaspreet and Amita [1] proposed a method for automatic method for image enhancement by which inspecting of leukocytes procedure is faster and easier the data handled is more when compared to normal. Their approach is to find out the best method for enhancing the images in acute leukemia.

Jonathan and Nigel [2] in their method generated an automatic color map for realistic volume visualization. Their approach says that most of the color maps used for volume rendering has value questionable and even data analysis information is also unclear so they proposed an automatic color map for realistic volume visualization. The method used is volume rendering and the result generated gains the realistic color by contrast perception which is typical in gray scale image.

Tareq, Shahed [3] in reproduction of color and processing of algorithm was based on real time mapping and the images used were endoscopic images. They used a dictionary based approach. Their algorithm had low complexity and execution is high compared to other methods.

Adithya and Maniuder [4] enhanced a false coloring method for medical image processing. This method was used because in diagnosis of ligaments, tissues, bones the images will be clear at one sight. This approach is used in medical applications. Cristian and Vasile [5] used contrast stretching and their detail enhancement for satellite images. They used genetic algorithm where the proposed method consists of a new operator problem in contrast enhancement.

III. METHODS

3.1. Image enhancement:

The main purpose of image enhancement is that to improve the quality or perception of the images. So we can enhance our original image which is more suitable for the particular type of application. We can classify image enhancement into two one is spatial domain and other one is frequency domain .Image enhancement [6] in Spatial domain refers to the image of the plane itself and the process is directly based on the calculation of pixels. Whereas image enhancement in Frequency domain depends upon the change in Fourier transformation of an image.

3.2. Enhancement in spatial domain:

The term spatial domain refers to the fusion of pixels of image. The Spatial domain can be represented as $h(a,b) = R[n(a,b)]$ where $n(a,b)$ input image and $h(a,b)$ is the image to be processed, R is the operator defined on h, defined in neighborhood of (a,b).
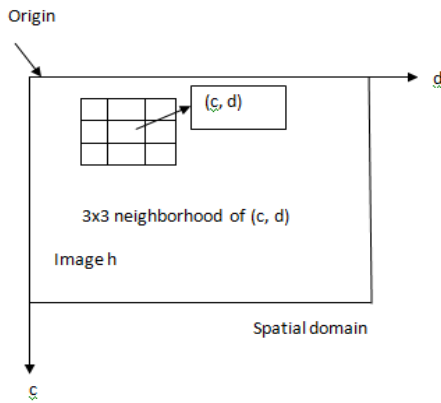

Figure: 1 A 3x3 neighborhood of image in spatial domain

3.3. The basic intensity level transformation:

The intensity level transformation of the image can be classified as logarithmic, linear and power law and piecewise linear transformation is as in figure 2.
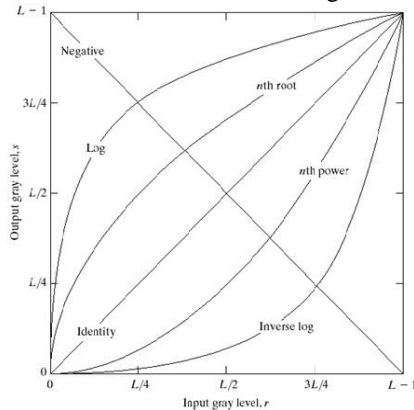

Figure 2: Intensity transformation function

3.4. Logarithmic Transformation:

The logarithmic transformation is expressed a $S=c\log(1+r)$, where c represents the constant and $r\geq0$, is the shape of log in the figure .For the compression of high-level values this type of log transformation is used for pixels with dark shade an image. The important characteristic of log function is that it compresses range of images with large variations of pixel values.

3.5. Image negatives transformation:

The Image negatives transformation is also called as linear and identity transformation. The linear level of the grey image limits from $[0,L-1]$ and is got from negative line which is as shown in figure and is represented as $S=L-1-r$.This approach of processing is used for enhancement of white or grey level images in dark.

3.6. Log Transformation:

The log transformation is generally represented as $S=c\log(1+r)$, c is constant and $r\geq0$, is shape of log is in figure this type of transformation is used for pixels dark shade in an image by the compression of high-level values.

3.7. Power-law Transformations:

The Power law transformation is otherwise known as Gamma transformation. A $s=cr^{\gamma}$ and when the input is zero the basic form can be represented as $s=c(r+\varepsilon)^{\gamma}$ where c and γ represents the positive constants ε is plot of the curve which is as shown in figure which is used for general purpose contrast manipulation.

3.8. Piecewise Linear transformation:

The Contrast stretching is the simplest form of piecewise linear transformation. If the images are of with very poor illumination or lacking of contrast to overcome it the contrast stretching is used where which the level of the intensity of the image can be improved [5].

IV. COLOR CONVERSION:

Color conversion is the way by which we change the grey scale image into colored one. There are different ways of color conversion which exists. This can be done effectively by color mapping. A color map [11] is one which consists of matrix value between 0 and 1 which shows the colors for images, patch objects and surfaces, images, and patch objects. MATLAB [8] draws has predefined color mapping and the graphical objects represents the data's for color in color map.

Cool:

Cool is a color map which is in shades of cyan and magenta. This color varies from the cyan and magenta. This is as shown in figure 3.

Figure 3: The cool color scale

Jet:

Jet [15] expanse from blue color to red color and then it traverse from cyan, yellow, and then to orange color. The main advantage of jet colormap is that all 256 colors are displayed using this colormap. Jet map is used when we use various colors for image. Figure 4 predicts the jet color scale

Figure 4: The jet color scale

Copper:

The copper colormap ranges from black color to bright copper color. This is as shown in figure 5.

Figure 5: The copper color scale

Hot:

The hot color map diverse from black through the tone of colors from red color, orange color, yellow color and then to white. This hot color scale is as in figure 6.

Figure 6: The hot color scale

V. PSEUDOCOLORING:

Pseudocolor image processing [12] is one which changes the grey values to colors which depends upon a specific approach or method. The term "Pseudocolor" says that the colors are applied artificially to the original colors. The main need for Pseudocoloring is that we can get a clear visual perception and a get clear scale of the image. There are many ways by which pseudocoloring is done [6] one is by Intensity slicing and other one is by Grey level to color transformation.

5.1. Intensity slicing:

A 3D image spatial coordinates where we are considering the height and intensity. With respect to the coordinate planes the planes are considered side by side. The value of one side of the plane is predicted in by one color and the other side is indicated by a different color.

Intensity slicing is denoted as a limit of [0,L-1] as grey scale where L-1 is white [f(x,y)=L-1],0 represents black [f(x,y)=0].here the vertical planes are P planes and the axis of intensity is at level l1,l2,l3......lp.0<P<L-1 where P planes divides the grey scale into P+1 intervals V1,V2,V3....VP+1.The color of the grey one is Vk where the partition planes are at l=k, the colored one is ck where the intensity level is k$^{th.}$
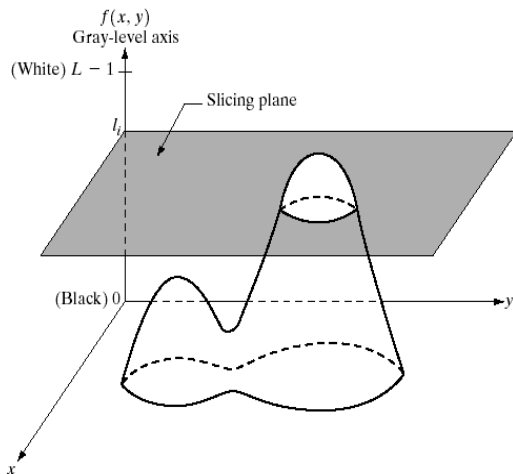

Figure 7: Intensity slicing representation

By the use of this intensity slicing the intensity range is divided into number of intervals and for a specific location colors are assigned based upon the intervals which the pseudo is colored image such that the intensity levels are sliced and we assign different colors for different slices.

5.2. Grey Level to Color Transformation

The Grey Level to Color Transformation is processed for large values for enhancement of pseudocolored one. For the three level grey level transformation are done on the grey

values of the input which is the input pixels, then for these grey values are sent into the red, green, blue channels of the monitor.fig 8 which is based on non linear functions, smoothing depends upon a single monochrome image. Based upon the change in frequency and phase in grey scale the image enhancement is obtained.
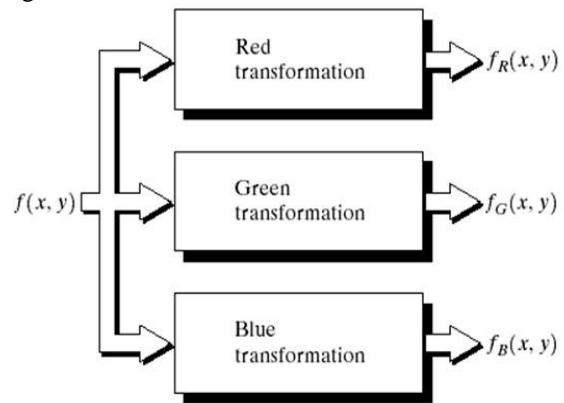

Figure 8: Block diagram for pseudocolor image processing

VI. PROPOSED METHOD:

A color mapping shifts the range from one main image to another destination image. There are predefined colormaps we are using jet colormap because jet is more pleasing, brilliant in color and the main thing is that no consideration of the scale value for example with small details we can get all the details in our plot value and never lacks variance and this jet colormap is applied to our medical images.
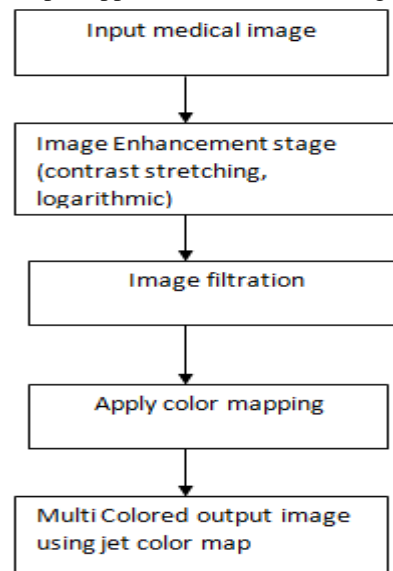

Figure 9: Work flow of the proposed work.

The figure 9 says about the work flow of the proposed work the input that we give is the medical image and next is the image enhancement stage where contrast stretching and logarithmic is done, then the image is filtered to remove any unwanted noise,

the next process is applying color mapping to the images and then we get the final multicolored output image using jet color map.

VII. SIMULATION RESULTS:

In this part, we present the experimental analysis of applying our novel approach for pseudocoloring of medical images using different color mapping. The images are retrieved by using DICOM [17] viewer and then we are converting it into jpeg format. DICOM viewer stands for Digital Imaging and Communications in Medicine (DICOM) is a format for storage and to send medical images where there are the medical images which stores MRI, CT, ultrasound images along with patients details in one file.. The colormaps used are Cool, Hot, JET, Copper. The simulation values are compared in two ways one is by the histogram [10] other one is by time taken by various color mapping. This is as shown in Table 1 and Table 2. The values are done by MATLAB.
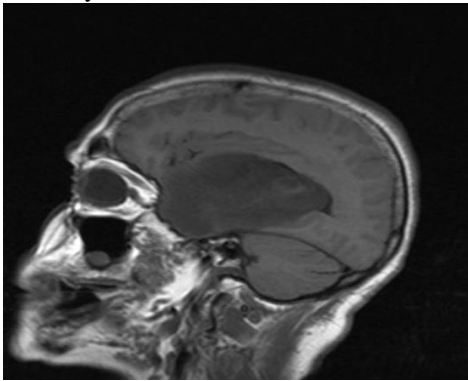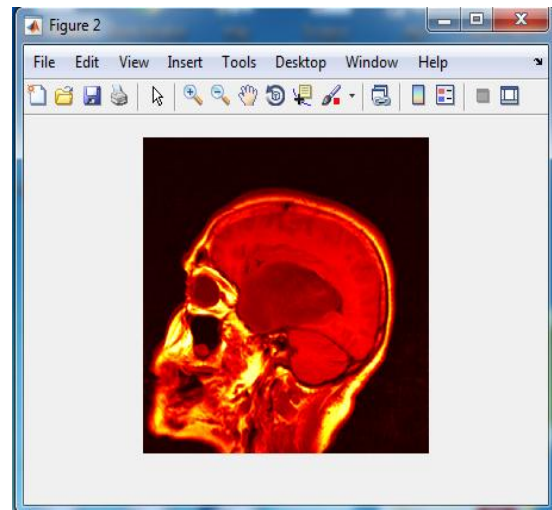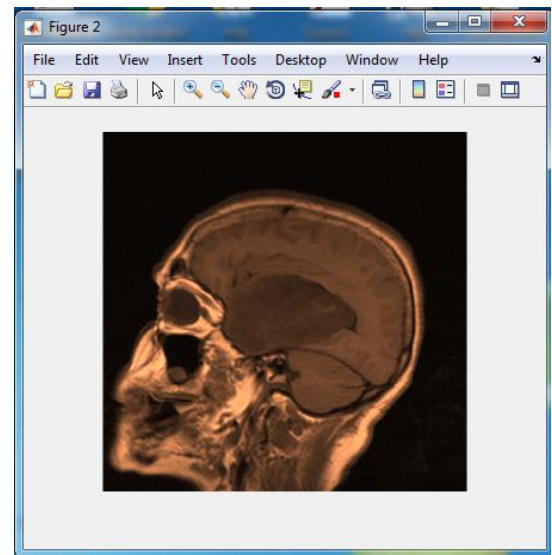

(a)
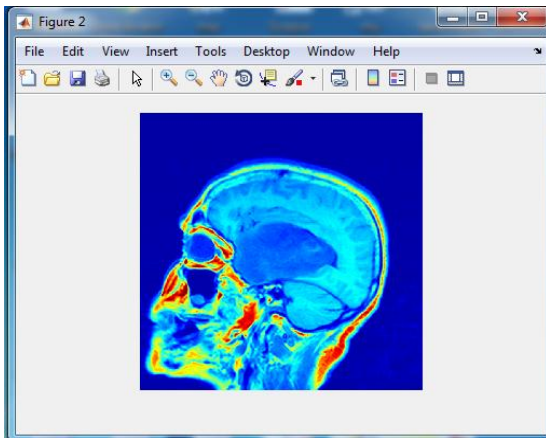
(b)
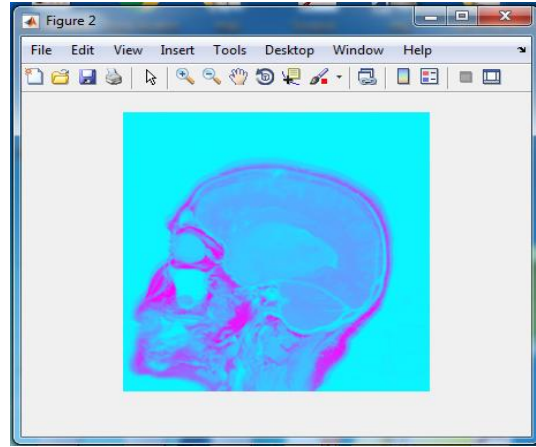
(c)

(d)

(e)

Figure 10: a) Original image, Pseudocolor using b) Jet c) cool d) Hot e) Copper

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From the figure 10 a says about the original grayscale MRI image, figure b gives the perception that the jet colormap displays multiple colors, figure c says about the cool color map which has shades of cyan and magenta only. Figure d has only the tones of red, orange yellow then to white. Figure e gives the shades of black to bright copper color. The proposed method jet color map gives better results when comparable to other color mapping methods because color displayed by jet is of multi colors and the insight of the jet colormap is clear. Because color is one of the way to enhance an image. The comparisons are done by using histogram [12] values of color maps which is shown in table 1. And table 2 says about the time taken by different color maps

Images	Size of the image(KB)	JET	COOL	HOT	COPPER
1	44.8	(14,1)	(35,18)	(94,3)	(19,3)
2	140	(9,4.8)	(21,15)	(10,5)	(15,10)
3	27.7	(12,4)	(22,12.4)	(10,15)	(17,12)
4	48.0	(9,4)	(94,31)	(20,5)	(18,13.5)
5	36.4	(10,4)	(36,2)	(12,13)	(17,12)
6	85.3	(11,10)	(18,23)	(20,15)	(18,21)
7	38.0	(9,1)	(18,23)	(19,18.3)	(51,43)
8	32.8	(10,8)	(21,4)	(60,48)	(18,25)
9	350	(10,5)	(83,12)	(17,7)	(31,15)
10	26.9	(13,4)	(20,8)	(21,15)	(20,18)

Table 1: Comparison of color maps using histogram.

Images	JET(Sec)	COOL(Sec)	HOT(Sec)	COPPER(Sec)
1	1.295	4.950	1.310	1.171
2	1.098	1.410	1.311	1.160
3	1.157	1.348	1.309	1.161
4	1.146	1.331	1.441	1.159
5	1.319	1.311	1.281	1.150
6	1.114	1.260	1.269	1.121
7	1.371	1.301	1.329	1.651
8	1.258	1.289	1.139	1.361
9	1.124	1.301	1.128	1. 241
10	1.060	1.270	1.252	1.171

Table 2: Time taken by different colormaps

VIII. CONCLUSION:

This paper says about a novel method for coloring medical images where most of the images are in gray scale format. By coloring an image the quality and the display of the image is improved. By giving colors to the image we can evaluate the perception of quality of the image. The proposed algorithm generates a color map for black and white medical images. The output generated by jet color map shows better valuation in term of display as well as in terms of performance. The proposed method can also be used for images with least brightness too. To conclude we can say that jet is more pleasing and the brightness of the image given by jet is very clear when compared to other color map in terms of color and display.

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