Open Journal of Radiology and Medical Imaging
Short Communication ISSN: 2583-1534 Open Access

Coloring CT Scan Images

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***Received Date:** May 09, 2022 / **Accepted Date:** May 25, 2022 / **Published Date:** May 27, 2022*

Abstract

There is a forensic necessity for coloring the organs of the corpuses to avoid doing full autopsy and allow the forensic pathologist to see the color of the organs. The aim of this study is proposing a new idea for CT coloration for forensic purposes since the present technologies have coloring, but it is not real coloration; rather than assigned colors which can't show how the organ really looks like inside the patient.

Keywords: Computed Tomography; Coloring; Hounsfield Unit; Volume Rendering Technique; Forensic Radiology

Cite this article as: Abdulwahab Alahmari. 2022. Coloring CT Scan Images. O J Radio Med Img. 5: 10-12.

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Introduction

In forensic radiology, there is a need to see how the organs color looks like to see if there is any inflammation process which is important in forensic medicine. As well, the surface of the body could be intense pale due to losing large amount of the blood externally which is important from forensic point of view. Therefore; there is a need to color CT scan images to allow seeing how the organs looks like from outside the body (i.e., on the CT scan) just similar to seeing the organs from inside the body (i.e., during autopsy). There are three conditions for this coloring in order to be useful.

- The image represents the real color of the organ inside the patient who undergo the CT scan and it is not just a coloration for the sake of seeing colors!
- The colors will not hide any radiological finding, but it will do the opposite. It will show if there is any pathology with different colors.
- It depends on converting the gray scale Hounsfield unit into colors to give a real representation of how the color of the organ of the patient looks like.

The Proposed Methodology

The image uses three colors which are; red, green, and blue (RGB) only because the eye has one rod, but it has three cones in the human eye which are: red-, green-, and blue-sensitive cones. Each cone has light absorbing molecule appears similar to the retinal found in rods.

DOI: https://doi.org/10.36811/ojrmi.2022.110044 OJRMI: May-2022: Page No: 10-12

There are two methods of converting a colored image to a gray scale image which are; A) Average Method and B) Weighted Luminosity Method. The average method converts from RBG image to gray scale image by adding;

$$\frac{R+G+B}{3} = gray\ scale\ image\ (black).$$

The issue with this method it will show the grey scale image "black". The image looks black because of the reduction is equal to the three colors RBG by 33% for each one (i.e., 33% of the red color, 33% of the blue color, and 33% of the green color). The other method is Weighted Luminosity Method which solves the black image issue. The red color has more wavelength than the other two colors (i.e., green and blue). This means in order to solve the black image, the red color must be decreased, the green color must be increased, and the blue color level must be in the middle between the red color and green color. The equation will be;

$$\big((0.3 \times R) + (0.59 \times G) + (0.11 \times B)\big) = gray\ scale\ image\ (brighter).$$

The contribution percent for the red color is 30%, green color is 59%, and the blue color is 11%.

If these two methods can be reversed (theoretically) it could give coloring to the CT images, but I would not be real images. The percentages of colors can be given to the pixels or in case of CT images voxels will be colored images, but it would be given percentages given from outside; even though; the pixel or the voxel have the information from inside the body. Therefore; these two methods could not work. In CT machines there is a coloring box (it is called "color lookup table") in image modulation which can be used, but the given percent are unknown and the three colors are not mixed together (i.e., the red color in separate option like the green and blue colors). The three colors need to be offered in the color look up table on CT machines mixed using Weighted Luminosity Method percentages for each of the three colors (i.e. RBG). The CT scanner will transmit the X-rays which will be absorbed differently between the body parts. Then the bone will look white by obscuring the X-ray and the lung will look dark because the air will not obscure the X-ray. Then based on the density, the Hounsfield units are given to the body part as voxel density. Therefore; if the Hounsfield unit can be used to give colors to body organs which lead to virtual endoscopy (VE) and volume rendering technique (VRT). The issue that VRT is using colors range to show something like the depth which is an old technique used since renaissance time by adding darker colors to show the depth. This is why VRT does not show real color images. As well, the organs which have close Hounsfield units, but have different color. The Hounsfield units vary in the same organ between many patients in different reference values. The real color of one organ can vary between many patients. To solve this issue many studies must be conducted with large sample sizes from all ages, genders, races, ethnicities, and backgrounds. Then make a reference value or a range with minimal standard deviations. Another study of colors must be done of organs to make a reference value for the shades of any organ's color and it must be collected and correlate with the Hounsfield units. Then the CT scan must be programmed to assign these shades of colors to organs which will be more real than VRT. Any pathology that has a higher Hounsfield unit than the registered reference values will be given a specific color to show it as a pathology. The missing part is the standardized data (i.e., reference values) of Hounsfield units, the data of colors shades of normal subjects only, the programming to assigned these colors to the organs, and the correlation between Hounsfield units and the colors. This is can be done on cadavers and dead corpuses for autopsies.

Discussion

A previous paper was published supports the idea of coloring radiology imaging for medical purposes [1]. Due to the low standards colored VRT, a new coloration method must be done and it must be more accurate. There is a medical use of applying coloring on radiology images have been reported [2].

DOI: https://doi.org/10.36811/ojrmi.2022.110044 OJRMI: May-2022: Page No: 10-12

Conclusion

The coloration of CT scan images can help in forensic radiology cases and prevent the need for doing autopsy to see the color of the organs. It could show any pathology or foreign body placed inside the body of the patient.

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