

Image Re-colourisation In Understanding the Red-Green Colour Blindness

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Abstract: The main objective of this research is to develop a re-colourisation image using MATLAB to mimic a type of Red-Green colour blindness, i.e Deuteranopia. Deuteranopia is one type of colour-deficient disease (CVD). People with deuteranopia cannot identify the difference between red and green colour, hence it is also known as red-green colour blindness. This paper focuses on the image processing technique to recolourisation of the image from red, green, yellow, and beige. The methodology involves image acquisition, image pre-processing, and detection of colour. There are two methods used such as RGB thresholding masking and recolour method. This project uses an RGB threshold for masking and detection of colour. recolour images are required to substitute colour from green or red to yellow or beige. After the recolour method was applied, compared processed images in this project with reference processed images to show a trend with the recolour method. The image quality after decolourisation showed very little degradation with the BRISQUE score difference between pre-processing image and the post-processing image of 1.067 and 2.4068 for the green and red images, respectively. In conclusion, the objective of evaluating the image's effectiveness in increasing public awareness of persons who suffer from colour vision deficiency should be achieved.

Keywords: Deuteranopia, Image Processing Technique, Re-colourisation method, Brisque Technique

1. Introduction

1 in 12 men (8%) and 1 in 200 women have suffered from colour blindness (CVD) [1]. Based on Malaysia population of 31.95 million, there are approximately 1.4 million people with CVD disease (4.5% of the entire population). In a study of 1214 primary school children in Petaling Jaya, Selangor, the prevalence of colour vision deficiency was found to be 2.6% (males 4.8%, females 0.2%) [2]. This indicates that males would be easy to get this disease.

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A normal person with correct colour vision deficiency (CVD) is called a trichromat. A person with correct CVD presents three kinds of cone cells (i.e., the retinal photoreceptors associated with colour sensation) [3]. Conversely, cones are only sensitive to brighter light levels but enable us to see different colours [4]. The spectral sensitivities of the three cone classes, with peak responses in the long (L), medium (M), and short (S) wavelength parts of the spectrum, respectively. If one cone cell is missing, it would be a CVD disease and can be classified as either protanopia, deuteranopes or tritanopes.

Red-green CVD is the most common type of Colour blindness. Protanopia and Deuteranopia can be classified as red-green CVD. Humans’ colour vision is based on the responses to photons in three different types of photoreceptors, which are named “cones” and are contained in the retina of human eyes [5]. Protanopia is CVD with missing or damaged red (long wavelength) cone cells. The colour red looks like dark grey. Some shades of orange and green look yellow. Deuteranopia is classified under Red-green CVD. Deuteranopia is a common type of red-green colour blindness. This disease may have difficulty seeing red and green, which happens when no green (medium wavelength) cone cells. Reds may look brownish-yellow, and greens may look beige. This disease happens when green cone cells are missing or damaged by physical damage. Deuteranopia is primarily caused by recessive genes in the X chromosome. Other factors that can cause this CVD happen such as retinal disease, age-related conditions, issues with the optic nerve and side effects from drugs, especially antimalarial drugs and chloroquine. With Deuteranopia, a few colours may look confusing to identify such as mid-reds with mid-greens, mid-reds with mid-brown and bright greens with yellow.

2. Methods

The proposed work aims at re-colourisation on images. The technique used are image acquisition, image pre-processing, image segmentation and recolour method. The overall process is shown in Figure 1.

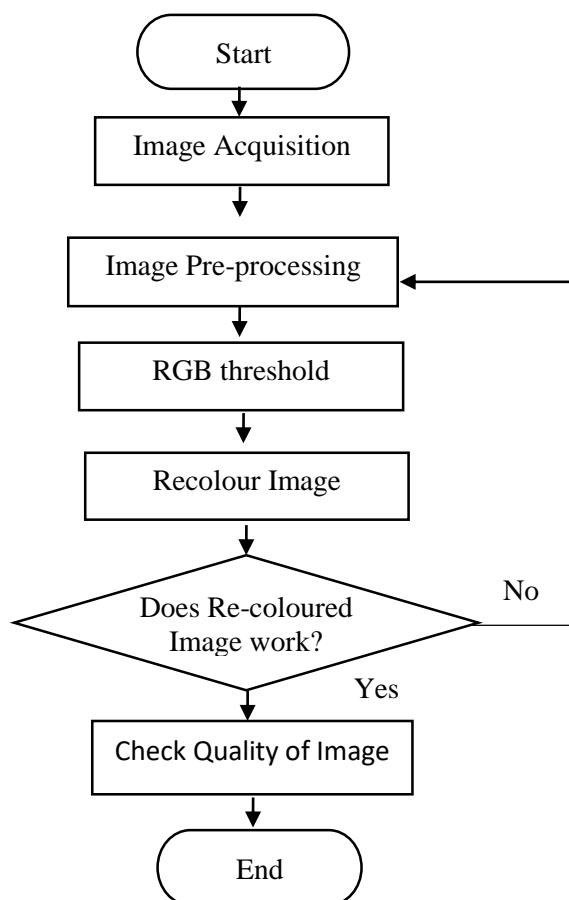


Figure 1: Flowchart to detect red and green colour on images.

2.1 Image Acquisition

For the initial step of re-colourisation, images with green and red hues are needed. This first step is required to find any images at Pixabay as input to the system. Better-quality images are required. This project uses images with a resolution of 1920x1080. The input images also are used as an image database.

2.2 Image Pre-processing

In image processing, any enhancement method that highlights edges and tiny details in an image is referred to as image sharpening. For boosting local contrast and sharpening images, image sharpening is commonly employed in the printing and photographic industries.

2.3 RGB Thresholds

The use of image thresholding to separate an image into foreground and background is a simple but efficient method. This is a form of image segmentation technology that isolates objects by turning grayscale images into binary images. Image thresholding works well with photos that have a lot of contrast. In line 2 and 3, the maximum and minimum RGB was used to determine the colour of red and green for masking:

2.4 Re-colour Images

A colour image is a picture that is presented in colour on an associated or independent display screen by digital equipment. This method is used to substitute a colour that has been detected and mask it with another colour. Colour substitution depends on the value that is set.

2.5 Brisque

This method is to measure the quality of pre-processing images and post-processing images, which are Blind/Referenceless Image Spatial Quality Evaluators (BRISQUE). BRISQUE is confined to evaluating the quality of photos with the same sort of distortion because it is trained on a database of images with known distortions. BRISQUE is opinion-aware, which means the training images are accompanied by subjective quality scores. The BRISQUE score is usually between 0 and 100. Lower score values indicate that the post-processing image has a higher perceptual quality than the input model.

3. Results and Discussion

The result is obtained from all processes for a processed image in MATLAB which is RGB threshold and recolours the image.

3.1 RGB threshold

Table 1 displays the RGB range value and RGB masking calculation based on histogram thresholds for detecting red colour in an image. The value of Red Color is the threshold channel 1 based on histogram settings (R). The minimum channel value of the Red colour is 128 and the maximum channel value is 255 for detecting the presence of Red colour in an image. The green colour is represented by Channel 2, which is based on a histogram. The green colour has a minimum value of 0 and a maximum value of 175. Channel 3's colour is blue, with a minimum value of 0 and a maximum value of 175.

Table 1: The range value RGB for detecting the Red colour in the image by using the RGB threshold

	Channel 1 (Red)	Channel 2 (Green)	Channel 3 (Blue)
Range value RGB	128-255	0-175	0-175

Table 2 displays the RGB range value and RGB masking calculation based on histogram thresholds for detecting the green colour in an image. The value of Red Colour is the threshold channel 1 based on histogram settings (R). The minimum channel value of the Red colour is 0 and the maximum channel value is 215 for detecting the presence of Red colour in an image. The green colour is represented by Channel 2, which is based on a histogram. The green colour has a minimum value of 50 and a maximum value of 255.



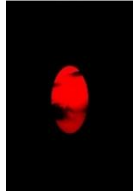





Channel 3's colour is blue, with a minimum value of 0 and a maximum value of 220. When MATLAB detect a red colour within the value that is stated on the table, MATLAB does recolour the image too yellow or beige.

Table 2: The range value RGB for detecting the Green colour in the image by using the RGB threshold

	Channel 1 (Red)	Channel 2 (Green)	Channel 3 (Blue)
Range value RGB	0-215	50-255	0-220

Table 3 shows the result of the red and green images by using the RGB threshold for masking. In this experiment, 4 sample images were used to obtain the data. 2 images of the red object and 2 images of was green object were used. For sample image number 1, the system detects the red colour of the rose and the green colour of the leaf. The output image in RGB threshold masking detects almost all red colour in images and the green colour of the leaf. For sample number 2, the system can detect the colour of red mood in the image and masking with RGB threshold. for sample number 3, the masking for the background looks almost the same and the foreground is masked with beige colour. In sample number 4, the system detected green colour in the image and masking into orange colour. When MATLAB detect a green colour within the value that is stated on the table, MATLAB does recolour the image to yellow or beige.

Table 3: The result of detecting red and green colour in the image using the RGB threshold masking technique





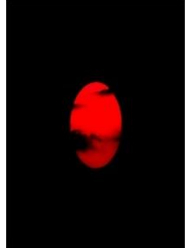
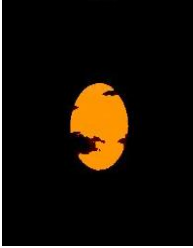










No.	Input image	RGB threshold masking
1		
2		
3		
4		

3.2 Recolour image

This method is used to mimic a type colour of Deuteranopia by using MATLAB to recolour images between red and green to yellow and brown. Deuteranopia is a type of colour blindness characterized by the inability to distinguish red and green pigment. The red and green are seen more like yellow and brown. The

background colours for products can be changed by replacing the colour in a picture. Users can also apply the recolouring concept to change the colour of the sky, clothes, eyes, and other objects. The purpose of comparison with the reference image is to prove the transformation colour with MATLAB is almost the same as the Deuteranopia view. Table 4 shows the comparison between input and output images and also reference images. The colorized images and green and red hues in processed images are in trend with reference processed images. The images that are processed were able to keep the nature of the images as much as possible and high-quality trend with the processed reference.

Table 4: Comparison between an original image and after applying to recolour the image in MATLAB and reference

No	Input Image	Post-processed image	Ref [6] Original Image	Ref [6] Post-processed Image
1				
2				
3				
4				

3.3 Image Quality

For this project, the quality of pre-processing image and post-processing images need to be measured. This project used a BRISQUE method to measure images. Figure 2 shows the original image, the image with Gaussian noise, the blurry image, and recoloured image. Figure 3 shows the image quality values of images shown in Figure 2 using the BRISQUE method. The BRISQUE score difference between pre-processing image and the post-processing image on the green image is 1.067, which is an acceptable quality value after recolouring the image.

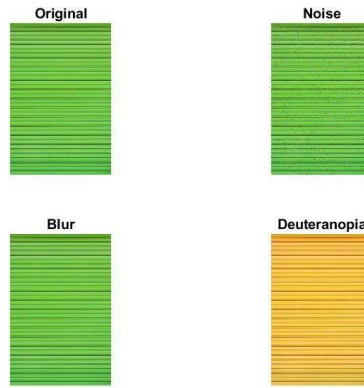


Figure 2: Images comparison between pre-processing image, filter image and post-processing image for green colour.

BRISQUE score for original image is 33.6597.
 BRISQUE score for noisy image is 49.1352.
 BRISQUE score for blurry image is 60.4319.
 BRISQUE score for recolour image is 34.7267.

Figure 3: BRISQUE value for the green image.

Figure 4 shows the original image, the image with noise, the blurred image, and recoloured image for red colour. Figure 5 shows the value of the BRISQUE method for the quality measurement of images depicted in Figure 4. The BRISQUE value for the red image is 2.4068 after subtracting the value for the original image and recolour the image. The value is still acceptable.

In both cases, the images do not degrade very much from their original images and the image quality is still within the acceptable range. This indicates that the recolourisation process does not degrade the image quality.

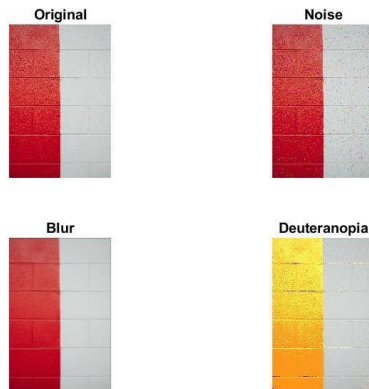


Figure 4: Images comparison between pre-processing image, filter image and post-processing image for red colour.

BRISQUE score for original image is 30.6042.
 BRISQUE score for noisy image is 51.2654.
 BRISQUE score for blurry image is 42.9673.
 BRISQUE score for recolour image is 33.0110.

Figure 5: BRISQUE value for the red image.

4. Conclusion

In conclusion, the first objective of this project is to achieve the investigation the type of colour vision deficiency. CVD can be classified as protanopes, deuteranopes, and tritanopes. This project focus on Deuteranopia. Deuteranopia is a type of colour blindness characterised by the inability to distinguish red and green pigments. The red and green are seen more like yellow or brown.

Following that, the second goal is also accomplished. A re-colourisation image was successfully developed using MATLAB to mimic a sort of colour vision deficiency, called Deuteranopia. The image can be recoloured to appear as Deuteranopia, which transforms red or green images into yellow or brown using the MATLAB image processing toolbox.

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