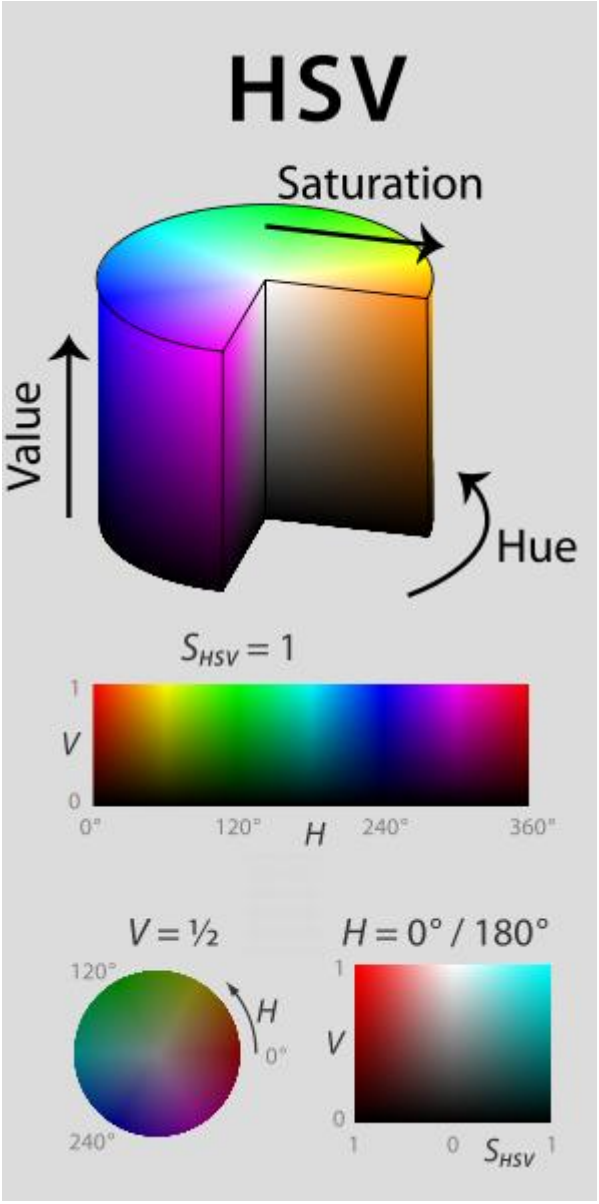
A Short note on the HSV color system

HSV stands for *hue*, *saturation*, and *value*, and is also often called **HSB** (*B* for *brightness*). A third model, common in computer vision applications, is **HSI**, for *hue*, *saturation*, and *intensity*.

The model is best visualized as a cylinder, where the angle around the central vertical axis corresponds to "hue", the distance from the axis corresponds to "saturation", and the distance along the axis corresponds to "lightness", "value" or "brightness" (see diagram below – source Wikipedia).



Brightness is just the intensity (number of photon per unit surface), and goes from maximum brightness to complete dark.

Hue is what people usually call « color », and corresponds to the dominant wavelength of light. The total gamut of hues is best displayed in a wheel of hues, with a set of primary colors, complementary colors (in between them), and all combinations in between.

Saturation is less intuitive, and can be seen as the density of color (say, the amount of pure color dye in a white liquid). At maximum saturation, color is most dense. A S=0, there is only « white » (or a shade of grey, depending on the value V). S=1 is more problematic, and actually is dependent on the device (just as a liquid could become more red than another depending on the amount of dye that you can possibly mix in).

The three values, combined, span the entire range of colors perceivable. Color is thus a 3D psychovisual experience, a combination born from the interaction between light and eye (color is NOT an intrinsic light attribute).

Images are usually stored with a triplet of RGB values. The standard HSV coordinates of a RGB color are obtained with :

$$M = \max(R, G, B)$$
$$m = \min(R, G, B)$$
$$C = M - m$$
$$H' = \begin{cases} \text{undefined}, & \text{if } C = 0 \\ \frac{G-B}{C} \bmod 6, & \text{if } M = R \\ \frac{B-R}{C} + 2, & \text{if } M = G \\ \frac{R-G}{C} + 4, & \text{if } M = B \end{cases}$$
$$H = 60^\circ \times H'$$

V = 0.3 R + 0.59 G + 0.11 B

$$S_{HSV} = \begin{cases} 0, & \text{if } C = 0 \\ \frac{C}{V}, & \text{otherwise} \end{cases}$$

HSV is not the best way to represent colors, but it is much more efficient than any arbitrary decomposition into 3 primaries to distinguish all colors in a sensible fashion.

A most complete description of color system s can be found at Charles Poynton's website at http://www.poynton.com .