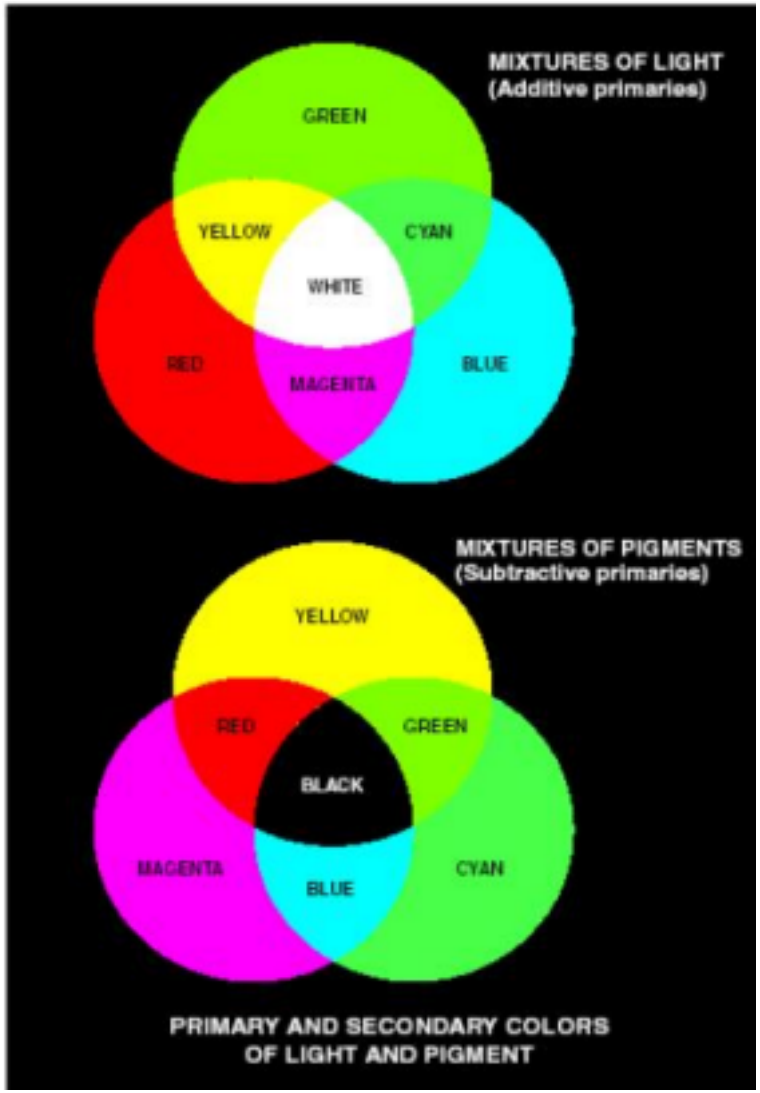
COLOR MODELS

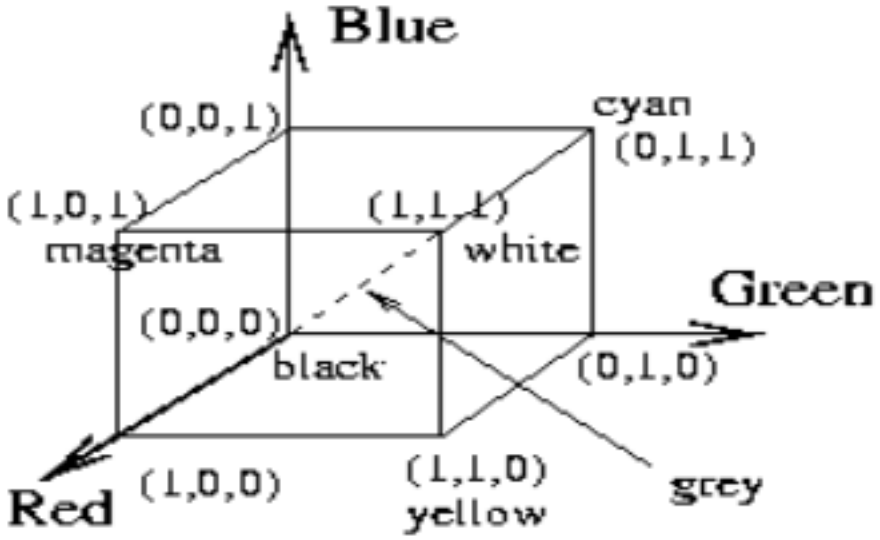
- Also known as color space or color system.



RGB COLOR MODEL

- Each color is represented in its primary color

components Red, Green and Blue. • This model is based on Cartesian coordinate system.



- It is an additive model, in which colors are produced by adding components, with white having all colors present and black being the absence of any color.

- This model is used in computer graphics and for active displays such as television and computer screens.

- In the RGB colour model, Color image is represented by intensity function:-

$I_{RGB}=(f_R,f_G,f_B)$

Where $f_R(x,y)$->intensity of pixel (x,y) in red channel

$f_G(x,y)$->intensity of pixel (x,y) in green channel

$f_B(x,y)$->intensity of pixel (x,y) in blue channel

- When the 3 colors RGB are fed into the color monitor, it produces a composite color image.

- The RGB model is usually represented by a unit cube with one corner located at the origin of a three dimensional color coordinate system, the axes being labeled R, G, B, and having a range of values [0, 1].

- The origin (0, 0, 0) is considered black and the diagonally opposite corner (1, 1, 1) is called white.

- The line joining black to white represents a gray

scale.

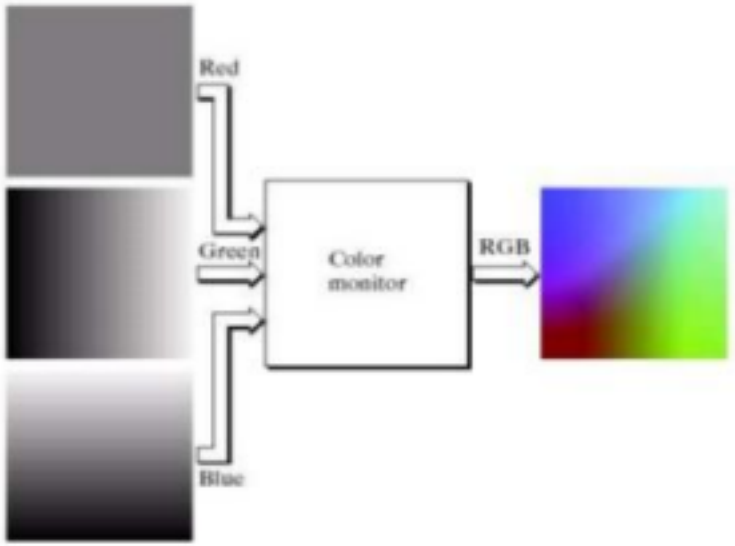


FIGURE 6.8 RGB 24-bit color cube.

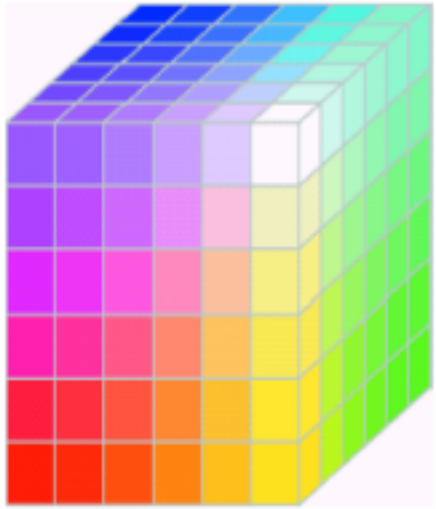


FIGURE 6.11 The RGB safe-color cube.

Number of bits used to represent each pixel in RGB space is

called **pixel depth**.

The total number of colors in a 24 Bit image is

$$2^{24} = 16777216$$

COLOR TO GRAYSCALE

CONVERSION $I_y = 0.30 f_R + 0.59 f_G + 0.11 f_B$

I_Y - Intensity of gray scale pixel

f_R- intensity of the pixel in the red channel f_G-

intensity of the pixel in the green channel f_B-

intensity of the pixel in the blue channel

CMY and CMYK COLOR MODEL

- Cyan, magenta, and yellow are the secondary colors of light or primary colors of pigments.
- When surface is coated with cyan pigment is illuminated with white light, no red light is reflected from the surface. Similar case with magenta and yellow.
- Most devices that deposit color pigments on paper (such as Color Printers) requires CMY data input or perform RGB to CMY conversion internally.

$$\begin{bmatrix} C \\ M \\ Y \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} C \\ M \\ Y \end{bmatrix}$$

- Equal amounts of Pigment primaries (Cyan, Magenta and Yellow) produce Black.
- In practice, combining these colors for printing produces a "Muddy-Black" color.
- So in order to produce "True-Black" a fourth color "Black" is added giving rise to CMYK model.
- Such models are used in

color printing such as books ,magazines etc.

RGB TO CMYK CONVERSION

The R,G,B values are divided by 255 to change the range from 0..255 to 0..1:

$$R' = R/255$$

$$G' = G/255$$

$$B' = \mathrm{B}/255$$

The black key (K) color is calculated from the red (R'), green (G') and blue (B') colors:

$$K = 1\text{-}\max(R', G', B')$$

The cyan color (C) is calculated from the red (R') and black (K) colors:

$$C = (1\text{-}R'\text{-}K) \,/\, (1\text{-}K)$$

The magenta color (M) is calculated from the green (G') and black (K) colors:

$$M = (1\text{-}G'\text{-}K) \,/\, (1\text{-}K)$$

The yellow color (Y) is calculated from the blue (B') and black (K) colors:

$$Y = (1\text{-}B'\text{-}K) \,/\, (1\text{-}K)$$

CMYK TO RGB CONVERSION

The R,G,B values are given in the range of 0..255.

The red (R) color is calculated from the cyan (C) and black (K) colors:

$$R = 255 \times (1-C) \times (1-K)$$

The green color (G) is calculated from the magenta (M) and black (K) colors:

$$G = 255 \times (1-M) \times (1-K)$$

The blue color (B) is calculated from the yellow (Y) and black (K) colors:

$$B = 255 \times (1-Y) \times (1-K)$$

- If the RGB image has a pixel P(125,70,200), than what is its corresponding gray scale value?

  I=0.30*125+0.59*70+0.11*200

  =100.8

- Red, green and blue values of pixels are 108,110,98 resp. Maximum intensity in RGB is 255 then what are its

corresponding values in CMY model in the range 0 to 1?

The R,G,B values are divided by 255 to change the range from 0..255 to 0..1:

$$R' = R/255$$

$$G' = G/255$$

$$B' = B/255$$

- R’=108/255=0.424
- G’=110/255=0.431
- B’=98/255=0.384

$$\begin{bmatrix} C \\ M \\ Y \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} R' \\ G' \\ B' \end{bmatrix}$$

$$\begin{bmatrix} 0.576 \\ 0.568 \\ 0.616 \end{bmatrix}$$