ABSTRACT

The RGB color retinal image has an interesting characteristic, i.e. the G channel contains more important information than the other ones. One of the most important features in a retinal image is the retinal blood vessel structure. Many diseases can be diagnosed based on the retinal blood vessel, such as micro aneurysms that can lead to blindness. In the G channel, the contrast between retinal blood vessel and its background is significantly high. The authors explore this retinal image characteristic to construct a more suitable image coding system. The coding processes are conducted in three schemes: weighted R channel, weighted G channel, and weighted B channel coding. Their hypothesis is that allocating more bits in the G channel will improve the coding performance. The authors seek for image quality assessment (IQA) metrics that can be used to measure the distortion in retinal image coding. Three different metrics, namely Peak Signal to Noise Ratio (PSNR), Structure Similarity (SSIM), and Visual Information Fidelity (VIF) are compared as objective assessment in image coding and to show quantitatively that G channel has more important role compared to the other ones. The authors use Vector Quantization (VQ) as image coding method due to its simplicity and low-complexity than the other methods. Experiments with actual retinal image shows that the minimum value of SSIM and VIF required in this coding scheme is 0.9940 and 0.8637.

Keywords: Asymmetric Channel Coding, Color Retinal Image, Peak Signal to Noise Ratio (PSNR), Structure Similarity (SSIM), Vector Quantization (VQ), Visual Information Fidelity (VIF)
INTRODUCTION

One of the most important information on the retinal image is the blood vessels. Through the retinal blood vessels, the ophthalmologist can diagnose several diseases, for example: micro aneurysms (tiny dilations of the retinal capillaries), haemorrhage, soft exudate, hard exudate, and neurovascularisation. Figure 1 shows the RGB color retinal image, the image of the channel R, G, and B. If we look at the retinal image in each channel, we can get that the green channel shows the best contrast of the blood vessels.

Explanation of why the image of the channel G has the most contrast of blood vessels is due to the green light, the absorption coefficient of hemoglobin is at the peak of the spectrum. As a result, blood vessels containing hemoglobin that absorbs more green light than the surrounding tissue. This tissue was dark, so the blood vessels will be seen more contrast in image taken with green light. A little red light is absorbed by the pigment in the eye, and red light dominates the spectrum of the reflected. This is why color fundus images appear redish. Because the absorption coefficient of the red light is less absorbs by the inner eye than green light, the R channel image is not too much contrast as the G channel image. Nevertheless, this does not mean that there is no useful information on the R and B channels (Thomas Walter et al., 2007).

Figures 2-4 show a color coded image of the retina with an asymmetric coding scheme at each channel. In Figure 3, the number of bits in the channel R = 0.5 bits/pixel (bpp), G = 0.125 bpp, and B = 0.5 bpp, and the total bits in Figure 3 is 1.125 bpp, the value of PSNR = 40.61 dB. While Figure 4, the number of bits in the channel R = 0.125 bpp, G = 0.5 bpp, and B = 0.125 bpp. So that the total bits in Figure 4

Figure 1. RGB color retinal image and its channels
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