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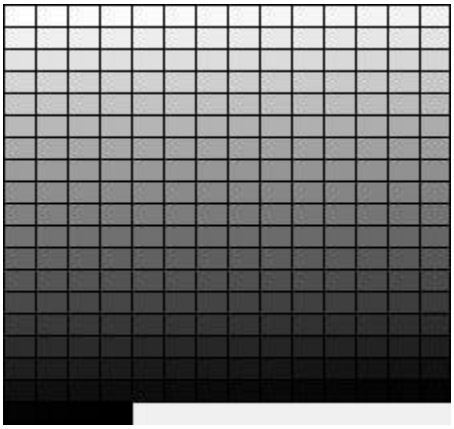
Aim: Processing Image with OpenCV3

Objective: To perform conversion between different color space, The fourier transform, high pass filter and low pass filter.

Theory:

The color spaces in image processing aim to facilitate the specifications of colors in some standard way. Different types of color spaces are used in multiple fields like in hardware, in multiple applications of creating animation, etc. Different types of color models are used in multiple fields. Lets see different types of color model:

Grayscale Color Space: 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 just a little bit lighter than the previous one!



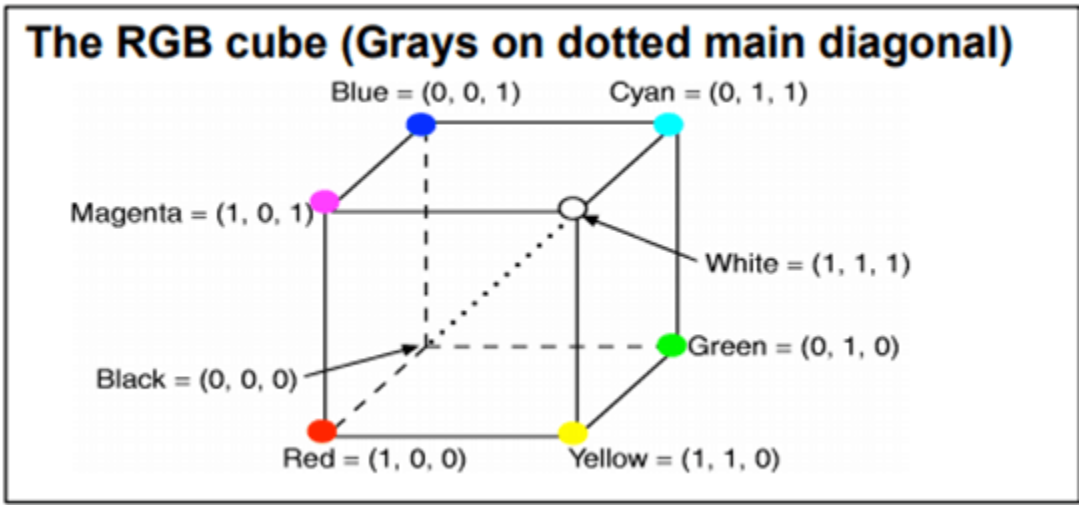
The grayscale palette

So for a grayscale image, all we 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.

So in the memory, a grayscale image is represented by a two dimensional array of bytes. The size of the array being equal to the height and width of the image. Technically, this array is a "channel". So, a grayscale image has only one channel. And this channel represents the intensity of whites.

RGB Color Space: **RGB** stands for **Red**, **Green**, and **Blue**. This color space is widely used in computer graphics. RGB are the main colors from which many colors can be made.

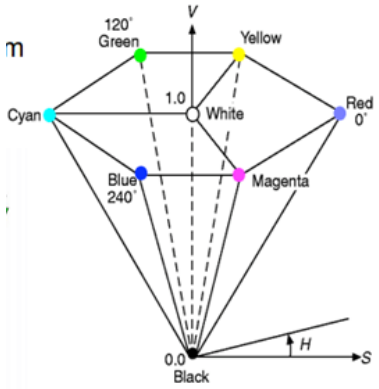
RGB can be represented in the 3-dimensional form:



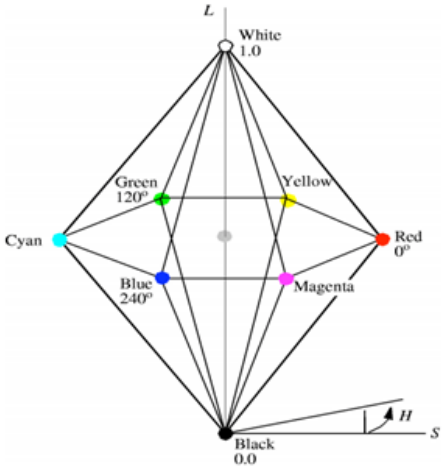
Below table is 100% RGB color bar contains values for 100% amplitude, 100% saturated, and for video test signal.

	Nominal Range	White	Yellow	Cyan	Green	Magenta	Red	Blue	Black
R	0 to 255	255	255	0	0	255	255	0	0
G	0 to 255	255	255	255	255	0	0	0	0
B	0 to 255	255	0	255	0	255	0	255	0

HSV Color Model : **HSV** stands for **Hue**, **Saturation**, and **Value (brightness)**. It is a hexcone subset of the cylindrical coordinate system. The human eye can see 128 different hues, 130 different saturations and number values between 16 (blue) and 23 (yellow).



HLS Color Model: **HLS** stands for **Hue Light Saturation**. It is a double hexcone subset. The maximum saturation of hue is S= 1 and L= 0.5. It is conceptually easy for people who want to



view white as a point.

Fourier Transform: Fourier transform is mainly used for image processing. In the Fourier transform, the intensity of the image is transformed into frequency variation and then to the frequency domain. It is used for slow varying intensity images such as the background of a passport size photo can be represented as low-frequency components and the edges can be represented as high-frequency components. Low-frequency components can be removed using filters of FT domain. When an image is filtered in the FT domain, it contains only the edges of

the image. And if we do inverse FT domain to spatial domain then also an image contains only edges. Fourier transform is the simplest technique in which edges of the image can be fined.

High pass filter:

A high-pass filter can be used to make an image appear sharper. These filters emphasize fine details in the image – exactly the opposite of the low-pass filter. High-pass filtering works in exactly the same way as low-pass filtering; it just uses a different convolution kernel.

Low Pass Filter:

Low pass filtering (aka smoothing), is employed to remove high spatial frequency noise from a digital image. The low-pass filters usually employ moving window operator which affects one pixel of the image at a time, changing its value by some function of a local region (window) of pixels.

Conclusion:

This experiment focused on OpenCV3 image processing techniques. Color space conversions (grayscale, RGB, HSV, HLS) were explored. Fourier Transform enabled frequency domain analysis, utilizing high-pass filters for sharpness and low-pass filters for noise removal. Understanding these concepts is crucial in computer graphics, animation, and hardware applications. Overall, OpenCV3 provides effective tools for image analysis, enhancement, and manipulation.