Colorization using Desired Color for Medical Images

Selvapriya B, Raghu B

Abstract:Colorization is the terminology which describes a computerized process for adding colors to black and white movies, pictures or television programs. Colorization is the way of coloring a grayscale image or video which assigns luminance or intensity for red, green and blue channels. The general problem of adding chromatic values to gray scale image has no exact objective solution. The current approach that we use provides a method to minimize the amount of human work done during colorization. The medical images such as CT, MRI, X-ray and mammograms are mostly in black and white color so to get a better perception of images we are in need of coloring the images. Medical images should be clear such that the patient can be diagnosed and the treatment can be given accurately .This method is used to convert the gray scale medical image to color as color increases the visual appearance of image and also makes the visualizations more attractive. In this paper we present a novel method for applying colors. The coloring process is done by pseudocoloring method. The effectiveness of this method allows to works interactively and obtains result after providing colors. In this method we show that the proposed approach allows high colorization of images and the colored image is clear without loss in information.

Keywords: Colorization, medical images, pseudocolor, gray scale image, colors.

I. INTRODUCTION

Digital image processing is one which we use computer algorithm for creation of images, process an image, communicate an image, extraction of some information from images and displaying of digital images. Digital image processing is useful where we can improve the clarity of an image, for removing noises in images and for compression of images. Digital image processing is used in enormous areas some of the application areas where digital image processing is used are in medical field for medical images such as CT, MRI, PET, Mammography etc [1],robotics, processing of colors, Pattern recognition, Video processing. Medical imaging is one which is used for creation of images for different parts of human body such as bones, tissues, organs which is used for medical investigation, analysis and treatment for patients. Imaging methods is used in various fields such as Nuclear Medicine, Radiology, optical imaging etc. For examining diseases doctors often use X-Ray, CT scan, MRI, Ultrasound etc [1]. Medical images give a clear perception of defective area of the patients. Medical images play an important role for confirmation of treatment given to patients. By the follow up of Medical images after treatment we can monitor the development in patients.

Revised Manuscript Received on March 25, 2019.

Selvapriya B, Research Scholar, Department of Computer Science and Engineering Bharath Institute of Higher Education and Research, Chennai

Raghu B, Principal and Professor, Department of Computer Science and Engineering SVS Group of Institutions, Telangana

Early exposure of many diseases is possible by medical images for example the treatment given for cancer patients or detection of cancer in early stages. The most of the medical images that we get is in grey scale image or monochrome one. Our human eye can recognize only few shades of gray but millions of color [2]. So for a clear view of the images we are in need of coloring them. Adding colors to images gives a clear understanding of it where even a small bone or tissues can be clearly seen in medical images. So we are in need of coloring the medical images. The main objective of this paper is to add colors to the medical images without any loss of information. Such that the output images produced does not damages the original image.

II. EXISTING METHODS

2.1. Gray scale image:

A grayscale image is one which represents the value of individual pixel of an image. Gray scale image emits only particular source of light. Images that we get from gray scale image are in black and white or few shades of gray [3].Figure 1 say about the example of gray scale images. Gray scale image consists of one value or one color image. Gray scale image consists of information only on luminance but it does not contain any information about the color. The intensity level for gray scale image is black color at weakest level and white color at strongest level intensity is white in color .The gray image consists of 8 bits per pixel and the representation of the image is from 0 to 255 which represent different level of brightness.

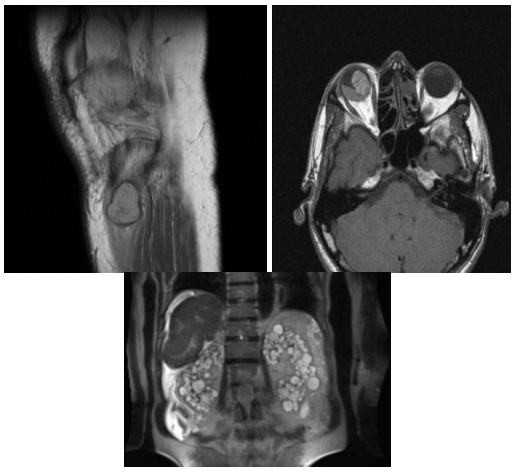

Figure 1: Some image representation of gray scale images

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A gray scale image is used in medical images, satellite images, photography etc. Representation of gray scale image depends upon the intensity levels of the image. Gray scale image has many shades of black and white.

Masking:

A mask is one which is a filter. Masking is also called as spatial filtering. Masking is also known as filtering. In this aspect of masking the operation of filter is done directly to the image. Image masking is primarily needed because we can separate a particular part of an image or its background. When we are in need of a particular part of an image masking comes on in hand. For binary images we use binary masking. A binary masking is one where the range of some pixel of image is zero and remaining is non zero. Masking can be done selecting a particular area which is done by using Region of Interest (ROI).masking can be done by particular portion of the image [4].

Importance of masking:

Masking is needed when we are in to cut or edit a particular part or portion of an image needs to be masked or for capturing.

Need for masking:

The images needed to be masked because if we are in need cutting or editing some portions of the image or only that particular portion alone needed to be masked or captured [5],[6]. In the figure 2 says about the original MRI image and figure b says about masked image. Suppose if we are need of some pixels in the image needed to be white in color. But it may not be visible to naked eye, so for a clear picture masking is used.

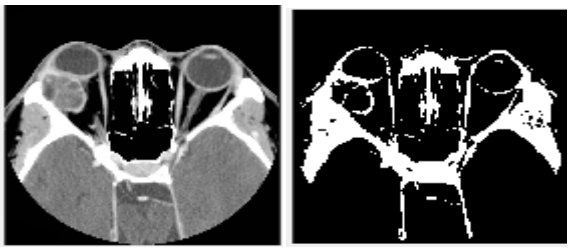

Figure 2. (a) Original medical image (b) masked image

Binary masking using region of interest:

The binary mask says about the region of interests (ROIs) of the original image. If the value of the mask pixel is 1 it says the pixel values if the mask pixel value is 0 it says about the image belongs to ROI. Any variety of binary images can be masked. Figure 3 a says about the original image and figure b says about the binary making using ROI.

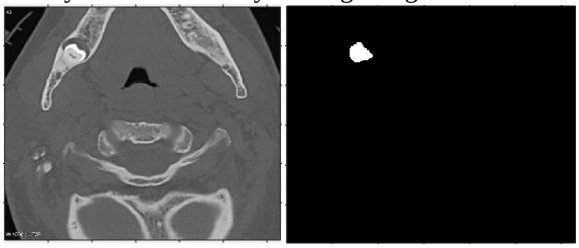

Figure 3. (a) Original medical image (b) Binary masked image using ROI

Color channels:

Color is seen by human eyes as a combination of three colors red (R), green (G) and blue (B) which is generally called as primary colors. It is usually called as RGB colors. A channel in this sense is same measure as the color image. An RGB images consists of three channels namely red, green and blue channels [7].RGB channels follows the senses for human eye this is usually used for image scanners and computer displays. Figure 4 says about the pictorial representation of the RGB channels of an image.

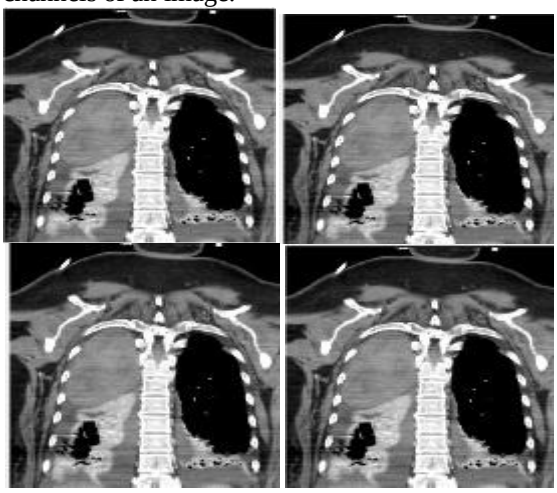

Figure 4. a) Original image b) Red channel c) Green channel d) Blue channel

Example if an image is of 24 bit each individual channel has 8 bits which is RGB channels. If it is 48 bits then each image consists of 16 bits for each channel. Similarly the size of the channels is divided into three depending upon the bit size of the image. This channel is used for illumination of an image.

Morphological structural element and dilate (MSED):

Morphology based image processing depends upon the processing of image which stands on shapes. Operations in morphological image processing apply a structural element to an input image, by which the output image created will be of same size of the input image [8]. Depending upon the related pixel of the neighbor of input image. Value of output image is based on the comparison of each pixel. There are many morphological operations used but the commonly used is dilation and erosion. In Dilation pixels are added to the object boundary of the image meanwhile in erosion removes the pixels of the object boundary. The adding or removing of pixels depends upon the shape and size of the structural element which is used for processing an image.

Uses of morphological operations:

It changes the shape of the objects by using nearby operations. Unwanted effects in post processing of segmentation can be removed. To fill the holes, to link the objects together, for object thinning etc.

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Pseudo color image processing:

Pseudocolor image processing [9] is one which converts gray values to colors based on particular method. The word "Pseudocolor" indicates that the colors are assigned unnaturally opposing to the real colors. The main purpose of Pseudocolor is used for clear human perception and clear gray scale details on an image. Intensity slicing and Gray level to color transformation are two ways in which pseudocoloring is done.

Intensity slicing:

An image is considered as a 3D spatial coordinates to intensities which is considered as heights. Planes are placed at particular levels side by side to the coordinate plane. If range is one side of such a plane one color is shown, and a different color is shown on another side. This is shown in figure 5.

In short intensity slicing can be represented as, [0, L-1] is grey scale L- 1 represents white [f (x, y)= L-1] ,0 represents black [f (x, y)= 0].Suppose P planes are vertical to intensity axis are defined at levels l1,l2, …, lp. Assume that 0 < P < L-1the P planes divides the grey scale into P +1intervals V1, V2,…, VP+1. Grey level colored value is where *Vk is in* partition planes at *l = k* –1and *l = k*, *ck* is the color with the *kth* intensity level.

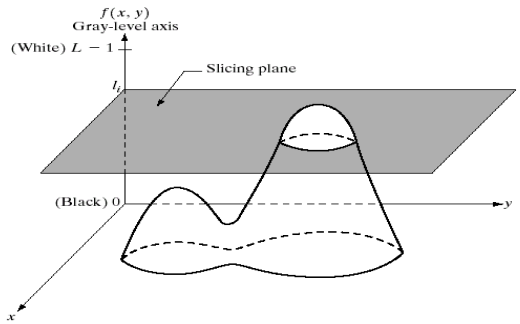


Figure 5: Intensity Slicing

By using this method we divide Intensity range into number of intervals and for particular location we assign color to intensity image which is obtained by intervals, is Pseudo color image which we slice the intensity levels and to that various slices we assign various colors.

2.5.2. Gray Level to Color Transformation

Gray Level to Color Transformation is done to achieve wide values of pseudo color enhancement. Three level independent transformations are performed on gray levels values for any input pixels; these values are sent separately into the red, green, and blue channels of a color television monitor. (Fig. 6) this can be based on smoothing, nonlinear functions, which based on a single monochrome image. Various degree of enhancement is obtained (Fig.6.24) by changing the frequency and phase of the gray scale.

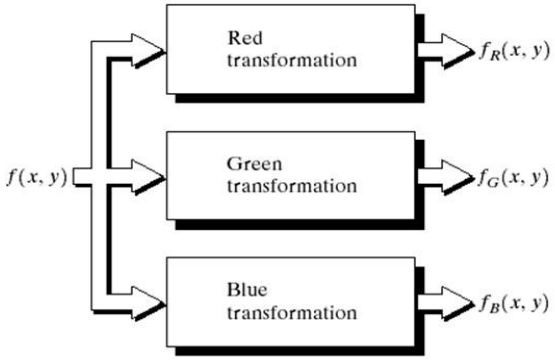


Figure 6: Block diagram for pseudocolor image processing

DICOM viewer:

The digital imaging and communications in medicine (DICOM) is the most common way of storing information related to medical imaging which is used in hospitals [10]. It is open source software which is convenient to use. This is as shown in figure 7. This is of less cost effective. DICOM is used for storing; transmit of images to printers, scanners. DICOM is used for MRI images; CT, X-Ray, ultrasound and those can be stored in DVD or CD format.

Figure 7: Representation of medical image in DICOM viewer

III. Literature survey

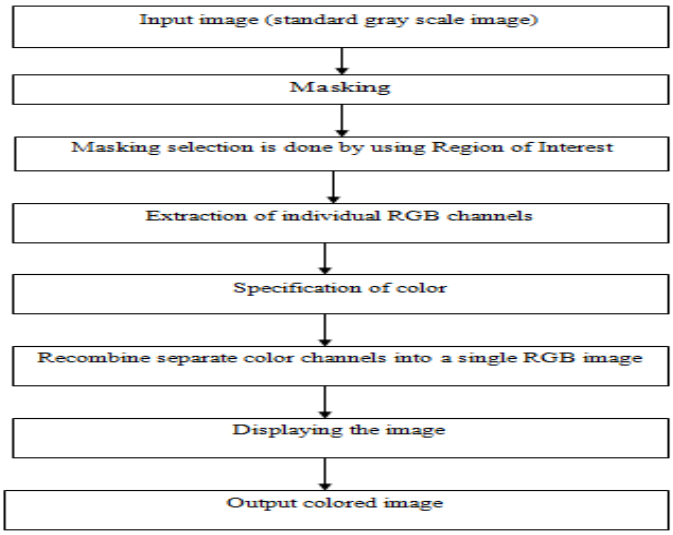
After doing an intensive analysis of the existing work carried out in this area the current method was proposed. There have been enormous works done in the areas of medical image processing in which coloring plays an important role for better perception of the images. Nudrat, Muhammad [11] in their paper generated an automatic framework for colorization of medical images. The method used in this process is enhancing an image and colorizing it which is based on structural features which remains same on the addition of chromatic features. Prezmyslaw, Bogdan [12] said about cololorization of medical images which converts the gray scale medical image into color by which the visual appearance of the image is clear. The approach used is luminance keying and motion estimation. The result obtained is there is no change in intensity of the original image without chromaticity component. Noda, Korekumi [13] in their method proposed an algorithm for colorization which is based on local Maximum a posteriori (MAP) estimation. In this method, coloring is done by MAP for a given monochrome image.

For modeling an image Markov random field (MRF) is used when the proposed method is done the high quality of color images is produced. Shah, Mikita, Shah [14] in their method colorization of medical image is done by an optimized technique where the visual appearance of image is clear and improved. The results obtained in this method there is no change in the content of the original image without any difference in intensity. Boopathi Kumar, Thiagarasu [8] said about extraction of color channels in RGB images by using image segmentation. This method says about the representation of color image segmentation and by the extraction of segmentation by extracting the RGB color channels by masking, filtering by methods of thresholding .The techniques used is image segmentation techniques which is based on RGB model represented in this process. Then the modified color channel is used for the colored image. Ugrasenamaharaj, Syeda Sana [15] presented a region of interest which is based on advanced image compression technique which can be applied for telemedicine system. In their method the implementation is based on encoder and decoder using region of interest using discrete wavelet transform. The region of interest is important because it says about the area of diagnosis of disease. This method is mainly used in assistance of telemedicine system where storage of data can be reduced. Priya, Kadhar [16] in their paper is said about morphological image processing technique which is used for reconstruction of image the method used is to process the pixel which is based on dilation for erosion. The morphological image processing is useful for removing unwanted details and reconstructing images.

IV. Proposed work

Essentiality for colorization:

An image is one which is the representation of some information. The information is stored in form of pictures. In medicinal field images are used for diagnosis of disease in patient for defects in bones, organs, tissues etc which cannot be seen by naked eye so we are in need of medical images. So these type of images can be perceived by MRI, CT, X-ray [1] etc and the images which is got from those ways are mostly in gray scale format. So to get a clear view we are in need of colorizing the images because human eyes can percept only few colors of shade but can identify millions of colors. So we are in need of coloring it. This is done by a method called pseudocoloring [9]. Coloring the entire image can be difficult because the image can be changed so we are selecting a particular area by masking using the Region of Interest (ROI) [13].the gray image is got from DICOM viewer. Then we will extract the individual RGB channels [5], color specification is done then we will recombine the separate color channel into a single RGB image then finally the colored medical image is obtained. The process of the proposed work is shown in flow chart. The flow chart for the desired color is as shown in figure 8. The methodological approach is as shown in figure. This involves creation of masking, extraction of individual RGB channels, and specification of color; recombine individual color channels into single RGB image, colored image using desired color.



Steps for the proposed work:

Medical Images are got from DICOM viewer. In the proposed work image processing toolbox (IPT) [17] is used from MATLAB and the following steps are done. The implementation is done by using following Steps.

Step 1. Load the MRI image.
Step 2. Then the original gray scale image is retrieved.
Step 3. Creation of binary image by masking using ROI.
Step 4. Extraction of individual RGB channels and specification of color.
Step 5. Recombine separate color channel into one RGB image.
Step 6: Display the image.
Step 7: Output colored image with inside the mask.

V. Experimental results and analysis

The proposed approach is applied from images collected from hospital and the implementation is done by using Matlab. In this process the Image Processing Toolbox (IPT) [17] from MATLAB is used.

Image Processing Toolbox:

Image processing toolbox (IPT) is one which is used to perform in the analysis and algorithm development in image processing. This is used for importing and exporting of imaging, conversion of images, enhancing an image. We can also perform image segmentation; calculate the Region of Interest (ROI). This tool box is used for creation of Histogram, display of big images.

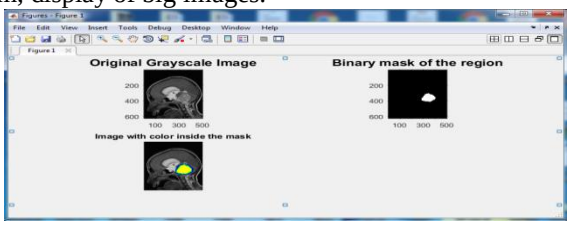


Figure 9: Desired color MRI image of the brain

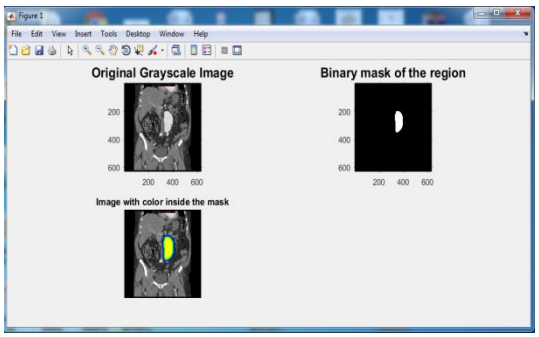


Figure 10: Desired color MRI image of the abdomen

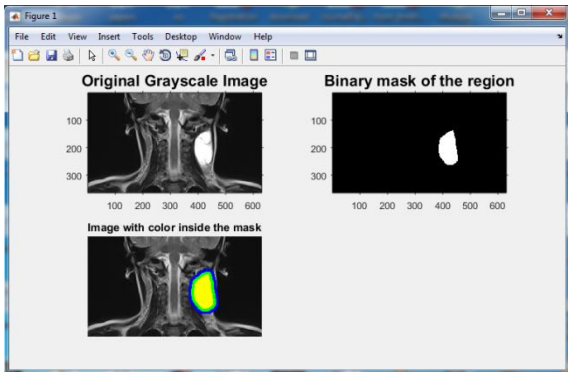


Figure 11: Desired color MRI image of the neck

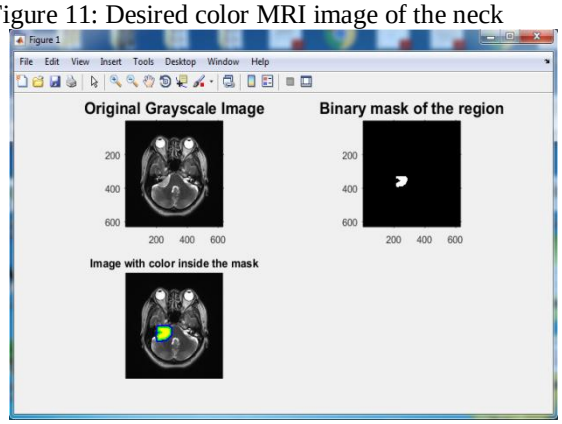


Figure 12: Desired color MRI image of the face

The result of the proposed work is as shown in figure 9,10,11,12. This method is applied to different body parts of MRI image. The figure 9,10,11,12 says about the original gray scale image, masking is done by using Region of interest, and then the image within the color mask is done. Three different colors are obtained by using desired color namely yellow, green and blue. The yellow color says about the intensive defect, green says about less defective and blue says about the least defective area of the MRI image of the patients. The values are obtained using the histogram of the images. The histogram of the colored image is as shown in the table 1.

S.no	Type of image	Masking value	Time taken (Seconds)
1	Neck	Y=(5,4) G=(4,3) B=(2,1)	0.670
2	Abdomen	Y=(5,5) G=(6,2) B=(7,1)	0.406
3	Brain	Y=(6,5) G=(7,2) B=(0,0)	0.430
4	Face	Y=(3,5) G=(4,5) B=(5,4)	0.710

Table 1: Histogram values of desired color for different body parts.

VI. Conclusion:

The main objective of this desired color medical images is to make easier for the medical practitioners for identification of the biological parts of the patients. Because of colorization the visual appearance of the images is increased. Because human eye percepts millions of color than few shades of gray. The result of the proposed work is applied for various medical images such as CT, MRI, X-Ray and ultrasound images. Here we colored the medical images by using binary masking using Region of Interest (ROI).The major advantage of this work is that instead of colorizing the entire image we are selecting the particular defective area such that the colors are given for that ROI. This colorization technique when applied to medical images does not give any changes in structure of the images. This approach can also be applied to satellite and aerial images regardless of the shape and size.

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