False Color Photography Effect using Hoya UV&IR Cut Filters Feature White Balance

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Abstract. The research inspired by modification DSLR camera become False Color Photography effect. False Color Photography is a technique to give results like near-infrared. Infrared photography engages capturing invisible light to produces a striking image. The objective of this research to know the effect by change a digital single-lens reflex (D-SLR) camera to be false color. The assumption adds a filter and make minor adjustments or can modify the camera permanently by removing the hot mirror. This experiment confirms change usual hot mirror to Hoya UV&IR Cut Filter in front of sensor CMOS. The result is false color effect using feature Auto White Balance such as the color of object photography change into reddish, purplish, old effect, in a pint of fact the skin of model object seems to be smoother according to White Balance level. The implication this study to get more various effect in photography.

1 Introduction

The eyes catch a variety of things that are exposed to light reflections (visible light) such as leaf color, skin color, sky color and others caught by normal cameras such as SLR, DSLR, Pocket, etc. Then produce a photo of what the eye sees. But also, there is the light that is invisible to the eye (IR and UV). In its terminology, the IR light is on the 700-1200nm spectrum (nanometers) [1]. That light is captured by a modified Infrared camera and translates it into digital form. As explained above, the light seen by the eye is the usual camera captured while the light that is invisible to the eye is the Infrared modified camera captured. False Color is an amalgamation of both, visible and invisible light. Being in the Infrared spectrum (below 700nm) false color changes only a few things and the color is not mono as Infrared. False Color is more widely used for Photography Modelling, but there is nothing wrong if this technique is used for landscape photography.

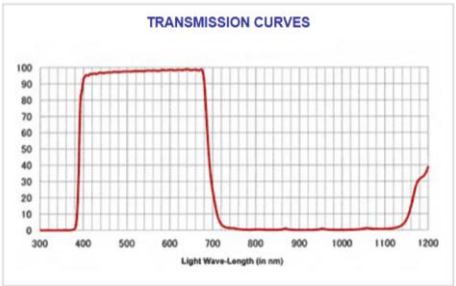

Fig.1. Transmission curve of light [2].

1.1 Color filter array, false color

The camera sensor is, in essence, monochromatic. To get color information, the preferred solution is to place Color Filter Arrays (CFA) in front of the sensor. This array consists of a mosaic of transparent colored material that only allows part of the spectrum to pass through. In general, CFAs can be represented by triplets [3].

$$c\,[n] = [cr\,[n], cg\,[n], cb\,[n]]\; T \in [0, 1]\; 3 \qquad (1)$$

in which three components indicate the relative percentages of R, G, and B information stored in the n pixel location. Note that we apply the CFA value range to be in [0, 1] to ensure physical realizability (via subtractive color layer). Let [n], g [n] and b [n] denote the basic truths R, G, B scene values (that is, we will get from camera-3-CCD); sensor readings after CFA can be modeled as [3].

$$yvis\,[n] = cr\,[n]\, r\,[n] + cg\,[n]\, g\,[n] + cb\,[n]\, b\,[n] \qquad (2)$$

Recent works [2], [4], [5] have shown that processing with visible data and NIR results in image enhancement and analytical capabilities beyond what can be achieved only by using visible information.

It has been emphasized that for natural color reproduction with subtractive colored films, emulsions must be sensitive to red, green and blue, respectively, and their complement, cyan, magenta and yellow. Of course, if it does not require natural color reproduction, then the emulsion may be sensitive in the spectral region and the dye formed by the screw does not have to be related to the complement (if any) of the emulsion's sensitivity. Any

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1.2 False color

It has been emphasized that for natural color reproduction with subtractive colored films, emulsions must be sensitive to red, green and blue, respectively, and their complement, cyan, magenta and yellow. Of course, if it does not require natural color reproduction, then the emulsion may be sensitive in the spectral region and the dye formed by the screw does not have to be related to the complement (if any) of the emulsion's sensitivity. Any change in natural color reproduction is called a false color [6]. Digital false color aerial photographs of four acres of vuoksi drainage basin, Finland, that differ in trophic state and water quality near-infrared (NIR) wavelengths [7]. False-color images may be made of the same subject matter or diffused by some of the other types of monochrome images (information channels) taken from the same subject at different wavelengths or showing variations of some kind. These images may be made in radiation that we cannot see (UV or IR), or cannot photograph in any conventional way (acoustic, gamma ray, radio etc.) [8].

The wavelength can also be expressed in nanometers (nm), which is 1 x 10-9 m. Thus, Visible light can be described as extending from 0.4 to 0.7 µm or from 400 to 700 nm CIR can be described as extending from 0.5 to 0.9 µm or from 500 to 900 nm, like figure 2 below [9]:

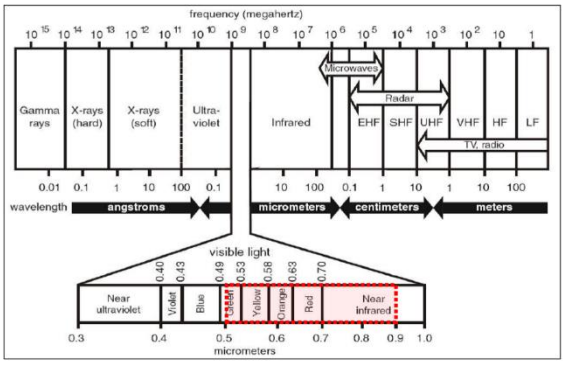


Fig. 2. The wavelength of light [9].

1.3 Hoya UV and IR Cut Filter

Hoya UV filter - IR Cut is a special filter that has the ability to cut both UV rays below 390nm and IR rays above 700mn leave only the light rays in the spectrum seen through the filter and into the camera. This filter is used in digital and video cameras, which do not have IR protection filters in the direction of the image sensor.

The use of filters is critical because unfiltered CCD and CMOS sensors are particularly vulnerable to UV and IR rays beyond the visible spectrum that can have a very negative impact on image quality. As a note that the CUT UV-IR Filter is intended for use with digital SLR cameras and camera cameras that do NOT have IR filters installed in front of the sensor. The effect of color balance can occur when this filter is used with a camera that has an IR filter installed in front of the sensor. The UV & IR Hoya ray transmission curve shows the sharp properties of filter glass and coatings as well as the consistent light transmission in the visible spectrum. This curve shows a more visible light transmission. This means that sharper images with deeper and smoother color gradations, richer colors are possible with Hoya UV & IR Cut filters [2].

2 Methodology

This research uses the methodology of research development of engineering design process. there are 5 stages as figure 3:

Fig. 3. Engineering design process [13].

Ask: looking for needs like What's the problem? What do you want to achieve? What are the project requirements? What are the limitations? Who's the customer? What is the purpose? Gather information and do research-talk to people from diverse backgrounds. In this study, the idea of the question is how to make a photo like in the 4 seasons country without having to edit through software applications.

Imagine: This phase brainstorms various designs: imagining and exchanging creative ideas; building up wild and crazy ideas of others. Investigate existing technologies and methods for use. Explore, compare, and analyze many possible solutions. This research process tries with a filter which is actually used to filter the sun rays causing the image to be flare and so then this filter is tried to replace the hot mirror and imagine the result of photography.

Plan: Picture diagram idea. How does it work? What will environmental and cultural considerations be evaluated? What materials and tools are needed? What analysis should be done? How is the test and confirmed successfully? The thing that will be done is to plan the camera to be tested by looking at the factors to be considered and what filter materials are suitable for testing eg UV filters & IR Cut Filter.

Create: Set the team assignment. Create prototype and test with design purpose. Push yourself for creativity, imagination, and excellence in design. Does it work? Analyze and talk about what works, what does not and what can be fixed. In this study modification of the camera is to replace the usual hot mirror with UV filters & IR Cut Filter, because it assumes that the specification of this filter has nano more than 700nm where the filter has nano above 700nm will be close to black and white color so almost just the IR color will be missed about camera sensors [1].

Improve: Discuss how to upgrade the product. Make a revision. Create a new design. Iteration design to make the product better. The thing done in this phase is to use the white balance (WB) feature of the camera to generate false color depending on the WB settings so that changes can be adjusted and can to produce a more varied image.

3 Results and discussion

The experiment using digital camera Canon 5D mark ii and Hoya UV&IR Cut filter. The specification is Cuts Out UV Rays Below 390 nm and Cuts Out IR Rays Above 700 nm [1]. The filter must suitable to hot mirror size 36x24mm to replacing the usual hot mirror with a new one as figure 4 [1]. The problem that often happens is the filter has a different thickness, this is resolved by the features in Canon 5D mark ii cameras that have a focal point customization. The structure of sensor, filter, and lens as figure 5.

The filter has Nano cutting that is, if the filter passed the light, then he can change the reception of light, cut off the light wave so that the different results. The larger nano cutting number means to spend the color, e.g. Nano 900 it becomes black and white, while the nano below 620 still looks close to normal colors. So, if the numbers are near 600, the more normal, the nearer 1000 is getting black and white.

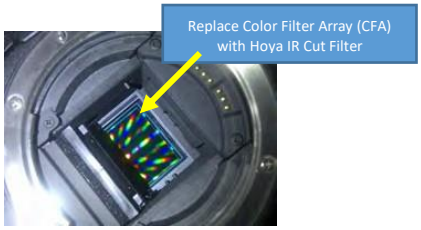


Fig.4. The sensor still uses Hot Mirror/ CFA

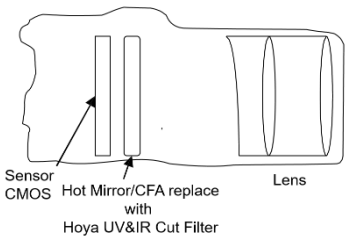
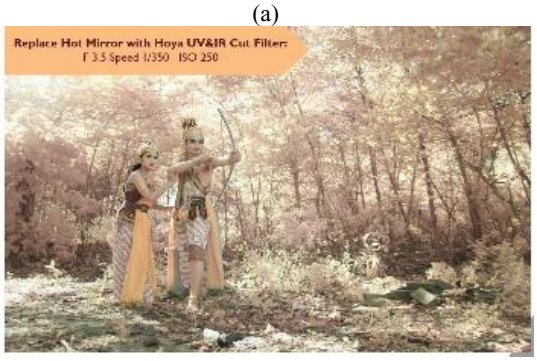


Fig.5. Camera body by replacing with UV&IR Cut Filter [1].

The figure 5 and 6 shows a very significant result that if the CFA filter is replaced with a Hoya UV & IR Cut Filter there are some advantages such as ISO can use the smallest value, the skin of the object looks smoother, if used photographing the scene looks like shooting in a country with 4 seasons

(a)



(b)

Fig. 5. (a) Normal hot mirror (b) Hoya UV&IR cut filter.

Hoya UR & IR Cut Filter is able to filter the incoming color rays to the sensor so that the resulting color is not natural, this happens because the filter should be installed above the sensor is an IR filter. The setting white balance levels also affect the color, if the white balance using kelvin, the photo becomes reddish [1,2].

(a)

(b)

Fig.6. (a) Normal hot mirror (b) Hoya UV&IR cut filter.

Another effect in the use of Hoya UR & IR Cut Filter when used in humans, the skin seems to be smoother

4 Conclusion

The effect of false color photography using filter Tiffen 80D features White Balance (WB) especially manual WB shows the advantage that this experiment success modifies Color Filter Array (CFA) digital camera Canon 5D Mark 2. The Results shows the advantages of the use of the minimal ISO, reduce the noise, change the color of leaf, and the skin of people as an object smoother.

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