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Research Article

Analysis Parameter of Digital Color Image Demosaicing using RGB

Diksha Shrivastava†* and Krinsha Gopal Soni†

†Electronics and Communication Department, Babulal Tarabai Institute of Research and Technology, Sagar India

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Abstract

Demosaicing schemes consider a frequency analysis, the basic principle is to use a frequency illustration of the bayer CFA (color filter array) image. For red & green rows and columns within the input mosaick image as in the directional estimates for the absent red and green pixel values are calculated. For blue & green rows and columns within the input mosaick image, the directional estimates for the missing blue and green pixel values are calculated. The results observed in the study are associated with the quality of images, their color plane and structural similarity index. Simulation shows the performance of the proposed algorithm gives better quality than other demosaicking algorithms. The PSNR was used as a measure to quantify the performance of the demosaicking methods. Graphs are evaluated for the comparison of performance of various algorithms with proposed system. All the system is design by the MATLAB software.

Keywords: *Red Channel, Green Channel, Blue Channel, Demosaicing*

1. Introduction

CFA is one of the foremost typical hardware elements in a single sensor imaging pipeline. It's a combination of tiny color filters positioned above the monochrome image sensors, typically Charge Coupled Devices (CCD), Charge Injection Devices (CID) or Complementary Metal Oxide Semiconductors (CMOS), to obtain the low resolution color information of the image scene (Arumugan *et al*. 2014).

Charge-coupled devices were first developed in 1969 as a way to store data employing bubble memory. In 1974, the first imaging CCD was produced by Fairchild electronics with a format of 100 100 pixels. CCDs capture light on the small photosites on their surface. These photosites are photodiodes or photogates. The charges on the first row of pixels are transferred to a read-out register (Arumugan *et al*. 2013).

From the register, the signals are then amplified and converted into digital. When the row has been read, its charges on the read-out register are deleted and also the next row enters the read-out register. The charges on each row are therefore coupled on the row above and so the name CCD. In 1974, Bayer has introduced CFA, a typical image –sensor arrangement, additionally called Bayer pattern, to capture the image with cut back cost, high speed, compact size and high quality using CCD technology [Abbas and Helmy - 2005].

R	G	R	G
G	B	G	B
R	G	R	G

Figure 1: Typical mosaic pattern

In the olden days, the color filter was fabricated on a separate glass plate and affixed on the photo detector, but presently, all single chip color cameras are obtainable with an image sensor that has built in on-chip color filter. Two kinds of materials for on-chip CFAs are offered (Abbas *et al*. 2005). They're pigment based and dye based. Pigment based CFAs are prevailing over dye based CFAs because pigment based CFAs exhibit high heat and light resistance. To permit the creation of a color image, a color filter is placed on the top of every sensor cell in CFA, making it sensitive to a specific color. Later, CMOS technologies have dominated and lead this adaption within the development of high quality digital still on video camera (Adams *et al*. 1997). An image sensor is one of the main building blocks in digital imaging systems to capture digital still image/video. Figure 2 represents a basic building block design of three sensor digital imaging system employing sensor models. This specific designated sensor arrangement deposited in CFA, could be a certain pattern on the top of the image sensor pixel array (Alain Hore *et al*. 2011).

*Corresponding author: **Diksha Shrivastava**

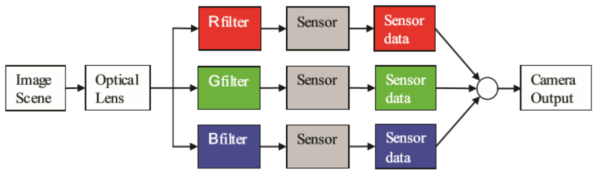

Figure 2: Three sensor digital camera architecture

Digital cameras became popular and a lot of people are selecting to take their pictures with digital cameras rather than film cameras. When a digital image is recorded, the camera must perform a significant amount of processing to provide the user with a visible image. CFA is one of the foremost distinctive hardware elements in a single-sensor imaging pipeline. The CFA is placed on top of the monochrome image sensor, typically a CCD or CMOS sensor, in order to obtain the low-resolution color information of the image scene [Alleysson *et al*. 2005]. Each sensor cell has its own spectrally selective filter and therefore, the acquired CFA data constitutes a mosaick-like monochrome image. In the demosaicking process, the idea of spectral interpolation is to estimate the missing color components and to produce a full-color image.

2. Problem Formulation

(Arumugan *et al*. 2014), described an overview on distinct Denoising methods like Linear and Non Linear filters. (Arumugan *et al*. 2013), defined a Decision Based Median Filter and Weighted Median Filter to suppress Salt & Pepper noise in an image. These filters are used to remove a noise which other filters are failed to remove. (Abbas *et al*. 2005), proposed a local adaptive Wiener filter applied for a 2-D Image. These 2-D images are reconstructed with 1-D windows weighted combination of filters. (Adams *et al*. 1997), proposed hybridization of wavelet and bilateral filters for denoising of images of type X-ray, Ultrasound and astronomical images. (Alain *et al*. 2011), proposed a denoising technique based on the Principal Component Analysis to remove color artifacts generated in single sensor digital cameras with cost effective implementation using Color Filter Array (CFA). (Alleyssan *et al*. 2005), put forward an extended Discrete Wavelet Transform for Multispectral filter array demosaicking for spectral correlation and spatial resolution of images.

3. Single-Sensor Array Camera

A virtual camera (or digital camera for quick) is a digicam that takes video or nonetheless pics, or both, digitally by using recording photographs through electronic picture sensor. Virtual cameras accumulate a scene through focusing the lens and transmitting the pondered light from the scene on a photo sensor array of millions of tiny pixels through an optical system so as to represent the final photo. A representation of a complete coloration photo requires all the 3 number one colorations crimson, green, and blue at each pixel vicinity.

Acquisition of color photographs calls for the presence of 3 sensors for detecting all the number one shades at every pixel location. The three-sensor digital camera requires large space to cut up the light beam into optical paths and for a financial institution of crimson, green and blue filters that operates concurrently on their respective optical paths. It also includes a space for three separate sensors to hit upon the colour channels. These extra necessities add a huge expenditure to the machine. Sensor array of a camera money owed great a part of the total fee of the digital.

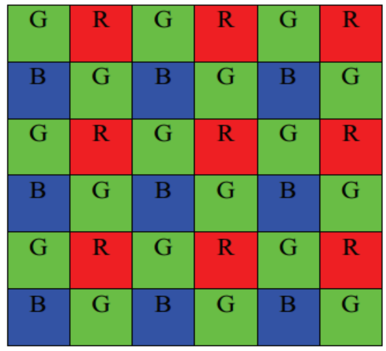

Figure 3: Bayer CFA pattern

Which will reduce the hardware fee and size; many purchaser virtual still cameras use a unmarried mosaiced sensor array to seize any one of the three primary shades at each pixel location. A mosaiced sensor is a monolithic array of many sensors, in which each sensor is blanketed via an optical coloration clear out touchy to a certain wavelength, arranged in a geometric sample called coloration clear out Array (CFA). The resultant photo of single-Sensor Array digital camera is mosaic image, which consists of anyone of the three primary shade aspect values at each pixel vicinity.

Commercially, the foremost generally used CFA configuration is the Bayer CFA. The Bayer CFA [1976] is known as by means of its inventor Dr. Bryce E. Bayer from Eastman Kodak. The Bayer color filter changed into patented in 1976. This has alternating purple (R) and green (G) filters for extraordinary rows and alternating inexperienced (G) and blue (B) filters for even rows as proven in determine 1. There are double as several green filters as pink or blue ones, based totally on the human eye's better sensitivity to green light.

Channel Interpolation

Proposed color difference gradient corresponds to taking the difference between the accessible color channel values two pixels away from the target pixel, doing a similar operation in terms of the other color channel by using simple averaging and so finding the difference between these two operations. It might be argued that the performance of such an algorithm depends on its ability to successfully combine directional estimates.

Here take the difference between the obtainable color channel values one pixel away from the target pixel.

The first step of the directional CFA interpolation algorithm is to interpolate the missing green channel pixels. Next perform this interpolation adaptively employing the multiscale color gradients equation derived above.

Additionally to the horizontal and vertical pixel value and color difference estimations represented in equations. Then combine the directional color difference adaptively:

$$\hat{B} = \frac{1}{4}(B_{-1,-1} + B_{1,-1} + B_{-1,1} + B_{1,1}) \qquad (1)$$

$$\hat{G} = \frac{1}{4}(G_{0,-1} + G_{-1,0} + G_{1,0} + G_{0,1}) \qquad (2)$$

As for the Bayer structure, the missing red and blue component levels are calculated as follows

$$\hat{R} = \frac{1}{2}(R_{-1,0} + R_{1,0}) \qquad (3)$$

$$\hat{B} = \frac{1}{2}(B_{0,-1} + B_{0,1}) \qquad (4)$$

After the initial green channel interpolation, it update the results using directional multiscale gradients again, except it measure all the directions individually. It's accustomed to improve the green channel results.

4 Proposed Methodology

The main contributions of the projected technique are:

- To improve the quality of the RGB images using human eye visual based color filter array for patterns.
- To device an improvised adaptive color difference based image demosaicking and to evaluate the performance of the improvised technique comparing it with the existing demosaicking algorithm.
- To analyze the importance of postprocessing in demosaicking approaches for noise free image reconstruction.
- To analyze and introduce proper edge identification method for RGB image reconstruction.

Block Diagram of Proposed System for Full Color Image Restorations

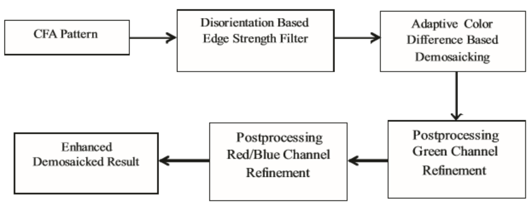

Figure 4: Architecture diagram for proposed demosaicking

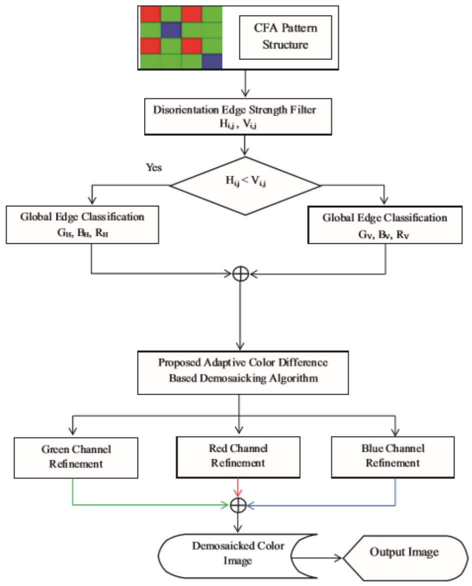

Figure 5: Flow diagram for our proposed demosaicking

The simplest model of a digital camera consists of a sensor array, which converts photons into an electrical charge, a lens which focuses the scene being photographed onto the sensor array, an aperture which limits the amount of light entering the lens, and as hutter to limit exposure time. The sensor arrays in digital cameras record light intensity based on the number of photons that reach the sensor. The intensities of specific wavelengths would be completely lost, leaving a gray-scale image if additional hardware is not included in this model.

In order to produce color images, specific wavelengths of light must be strategically filtered. One method of doing this is using a prism to split light between three separate sensors, each with a different filter placed in front of it resulting in three complete color channels as seen in Figure 4. Since the light is split between three sensor arrays, fewer photons reach each array and thus more noise is present in the final image. This method tends to be more expensive to implement and results in larger cameras due to the additional sensors required.

CFA is one of the foremost distinctive hardware elements in a single sensor imaging pipeline. The CFA is placed on top of the monochrome image sensor, typically a CCD or CMOS sensor, to attain the low-resolution color information of the image scene. Every sensor cell has its own spectrally selective filter and so, the acquired CFA data constitutes a mosaick-like monochrome image. As the information regarding the arrangement of the color filters within the CFA will be identified from the camera manufacturers or it may be obtained using the Tagged Image File Format for Electronic Photography (TIFF-EP), the gray scale CFA image will be re-arranged as a low- resolution color image.

This is the initial operation in the demosaicking process that uses the thought of spectral interpolation to estimate the missing color components and to produce a full-color image. The arrangement of the color filters with in the CFA varies depending on the manufacturer. Different cost and implementation constraints are expected for a camera that stores the image within the CFA format and uses a companion personal computer to demosaick the acquired image data, than for a camera that directly produces the demosaicked image [Lukac and Plataniotis - 2005].

The design and performance characteristics of the CFA are essentially determined by the kind of a color system and also the arrangements of the color filters within the CFA. The visual effect of an RGB color image relies on the weight given to the RGB components. The projected pattern relies on actual weight of the HVS as shown in figure 5. In proposed pattern it's given additional weight age to the green samples. Red samples are given weightage same as to the Bayer CFA pattern however small weightage is given to the blue samples.

5. Experiment Result

To test the act of the proposed method by using a large number of color images. The proposed method PCA fusion with color demosaicking is used to produce full color images. In this section the results are made on two different images. Two Different types of experiments are made. First experimental results are made to evaluating the denoising with the different types of techniques, and comparing these techniques by calculating the PSNR value and MSE value.

Peak Signal Noise Ratio: - The ratio between the original signal and the noise signal can be calculated, the ratio between the signals maximum power and the power of corrupting noise. That affects the exact representation of the original image in equation

$$PSNR = 10.log_{10}\left(\frac{MAX_1^2}{MSE}\right)$$

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$


(a)


(b)


(c)


(d)


(e)


(f)

Table 1: Comparative Study of Proposed Method on different images

Image		MSE	PSNR
Flower Image	Previous	498.52	38.15
	Proposed	479.12	40.21
Baboon Image	Previous	458.25	41.62
	Proposed	439.98	43.21
Lena Image	Previous	501.326	36.91
	Proposed	489.278	39.87

Table 2: PSNR Calculate of R, G, B channel refinement

Image	Red channel	Green Channel	Blue Channel
Baboon Image	35.1957	35.1401	34.8256
Lena image	36.6889	36.4779	36.8824
Bike Image	33.1614	33.2006	33.1019

Conclusion

This paper present adaptive color difference based Demosaicking algorithm of color images collected from single sensor cameras. Proposed method used to suppress the different types of de-noising before demosaicking strategy. These methods are used in three different channels i.e. red, green and blue are used in 0-255 pixel value. The result images clearly indicate that the quality of de-noised image using demosaicking is better in visual form at that much high noise density. The proposed method improved the quality of de-noised image especially for random valued impulse noise. Proposed method is evaluated on the standard images like Flower, lena and baoon Images. Peak Signal Noise to Ratio & Mean Square Error values proven that proposed method outperforms the existing method.

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