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Processing image with opencv3
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Aim: Processing image with opencv3

Objective:To conversion between different color spaces.The fourier transformation, high pass filter and low pass filter

Theory:

Converting between different color spaces:

A color space is a specific organization of colors. In combination with color profiling supported by various physical devices, it supports reproducible representations of color. It can be easily done using OpenCV. There are more than 150 color-space conversion methods available in OpenCV. But most widely used ones: BGR ↔ Gray and BGR ↔ HSV. Understanding the properties and appropriate use of each color space is vital for tasks like color correction, image segmentation, and object recognition.
Colour Spaces are as follow:

1. Grayscale

A grayscale picture just needs intensity information - how bright is a particular pixel. The higher the value, the greater the intensity. Current displays support 256 distinct shades of gray. Each one is just a little bit lighter than the previous one!So for a grayscale image, all you need is one single byte for each pixel. One byte (or 8-bits) can store a value from 0 to 255, and thus you'd cover all possible shades of gray.

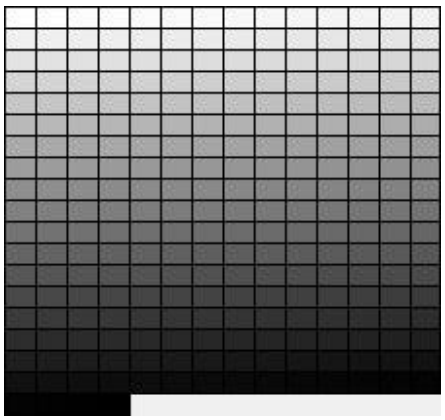

Fig1: GrayScale Palette

2. RGB and BGR color space

The RGB color model is implemented in different ways, depending on the capabilities of the system used. The most common incarnation in general use as of 2021 is the 24-bit implementation, with 8 bits, or 256 discrete levels of color per channel. Any color space based on such a 24-bit RGB model is thus limited to a range of 256×256×256 ≈ 16.7 million colors.

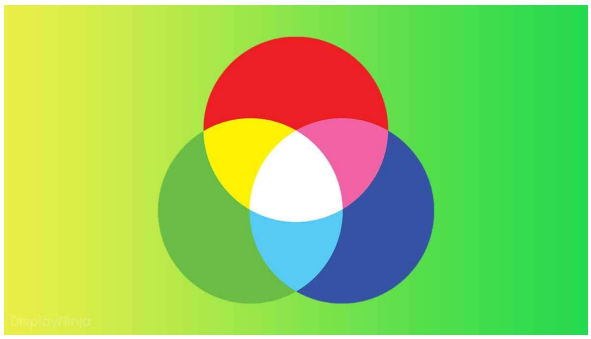

Fig2: RGB vs BGR Subpixel Layout

3. HSL and HSV Color Space

HSL (Hue, Saturation, Lightness) and HSV (Hue, Saturation, Value) are two popular color spaces commonly used in machine vision and image processing. Both color spaces are derived from the RGB color model, but they represent colors in different ways, making them advantageous for certain applications. HSL (Hue, Saturation, Lightness) is another color space commonly used in computer graphics, image processing, and computer vision. It is also derived from the RGB color model and provides a different way to represent and manipulate colors

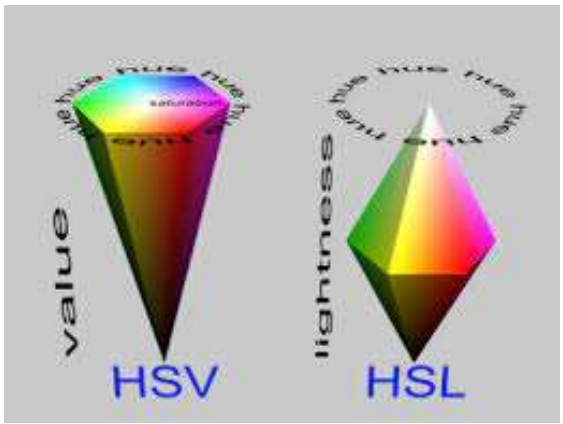

Fig3: HSL and HSV spaces

The Fourier Transformation

The Fourier transform proves to be a potent asset in signal analysis, finding applications ranging from audio processing to image compression. SciPy offers a well-developed implementation within its scipy.fft module. With its significance extending across scientific computing and data science realms, the Fourier transform and its related variations have long been supported by SciPy.

The equation for the Fourier transform, X, of a signal x, is given by the complex integral below:

$$X(\omega) = \int_{-\infty}^{\infty} x(t) e^{-i\omega t}\, dt$$

Low Pass Filter

A Low-Pass Filter is used to remove the higher frequencies in a signal of data. It passes signals with a frequency lower than a certain cutoff frequency and attenuates signals with frequencies higher than the cutoff frequency.

High Pass Filter:

A high pass filter is a technique used to enhance or extract the high-frequency components of an image while suppressing the low-frequency components. High-frequency components represent the fine details and edges in an image, making them crucial for tasks such as edge detection and sharpening. It works by attenuating the low-frequency components and preserving or amplifying the high-frequency components. This can be achieved by convolving the image with a high pass filter kernel, also known as a high pass filter mask or a sharpening filter. Unfortunately, while low-pass filtering smooths out noise, high-pass filtering does just the opposite: it amplifies noise.

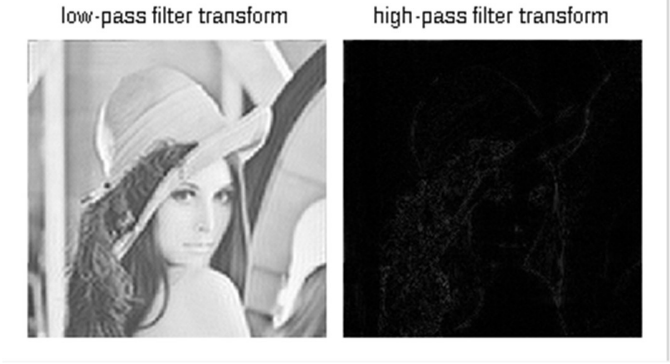

Fig4:Comparison of High pass and Low pass filter

Conclusion:

In summary, the conversion between diverse color spaces, coupled with the utilization of Fourier transformation, high pass filters, and low pass filters, constitutes a powerful toolkit. These tools play a pivotal role in refining image manipulation, enabling a deeper comprehension of visual data, and fostering advancements in image processing applications.