A novel based image encryption by using Adaptive Histogram Equalization and RGB color cube, YUV color model

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Abstract: In this paper a novel based image encryption by using Adaptive Histogram Equalization and RGB color cube, YUV color model. Image enhancement plays a fundamental role in lots of image processing applications. Image enhancement process includes a couple of techniques that seek to improve the visual appearance of a graphic or to convert the image to an application better fitted to analysis by an individual or machine. The principal objective of image enhancement is to change attributes of a graphic to make it more ideal for confirmed task and to a certain observer. Histogram equalization is used to enhance contrast. It is not necessary that contrast will always be increase in this. There may be some cases were histogram equalization can be worse. In that case the contrast is decreased.

Keywords: Image Enhancement, Histogram Equalization, Adaptive Histogram Equalization, RGB color cube, YUV color model.

1. Interdiction:

Histogram equalization is a common approach for enhancing contrast and brightness in grayscale images. Extending this tool to color images is not straightforward. Color histogram equalization is a three-dimensional problem. Moreover, RGB is not a suitable color space because of its poor correlation with human visual system, requiring a color space transformation. Histogram equalization on the intensity component can improve the contrast, but can cause de-saturation in areas where histogram equalization results in a large reduction in intensity. Similarly, equalization of the saturation component alone can lead to color artifacts. Independent equalization of RGB components is also not advisable as it can lead to a hue shift. In one of the earliest papers on color processing in color difference space (YCC), Hague, Weeks and Myler [Hague 1994] presented an approach where histogram equalization was performed on saturation for each hue in the image, taking into account the maximum allowable saturation for a given luminance. The color space was segmented into various pie-shaped hue regions, each of which was further divided into several luminance regions. For each of these regions, the minimum possible saturation value was zero, while the maximum possible saturation value was a function of both hue and luminance. Maximum allowable saturation for each region was determined by computing the saturation for every RGB combination and retaining the largest value computed within each hue region for all different luminance regions. Once the saturation limits were determined, histogram equalization was applied to each of the luminance regions within each hue region. Saturation equalization was followed by luminance equalization over the entire luminance image. This method helped reduce the number of out-of-gamut colors as well as color artifacts.

2.0 WHAT IS IMAGE PROCESSING.

As we have discussed in the introduction to image processing tutorials and in the signal and system that image processing is more or less the study of signals and systems because an image is nothing but a two dimensional signal.

Also we have discussed , that in image processing , we are developing a system whose input is an image and output would be an image. This is pictorially represented as.

The box is that is shown in the above figure labeled as "Digital Image Processing system" could be thought of as a black box

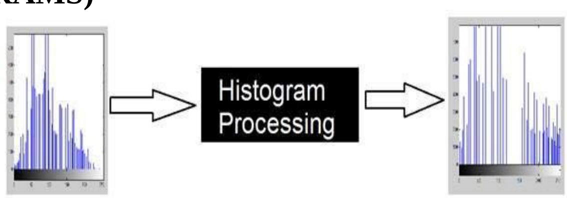
It can be better represented as:

2.1 WHERE HAVE WE REACHED UNTIL NOW

Till now we have discussed two important methods to manipulate images. Or in other words we can say that, our black box works in two different ways till now.

The two different ways of manipulating images were

2.3 GRAPHS (HISTOGRAMS)



2.4 TRANSFORMATION FUNCTIONS

This method is known as transformations , in which we discussed different type of transformations and some gray level transformations

2.5 ANOTHER WAY OF DEALING IMAGES

Here we are going to discuss another method of dealing with images. This other method is known as convolution. Usually the black box(system) used for image processing is an LTI system or linear time invariant system. By linear we mean that such a system where output is always linear , neither log nor exponent or any other. And by time invariant we means that a system which remains same during time.

So now we are going to use this third method. It can be represented as.

It can be mathematically represented as two ways

g(x,y) = h(x,y) * f(x,y)

It can be explained as the “mask convolved with an image”.

Or

g(x,y) = f(x,y) * h(x,y)

It can be explained as “image convolved with mask”.

There are two ways to represent this because the convolution operator(*) is commutative. The h(x,y) is the mask or filter.

3. Proposed Method

3.1. RGB to YUV Conversion

Figure 1 shows block diagram of the proposed method. Once original RGB image is obtained, RGB to YUV conversion is applied to obtain YUV image. Then, proposed histogram

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equalization is applied to Y channel to obtain improved Y' signal. Finally, the merged Y'UV image is conversed to R'G'B' image. In the Cartesian coordinate system, the RGB color model is outlined by a 3D cube format where red, green, and blue channels are located at the corners on each axis of the cube. Every pixel in a color image are described by adopting *n* (normally *n*=8) bits per color signal to produce the range of values from 0 to 255. Figure 2 shows an example of RGB color model cube where all values of red, green, and blue information are supposed to be in the interval of [0, 2*n*-1]. The origin point and the farthest point from the origin are the black and the white.

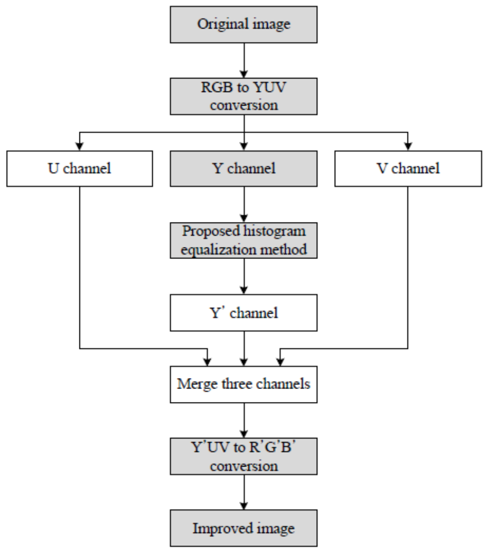


Figure 1. Flowchart of the Proposed System

In addition, all points between the black and the white are colorless. The RGB color model is normally one of the accepted color spaces for its simple structure for human to understand. However, RGB color model is not suitable for computer for some reason, and therefore YUV color model is widely adopted for computer graphics.

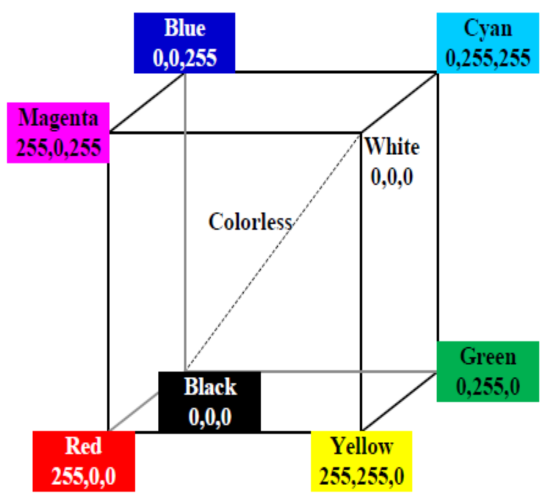


Figure 2. RGB Color Model

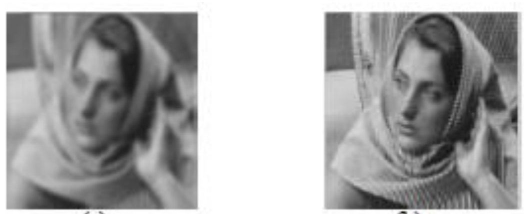
The YUV color model is used for compound video color criterion, which is adopted in the National Television System Committee (NTSC) and Phase Alternate Line (PAL) systems. As can be seen from YUV, it has three channels, Y, U, and V. Y stands for luminance, and U and V represent chrominance, respectively. There is equation to transform RGB signal to YUV color model,

$$\begin{bmatrix} Y \\ U \\ V \end{bmatrix} = \begin{bmatrix} .299 & .587 & .114 \\ -.147 & -.289 & .436 \\ .615 & -.515 & -.100 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \quad (1)$$

When we obtain YUV image, we apply our proposed histogram equalization method to Y signal to obtain Y' signal. In other words, only Y channel is process using the proposed method after RGB to YUV transform. After obtaining Y' signal, the inverse color transformation from Y'UV to R'G'B' is applied, which is described as,

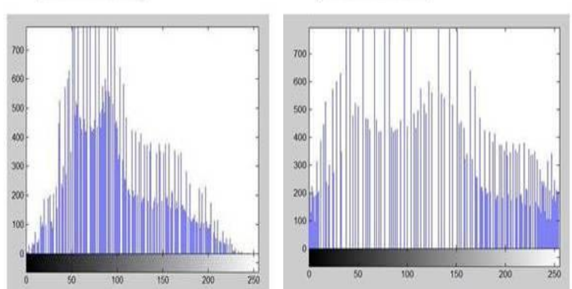
$$\begin{bmatrix} R' \\ G' \\ B' \end{bmatrix} = \begin{bmatrix} 1.000 & 0.000 & 1.140 \\ 1.000 & -.395 & -.581 \\ 1.000 & 2.032 & 0.000 \end{bmatrix} \begin{bmatrix} Y' \\ U \\ V \end{bmatrix} \quad (2)$$

Old image new image



(a) (b)

Old Histogram New Histogram



CALCULATE CDF ACCORDING TO GRAY LEVELS

Gray Level Value	New Gray Level Value	Frequency
0	0	2
1	1	4
2	2	6
3	3	8
4	4	10
5	5	12
6	6	14
7	7	16

Table : Evolution Results

Evaluation Images	Existing techniques	Proposed techniques
1	0.72	0.8
2	0.84	0.9
3	0.74	0.78
4	0.84	0.18
5	0.76	0.81
6	0.9	0.88
7	0.94	0.99
8	0.73	0.74
9	0.99	0.94
10	0.88	0.96
11	0.9	0.97

4. Conclusions

This paper highlights the various image enhancement techniques which can be used particularly for medical image enhancement which enable medical professional. The paper briefly reiterated the facts that, there still much improvements are required in existing techniques to get better results. In order to overcome the limitations of the earlier techniques a hybrid algorithm will be introduced in near future. The newest approach could have the ability to boost the contrast in digital images in efficient manner by utilizing the edge preserving fuzzy filter hypothesis. The presented histogram equalization method is only implemented to Y channel of YUV color model, which is transformed signal from RGB image. Simulation results show the performance of the proposed method.

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