Representação de imagens, quantização, sistemas de cores, conversão colorido-escala de cinza

ES235 - Aula 02

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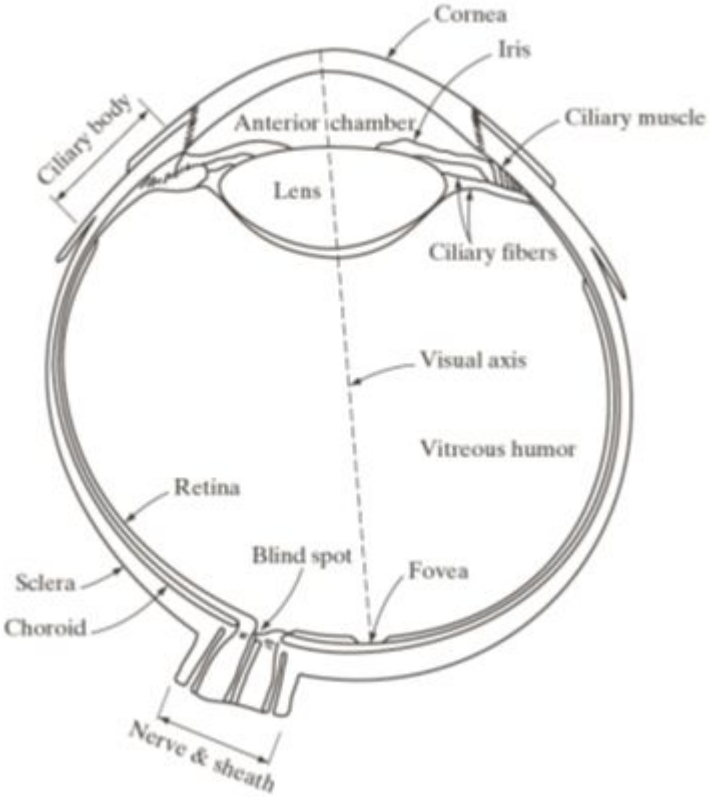
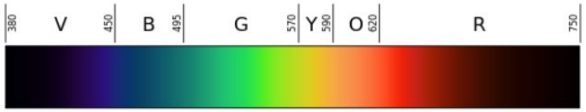
Representação de imagens





Color	Wavelength	Frequency	Photon energy
Violet	380–450 nm	680–790 THz	2.95–3.10 eV
Blue	450–485 nm	620–680 THz	2.64–2.75 eV
Cyan	485–500 nm	600–620 THz	2.48–2.52 eV
Green	500–565 nm	530–600 THz	2.25–2.34 eV
Yellow	565–590 nm	510–530 THz	2.10–2.17 eV
Orange	590–625 nm	480–510 THz	2.00–2.10 eV
Red	625–740 nm	405–480 THz	1.65–2.00 eV

Representação de imagens

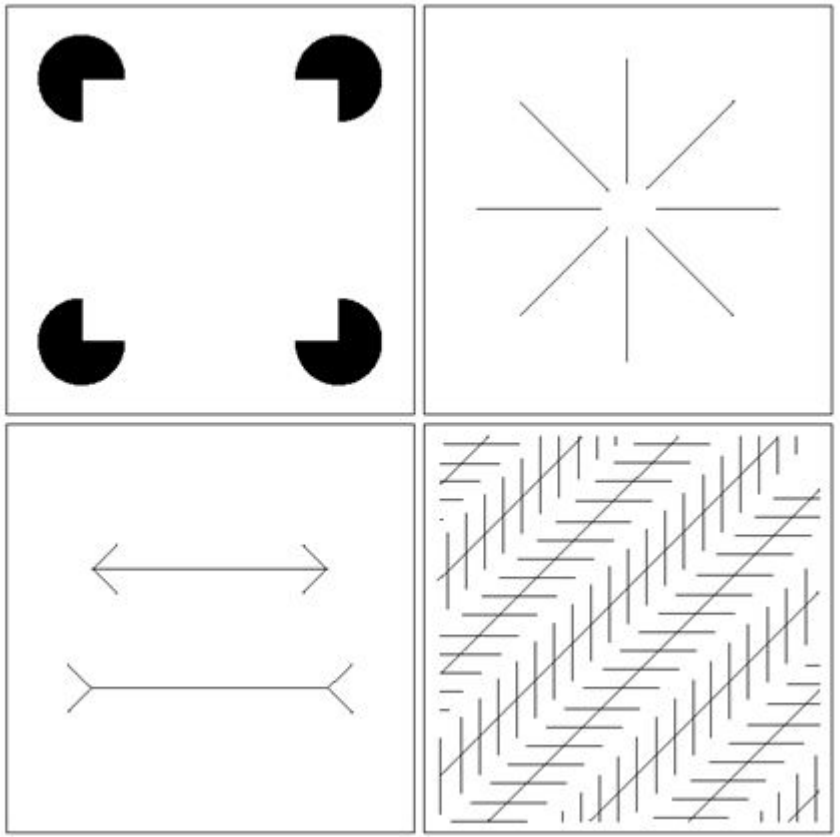
Enganando o olho humano...

a b c

FIGURE 2.8 Examples of simultaneous contrast. All the inner squares have the same intensity, but they appear progressively darker as the background becomes lighter.

Representação de imagens

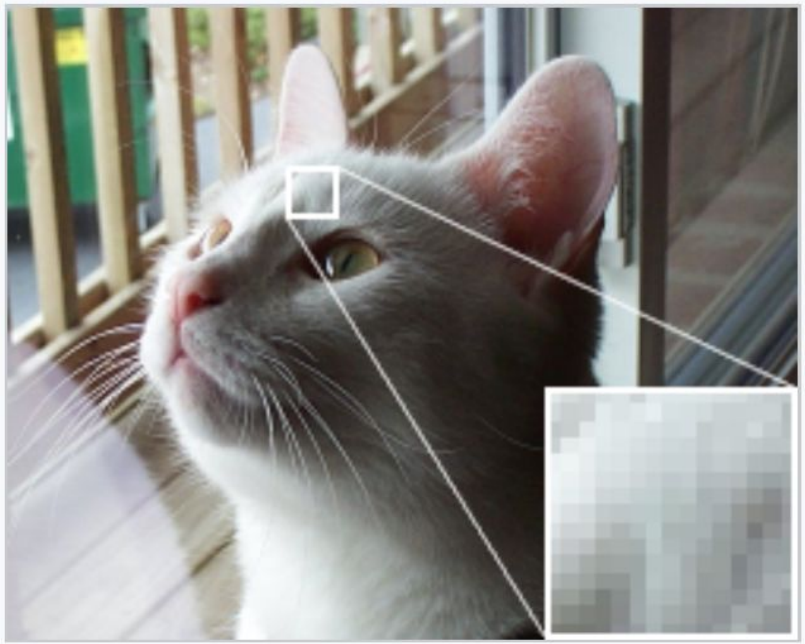
Mais ilusões...



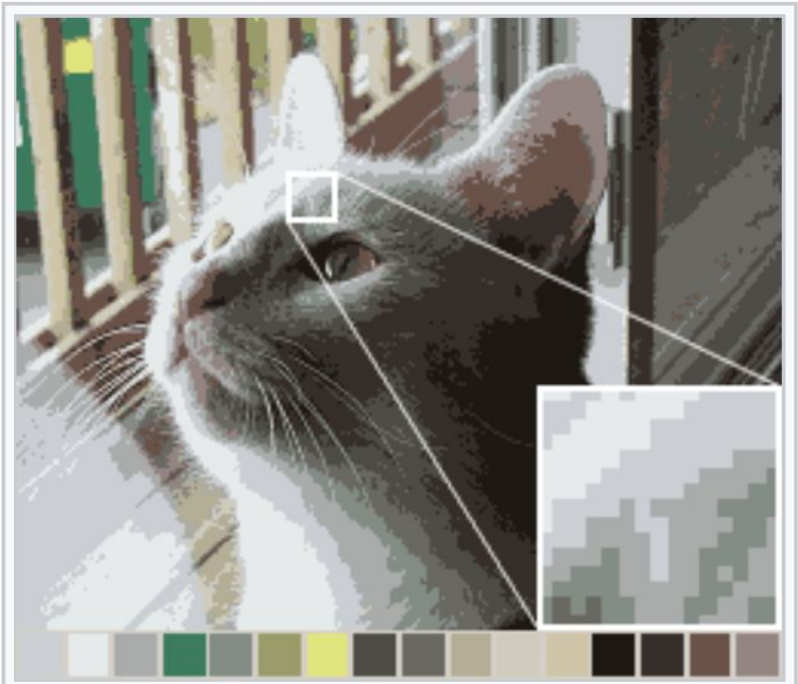
a b
c d

FIGURE 2.9 Some well-known optical illusions.

Quantização

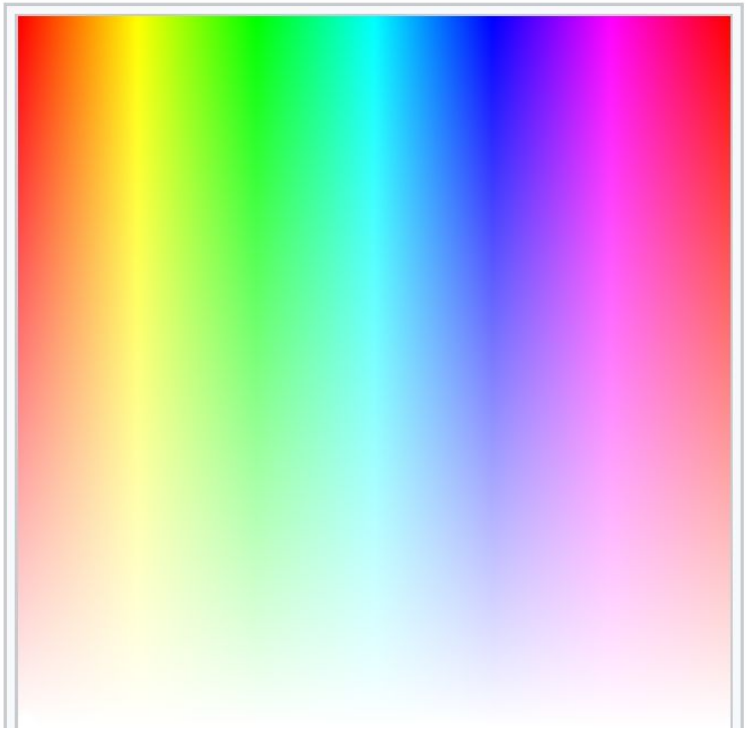


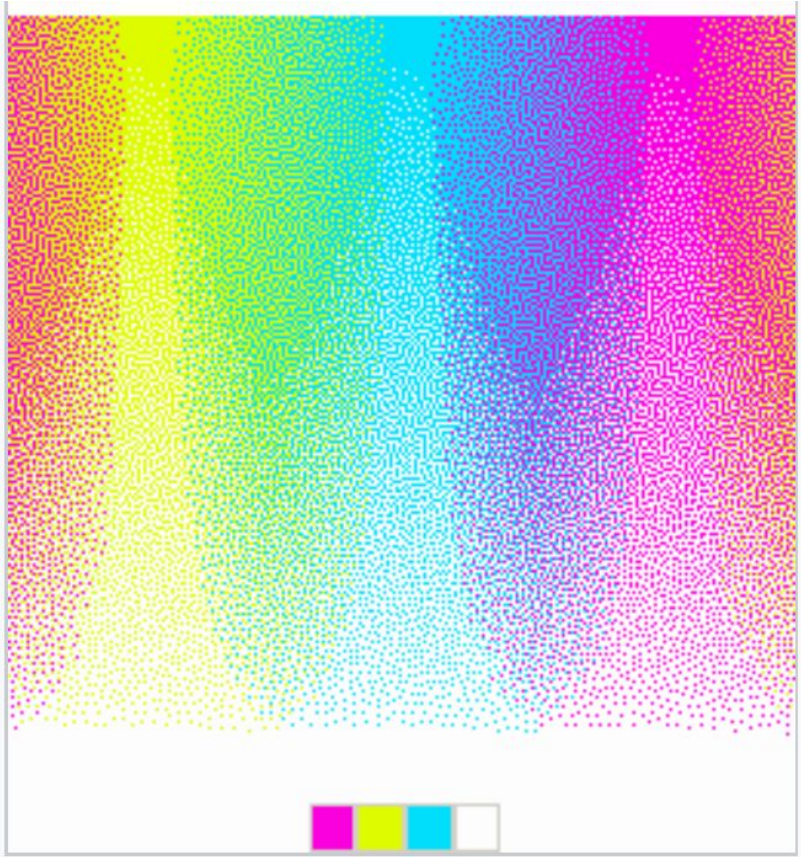
An example image in 24-bit RGB color



The same image reduced to a palette of 16 colors specifically chosen to best represent the image; the selected palette is shown by the squares above

Quantização

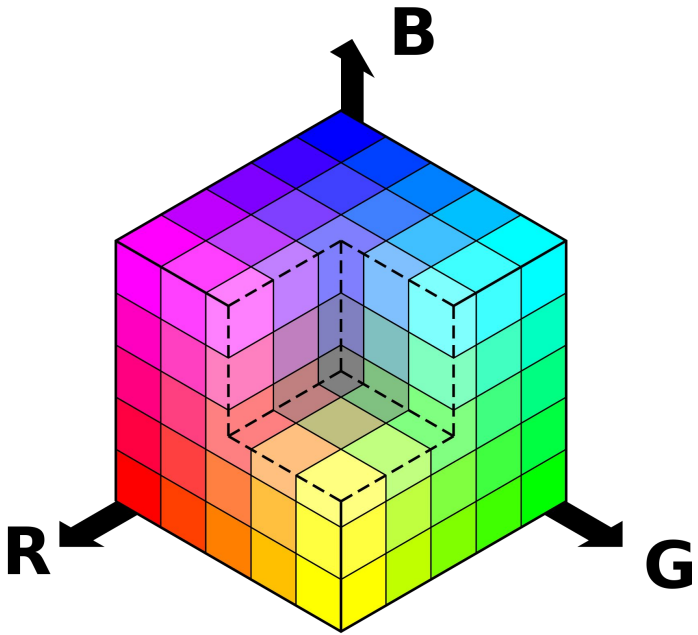




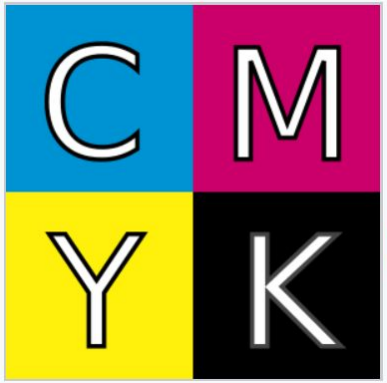
A colorful image reduced to 4 colors using spatial color quantization.

Sistemas de cores

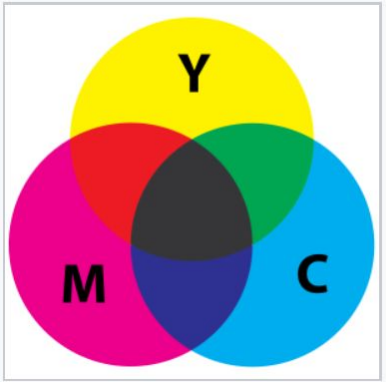
Aditivo (RGB)



Subtrativo (CMYK)



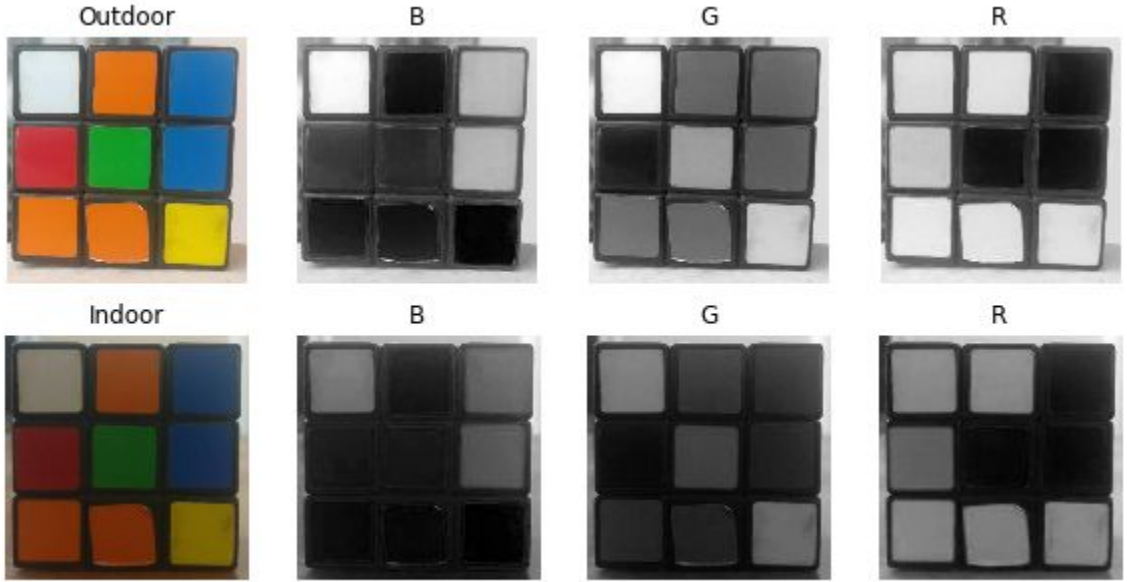
Color printing typically uses ink of four colors: cyan, magenta, yellow, and black.



When CMY “primaries” are combined at full strength, the resulting “secondary” mixtures are red, green, and blue. Mixing all three gives an imperfect black or a perfect grey.

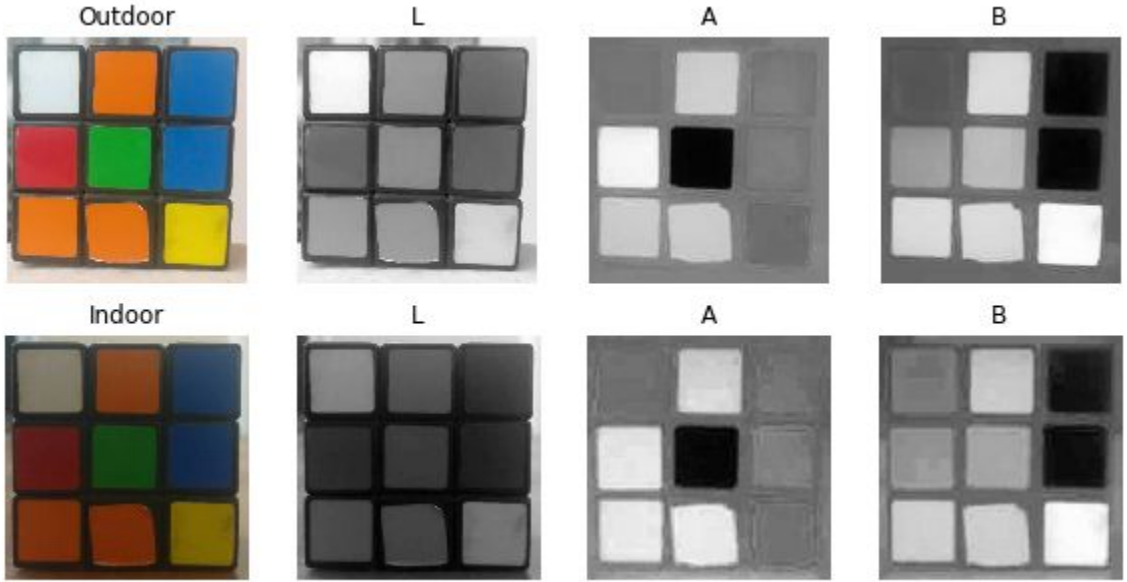
Outros Sistemas de cores

RGB



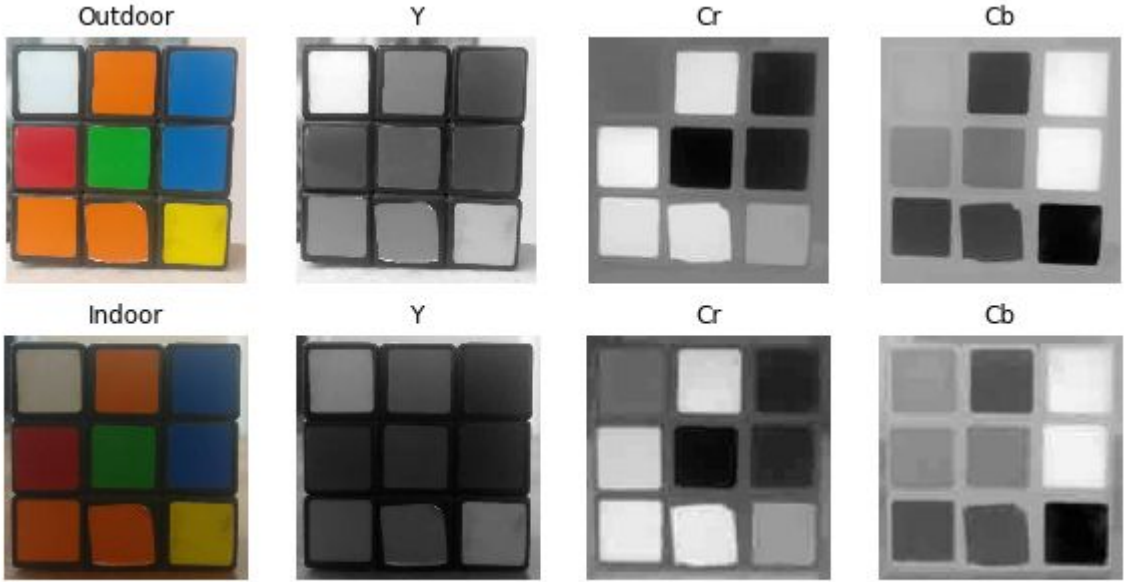
Outros Sistemas de cores

LAB



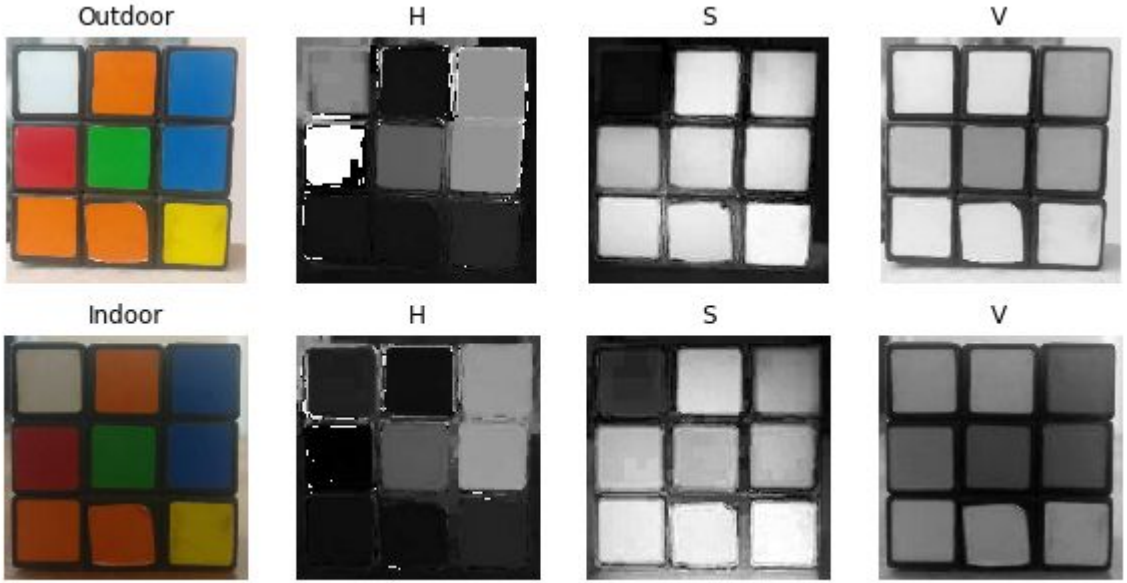
Outros Sistemas de cores

YCrCb



Outros Sistemas de cores

HSV



Conversão colorido-escala de cinza

$$\text{RGB[A] to Gray:} \quad Y \leftarrow 0.299 \cdot R + 0.587 \cdot G + 0.114 \cdot B$$

$$\text{Gray to RGB[A]:} \quad R \leftarrow Y, G \leftarrow Y, B \leftarrow Y, A \leftarrow \max(ChannelRange)$$

Outras Conversões

In case of 8-bit and 16-bit images, R, G, and B are converted to the floating-point format and scaled to fit the 0 to 1 range.

$$V \leftarrow max(R,G,B)$$

$$S \leftarrow \begin{cases} \frac{V-min(R,G,B)}{V} & \text{if } V \neq 0 \\ 0 & \text{otherwise} \end{cases}$$

$$H \leftarrow \begin{cases} 60(G-B)/(V-min(R,G,B)) & \text{if } V = R \\ 120+60(B-R)/(V-min(R,G,B)) & \text{if } V = G \\ 240+60(R-G)/(V-min(R,G,B)) & \text{if } V = B \end{cases}$$

If $H < 0$ then $H \leftarrow H + 360$. On output $0 \leq V \leq 1, 0 \leq S \leq 1, 0 \leq H \leq 360$.

The values are then converted to the destination data type:

- 8-bit images: $V \leftarrow 255V, S \leftarrow 255S, H \leftarrow H/2 (\text{to fit to 0 to 255})$
- 16-bit images: (currently not supported) $V < -65535V, S < -65535S, H < -H$
- 32-bit images: H, S, and V are left as is

REFERÊNCIAS

Rafael C. Gonzalez and Richard E. Woods. 2006. Digital Image Processing (3rd Edition). Prentice-Hall, Inc., Upper Saddle River, NJ, USA.

https://www.learnopencv.com/color-spaces-in-opencv-cpp-python/