



## A Flexible Algorithm for Conversion of RGB Image to Gray Image using MATLAB

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**Abstract:** Digital image plays a vital role in the world of multimedia because of its wide variety of application requirements. The common preliminary step of image processing is the conversion of color into grayscale image for simplicity. Many fundamental methods for converting color into grayscale are available. But the applications are influenced by the selection of RGB to gray scale method. MATLAB based image processing is a very convenient platform and very easy to construct an algorithm. In this paper, we propose a new transformation equation and compare the result with existing algorithm. MATLAB 8.1 was used for the implementation result.

**Keywords:** True Color Image, Grayscale Image, MATLAB.

### 1. INTRODUCTION

Color to gray image conversion has been widely used in real-world applications such as printing color images in black and white format and preprocessing in image processing. The main reason for using grayscale representations instead of operating on color images directly is that grayscale simplifies algorithm and reduces computational requirements. For many applications of image processing, color information does not help us to identify important edges or other features and also producing unwanted information which could increase the number of training data required to achieve good performance.

#### 1.1. Types of images

##### 1.1.1. Binary images

Binary image is the simplest type of image and has two values, black and white or '0' or '1'. A binary image is referred to as a 1-bit image because it takes only one binary digit to represent each pixel.

##### 1.1.2. Grayscale images

Grayscale image is a monochrome image or one-color image. It contains brightness information only and no color information. Then grayscale data matrix values represent intensities. Array of class uint8, uint16, int16, single, or double whose pixel values specify intensity values. For single or double arrays, values range from [0, 1]. For uint8, values range from [0,255]. For uint16, values range from [0, 65535]. For int16, values range from [-32768, 32767].

### 1.1.3. Indexed image

An indexed image consists of an array and a color map matrix. The pixel values in the array are direct indices into a color map. The color map matrix is an  $m$ -by-3 array which is contained floating-point values in the range [0,1]. Each row specifies the red, green, and blue components of a single color. An indexed image uses direct mapping of pixel values to colormap values.

### 1.1.4. RGB Image

RGB image is also known as True color image. A true color image is an image in which each pixel is specified by three values one each for the red, blue, and green components of the pixel scalar. The intensity values are specified by  $m$ -by- $n$ -by-3 arrays of class unit 8, unit 16, single or double. For single or double arrays, values range from [0, 1]. For unit 8, values range from [0, 255]. For unit 16, values range from [0, 65535].

## 2. MATLAB TOOLS

Image processing using MATLAB is a very expedient platform and very easy to develop an algorithm. In MATLAB, an image is represented the matrix of image pixel values. It takes up every input as a matrix. For this reason MATLAB provides an easy tool for image processing as a user can easily access each and every pixel value from the image matrices and edit it. Mainly users deal with three types of image, hence three different matrices[1]. Black and white or binary image matrix consists of only zero and one, one being the brighter portion and zero being the dark part. Generally images are 8-bit and corresponding image matrix is 256x256. Gray scale image is also a two dimensional matrix with each element value varying from 0 to 256. Like gray scale image RGB image can be denoted by matrix with each pixel values varying from 0 to 256. In case of RGB image, three separate matrices for each red, green and blue components overlap to form a RGB image of 256x256x3 dimension.

### 2.1. Conversion of RGB image to grayscale using matlab

A gray-scale image is constructed of different shades of gray color. A true color image can be converted to a gray scale image by maintaining the luminance(brightness) of the image.

MATLAB provides the 'rgb2gray' function which converts RGB images to grayscale by removing the hue and saturation information.

$$I = \text{rgb2gray}(Img)$$

The above function converts the true color image  $Img$  to the grayscale image  $I$ .

The RGB image is a combination of RED, BLUE AND GREEN colors. It is the three dimensional image. At a particular position call  $(i, j)$  in an image,  $Image(i, j, 1)$ , produce the value of RED pixel.  $Image(i, j, 2)$ , produce the value of GREEN pixel.  $Image(i, j, 3)$ , produce the value of BLUE pixel. The combination of these primary colors are normalized with  $R + G + B = 1$ . This gives the neutral white color. The grayscale image is attained from the RGB image by combining 30% of RED, 60% of GREEN and 11% of BLUE. This produces the brightness information of the image. The resulting image will be two dimensional. The value 0 represents black and the value 255 represents white. The range will be between black and white values.

## 3. GRAY SCALE IMAGES

Grayscale is a scope of monochromatic shades from black to white. Therefore, a grayscale image holds only shades of gray and no color. Normally, color images contain gray scale information. This is because each pixel has a luminance value, regardless of its color. Luminance can also be described as brightness or intensity, which can be measured on a scale from black (zero intensity) to white (full intensity). Most image file formats support a minimum of 8-bit grayscale, which provides 256 levels of luminance per pixel. Some formats

support 16-bit grayscale, which provides 65,536 levels of luminance. Many image editing programs allow , to convert a color image to black and white, or grayscale. This process removes all color information, leaving only the luminance of each pixel. Since digital images are displayed using a combination of red, green, and blue (RGB) colors, each pixel has three separate luminance values. Therefore, these three values must be combined into a single value when removing color from an image. Figure 5(a) and figure 5(b) shows a typical gray scale image and a binary image, respectively.



**Figure 1: A RGB Image**

#### **4. RGB COLOR MODEL**

In this model, each color appears in its primary spectral components of red, green and blue. Each pixel is made up of three colors; red, green, and blue(RGB), described by their corresponding intensities. Color components are also known as color channels or color planes (components). In the RGB color model, a color image can be represented by the intensity function.

$$I_{\text{RGB}} = (I_{\text{R}}, I_{\text{G}}, I_{\text{B}})$$

Where  $I_{\text{R}}(x, y)$  represents the intensity value of the pixel  $(x, y)$  in the red component,  $I_{\text{G}}(x, y)$  represents the intensity value of the pixel  $(x, y)$  in the green component, and  $I_{\text{B}}(x, y)$  represents the intensity value of the pixel  $(x, y)$  in the blue component.

The intensity of each color channel is usually stored using eight bits, which indicates that the quantization level is 256. That is, a pixel in a color image requires a total storage of 24 bits. A 24 bit memory can express as  $2^{24} = 256 \times 256 \times 256 = 16777216$  distinct colors[1]. The number of colors should adequately meet the display effect of most images. Such images may be called true color images, where information of each pixel is kept by using a 24-bit memory.



Figure 2(a): Red Component

199	199	198	198	197	196	196	196	196
199	199	198	197	197	196	196	196	196
199	198	198	197	196	196	196	196	196
198	198	197	197	196	195	195	195	196
198	198	197	196	195	195	195	195	196
197	197	196	196	195	194	195	194	196

Pixel info: (1, 1) 199

Figure 2(b): Pixel region of figure 2(a)



**Figure 3(a): Green Component**



**Figure 3(b): Pixel region of figure 3(a)**

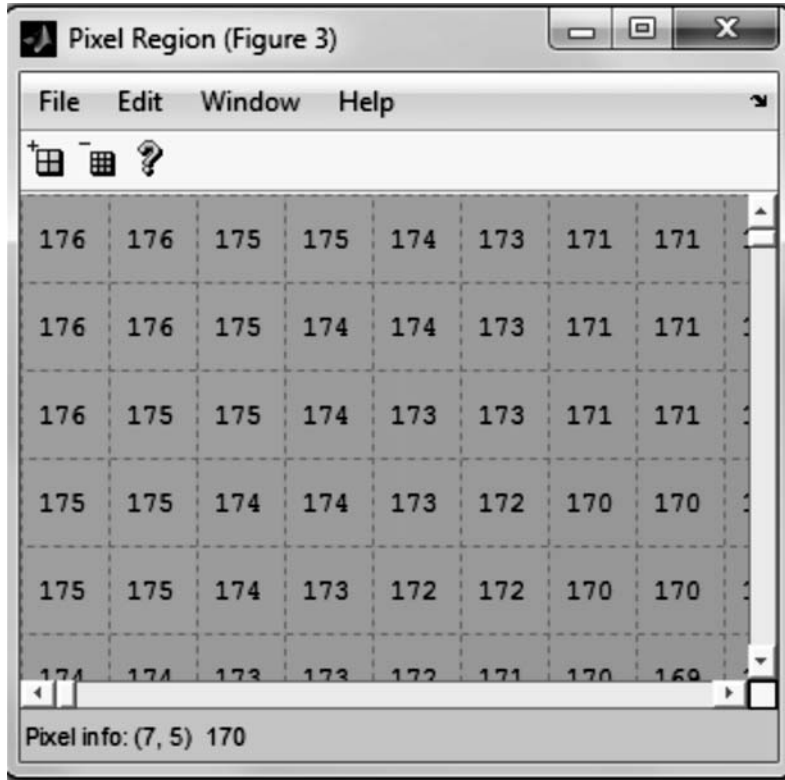


Figure 4(a): Blue Component

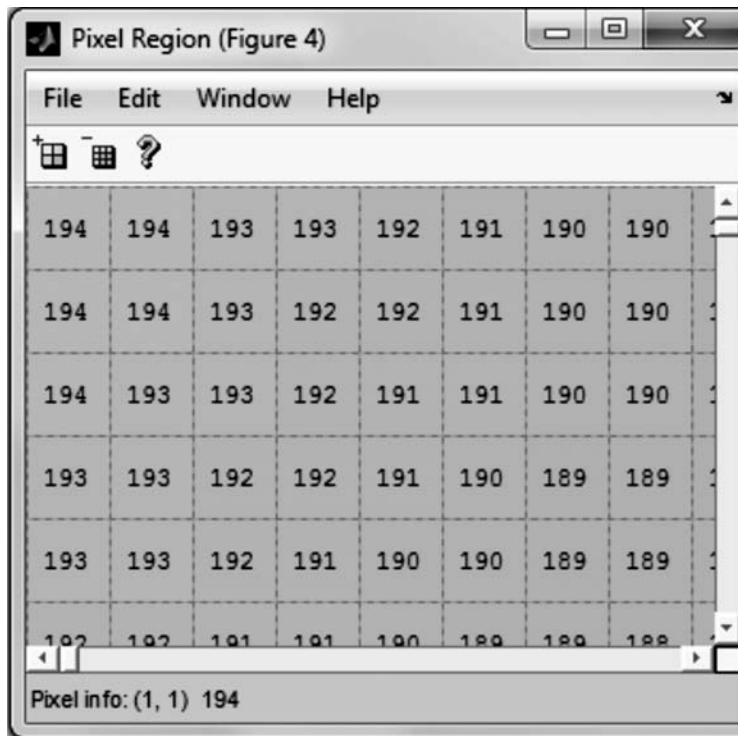


Figure 4(b): Pixel region of figure 4(a)

## 5. PROPOSED ALGORITHM

The input RGB image is shown in figure 1.

If the luminance detail is required, then color images should be transformed to gray scale images [2].The transformation can be made by using proposed equation.

$$I_y = 0.2952I_R + 0.5547I_G + 0.148I_B$$

Where  $I_R$ ,  $I_G$  and  $I_B$  are the intensity of R, G and B component respectively and  $I_y$  is the intensity of correspondence gray level image of RGB image.

The figure 2(a) and figure 2(b) show the red channel image and its corresponding pixel region of the input image. The intensity value of red component at pixel (1,1) is 199.

The figure 3(a) and figure3(b) show the green channel image and its corresponding pixel region of the input image. The intensity value of green component at pixel (1,1) is 176.

The figure 4(a) and figure4(b) show the blue channel image and its corresponding pixel region of the input image. The intensity value of blue component at pixel (1,1) is 194.

The corresponding grayscale image respect to the Input RGB image is shown in figure 5(a)



Figure 5(a): Grayscale Image

The intensity of pixel (1, 1) of grayscale image is computed by using the pixel values of RGB image in the proposed transformation equation.

$$\begin{aligned} I_y &= 0.2952*199 + 0.5547*176 + 0.148*194 \\ &= 185.084 \end{aligned}$$

This is the pixel information of gray image at pixel(1,1) shown in figure 5(b).

Similarly the intensity of pixel(3,1)(in figure 2(b), figure 3(b) and figure 4(b) i(e) the values of R,G and B) are 198,175,193.The intensity of gray image is calculated by

$$\begin{aligned} I_y &= 0.2952*198 + 0.5547*175 + 0.148*193 \\ &= 184.0861 \end{aligned}$$

It is match with the pixel information of gray level image at pixel(3,1)(shown in figure 5(b))

In this way we can check all other pixel information of gray scale image with this transformation equation.

Our proposed transformation equation produces better result than existing one. Comparison of our proposed transformation equation with K.M.Braun[4] and Tarun Kumar[5] are given below in Table 1 and also calculate error in percentage.

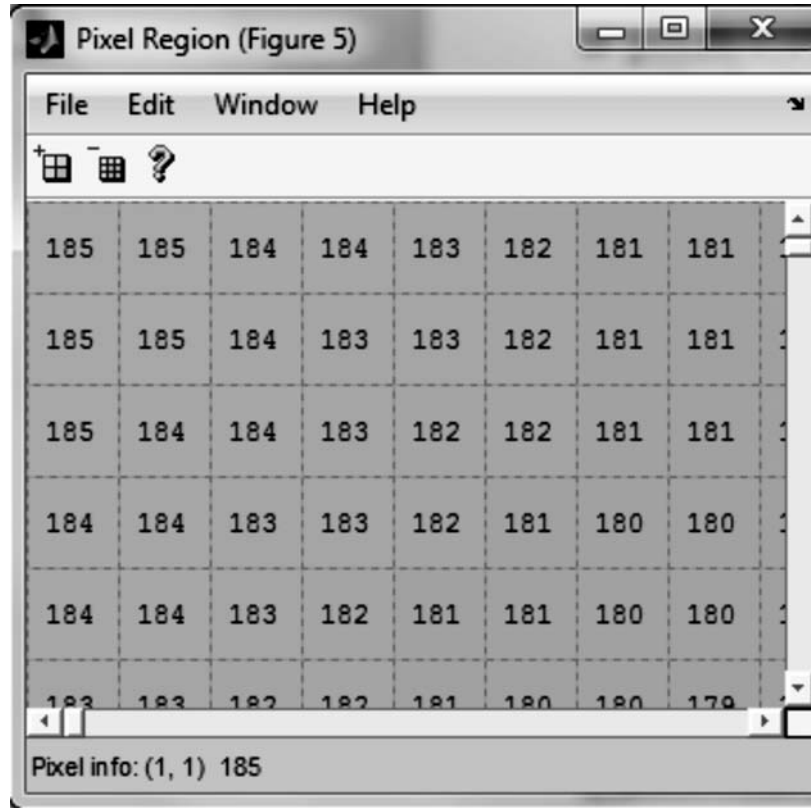


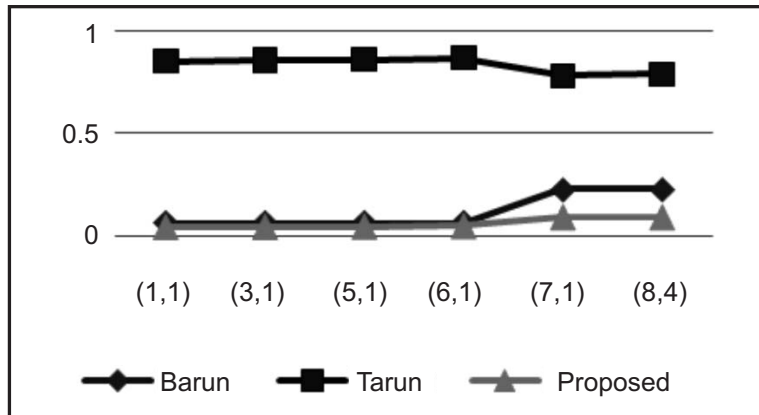
Figure 5(b): Pixel Region of Gray Image

Table 1  
Comparisons with existing methods

Pixel	Value By MATLAB	By Braun Method	By Tarun Method	By Proposed Method	Percentage error of Braun method	Percentage error of Tarun method	Percentage error of Proposed method
(1,1)	185	184.88	186.5874	185.084	0.0648649	0.8507541	0.045385
(3,1)	184	183.88	185.5878	184.0861	0.0652174	0.8555519	0.046772
(5,1)	183	182.88	184.5882	183.0882	0.0655738	0.8604017	0.048174
(6,1)	182	181.88	183.5886	182.0903	0.0659341	0.8653043	0.049591
(7,1)	181	180.59	182.422	180.8329	0.2265193	0.7795112	0.092320
(8,4)	180	179.59	181.4224	179.835	0.2277778	0.7840267	0.091666



As seen from figure 6 the percentage of error rate reduces in the proposed system.



**Figure 6: comparison Chart**

## 6. CONCLUSION

In this paper we use a RGB image as input image and split into Red, Green and Blue components. The RGB image is convert into gray image using MATLAB. Apply the intensity values of R,G and B components in our proposed transformation equation. According to the experiments result, our proposed algorithm is better than existing algorithms. All the new proposals on Color to Gray scale conversion are not preferable for all applications.

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