KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI

UNIA EUROPEJSKA
EUROPEJSKI
FUNDUSZ SPOŁECZNY

„Image Processing and Computer Graphics”

Prezentacja multimedialna współfinansowana przez Unię Europejską w ramach Europejskiego Funduszu Społecznego w projekcie pt.

„Innowacyjna dydaktyka bez ograniczeń - zintegrowany rozwój Politechniki Łódzkiej - zarządzanie Uczelnią, nowoczesna oferta edukacyjna i wzmacniania zdolności do zatrudniania osób niepełnosprawnych”

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Image Processing and Computer Graphics IP&CG

Colors
Raster and vector images, 2D and 3D
Acquisition of biomedical images
Image enhancement and filtering
Edge detection and segmentation
Image feature extraction and selection
Programs and programming for IP
3D space transformation and projection
Techniques for space projection
Programs and programming for CG

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Colors

- Color models/spaces
- Color model conversion
- Application of color models
- Digitized colors

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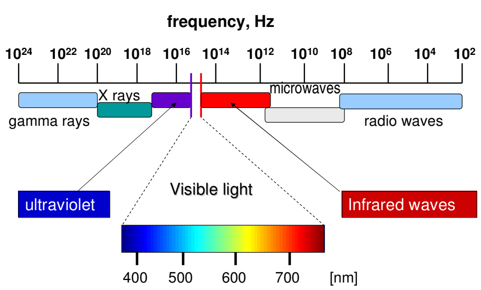
Electromagnetic spectrum



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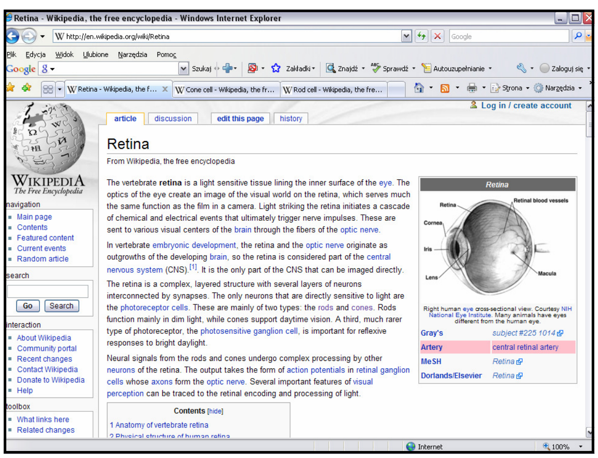
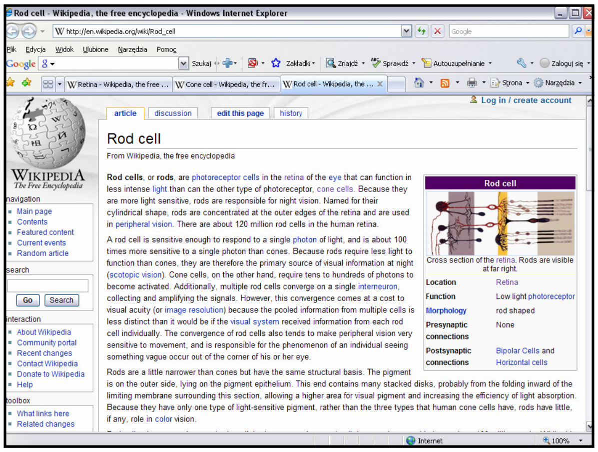
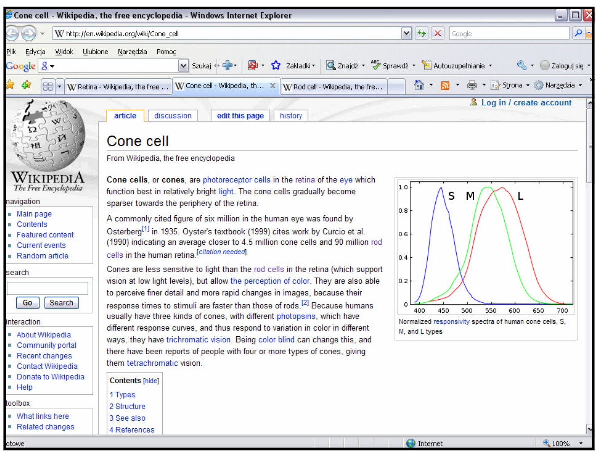



Rod cell - Wikipedia, the free encyclopedia - Windows Internet Explorer
Rod cell
From Wikipedia, the free encyclopedia
Rod cells, or rods, are photoreceptor cells in the retina of the eye that can function in less intense light than can the other type of photoreceptor, cone cells. Because they are more light sensitive, rods are responsible for night vision. Named for their cylindrical shape, rods are concentrated at the outer edges of the retina and are used in peripheral vision. There are about 120 million rod cells in the human retina.
A rod cell is sensitive enough to respond to a single photon of light, and is about 100 times more sensitive to a single photon than cones. Because rods require less light to function than cones, they are therefore the primary source of visual information at night (scotopic vision). Cone cells, on the other hand, require tens to hundreds of photons to become activated. Additionally, multiple rod cells converge on a single interneuron, collecting and amplifying the signals. However, this convergence comes at a cost to visual acuity (or image resolution) because the pooled information from multiple cells is less distinct than it would be if the visual system received information from each rod cell individually. The convergence of rod cells also tends to make peripheral vision very sensitive to movement, and is responsible for the phenomenon of an individual seeing something vague occur out of the corner of his or her eye.
Rods are a little narrower than cones but have the same structural basis. The pigment is on the outer side, lying on the pigment epithelium. This end contains many stacked disks, probably from the folding inward of the limiting membrane surrounding this section, allowing a higher area for visual pigment and increasing the efficiency of light absorption. Because they have only one type of light-sensitive pigment, rather than the three types that human cone cells have, rods have little, if any, role in color vision.
Rod cell
Cross section of the retina. Rods are visible at far right.
Location Retina
Function Low light photoreceptor
Morphology rod shaped
Presynaptic connections None
Postsynaptic connections Bipolar Cells and Horizontal cells


Cone cell - Wikipedia, the free encyclopedia - Windows Internet Explorer
Cone cell
From Wikipedia, the free encyclopedia
Cone cells, or cones, are photoreceptor cells in the retina of the eye which function best in relatively bright light. The cone cells gradually become sparser towards the periphery of the retina.
A commonly cited figure of six million in the human eye was found by Osterberg[1] in 1935. Oyster's textbook (1999) cites work by Curcio et al. (1990) indicating an average closer to 4.5 million cone cells and 90 million rod cells in the human retina.[citation needed]
Cones are less sensitive to light than the rod cells in the retina (which support vision at low light levels), but allow the perception of color. They are also able to perceive finer detail and more rapid changes in images, because their response times to stimuli are faster than those of rods.[2] Because humans usually have three kinds of cones, with different photopsins, which have different response curves, and thus respond to variation in color in different ways, they have trichromatic vision. Being color blind can change this, and there have been reports of people with four or more types of cones, giving them tetrachromatic vision.
Contents [hide]
1 Types
2 Structure
3 See also
4 References
S
M
L
Normalized responsivity spectra of human cone cells, S, M, and L types

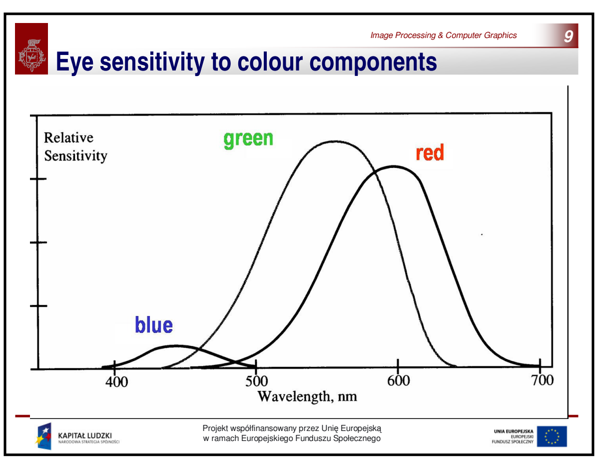


Image Processing & Computer Graphics
9
Eye sensitivity to colour components
Relative Sensitivity
green
red
blue
400
500
600
700
Wavelength, nm
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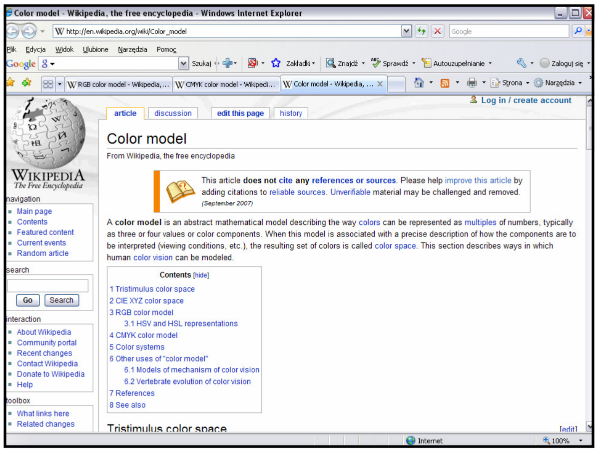
Color model - Wikipedia, the free encyclopedia - Windows Internet Explorer
http://en.wikipedia.org/wiki/Color_model
article
discussion
edit this page
history
Log in / create account
Color model
From Wikipedia, the free encyclopedia
This article does not cite any references or sources. Please help improve this article by adding citations to reliable sources. Unverifiable material may be challenged and removed. (September 2007)
A color model is an abstract mathematical model describing the way colors can be represented as multiples of numbers, typically as three or four values or color components. When this model is associated with a precise description of how the components are to be interpreted (viewing conditions, etc.), the resulting set of colors is called color space. This section describes ways in which human color vision can be modeled.
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1 Tristimulus color space
2 CIE XYZ color space
3 RGB color model
3.1 HSV and HSL representations
4 CMYK color model
5 Color systems
6 Other uses of "color model"
6.1 Models of mechanism of color vision
6.2 Vertebrate evolution of color vision
7 References
8 See also
Tristimulus color space

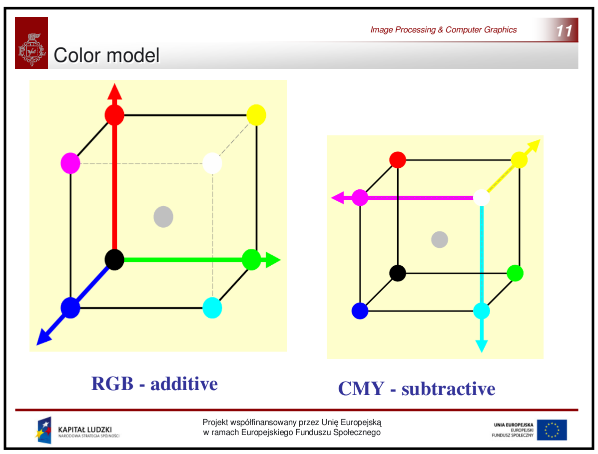
Image Processing & Computer Graphics
11
Color model
RGB - additive
CMY - subtractive
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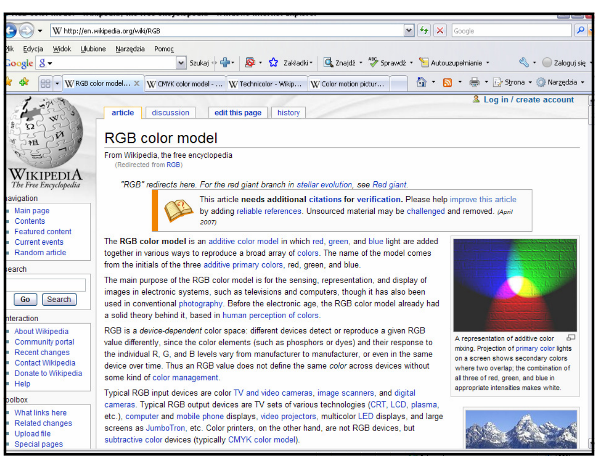
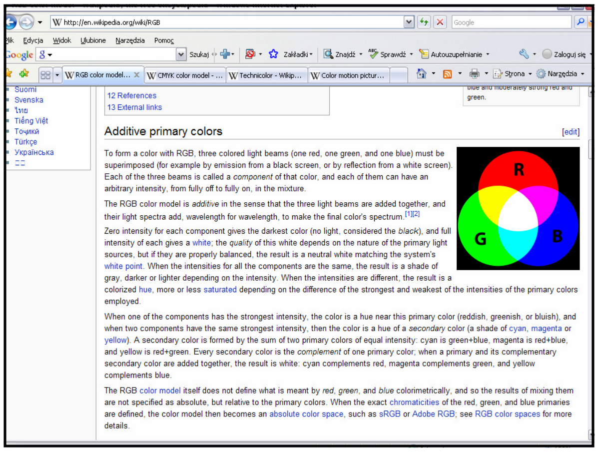

http://en.wikipedia.org/wiki/RGB
article
discussion
edit this page
history
Log in / create account
RGB color model
From Wikipedia, the free encyclopedia
(Redirected from RGB)
"RGB" redirects here. For the red giant branch in stellar evolution, see Red giant.
This article needs additional citations for verification. Please help improve this article by adding reliable references. Unsourced material may be challenged and removed. (April 2007)
The RGB color model is an additive color model in which red, green, and blue light are added together in various ways to reproduce a broad array of colors. The name of the model comes from the initials of the three additive primary colors, red, green, and blue.
The main purpose of the RGB color model is for the sensing, representation, and display of images in electronic systems, such as televisions and computers, though it has also been used in conventional photography. Before the electronic age, the RGB color model already had a solid theory behind it, based in human perception of colors.
RGB is a device-dependent color space: different devices detect or reproduce a given RGB value differently, since the color elements (such as phosphors or dyes) and their response to the individual R, G, and B levels vary from manufacturer to manufacturer, or even in the same device over time. Thus an RGB value does not define the same color across devices without some kind of color management.
Typical RGB input devices are color TV and video cameras, image scanners, and digital cameras. Typical RGB output devices are TV sets of various technologies (CRT, LCD, plasma, etc.), computer and mobile phone displays, video projectors, multicolor LED displays, and large screens as JumboTron, etc. Color printers, on the other hand, are not RGB devices, but subtractive color devices (typically CMYK color model).
A representation of additive color mixing. Projection of primary color lights on a screen shows secondary colors where two overlap; the combination of all three of red, green, and blue in appropriate intensities makes white.



http://en.wikipedia.org/wiki/RGB

12 References
13 External links

Additive primary colors

[edit]

To form a color with RGB, three colored light beams (one red, one green, and one blue) must be superimposed (for example by emission from a black screen, or by reflection from a white screen). Each of the three beams is called a *component* of that color, and each of them can have an arbitrary intensity, from fully off to fully on, in the mixture.

The RGB color model is *additive* in the sense that the three light beams are added together, and their light spectra add, wavelength for wavelength, to make the final color's spectrum.[1][2]

Zero intensity for each component gives the darkest color (no light, considered the *black*), and full intensity of each gives a white; the *quality* of this white depends on the nature of the primary light sources, but if they are properly balanced, the result is a neutral white matching the system's white point. When the intensities for all the components are the same, the result is a shade of gray, darker or lighter depending on the intensity. When the intensities are different, the result is a colorized hue, more or less saturated depending on the difference of the strongest and weakest of the intensities of the primary colors employed.

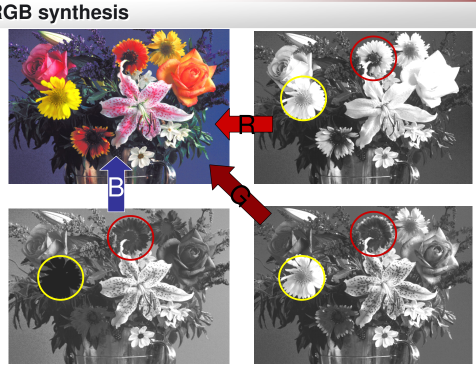
When one of the components has the strongest intensity, the color is a hue near this primary color (reddish, greenish, or bluish), and when two components have the same strongest intensity, then the color is a hue of a *secondary* color (a shade of cyan, magenta or yellow). A secondary color is formed by the sum of two primary colors of equal intensity: cyan is green+blue, magenta is red+blue, and yellow is red+green. Every secondary color is the *complement* of one primary color; when a primary and its complementary secondary color are added together, the result is white: cyan complements red, magenta complements green, and yellow complements blue.

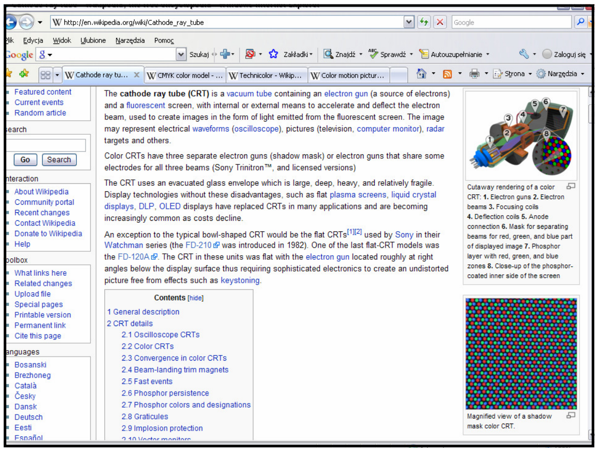
The RGB color model itself does not define what is meant by *red*, *green*, and *blue* colorimetrically, and so the results of mixing them are not specified as absolute, but relative to the primary colors. When the exact chromaticities of the red, green, and blue primaries are defined, the color model then becomes an absolute color space, such as sRGB or Adobe RGB; see RGB color spaces for more details.

RGB components (additive)

An RGB image, along with its separate R, G and B components; Note that the white snow consists of strong red, green, and blue; the brown barn is composed of strong red and green with little blue; the dark green grass consists of strong green with little red or blue; and the light blue sky is composed of strong blue and moderately strong red and green.

RGB synthesis





http://en.wikipedia.org/wiki/Cathode_ray_tube

The **cathode ray tube (CRT)** is a vacuum tube containing an electron gun (a source of electrons) and a fluorescent screen, with internal or external means to accelerate and deflect the electron beam, used to create images in the form of light emitted from the fluorescent screen. The image may represent electrical waveforms (oscilloscope), pictures (television, computer monitor), radar targets and others.

Color CRTs have three separate electron guns (shadow mask) or electron guns that share some electrodes for all three beams (Sony Trinitron™, and licensed versions)

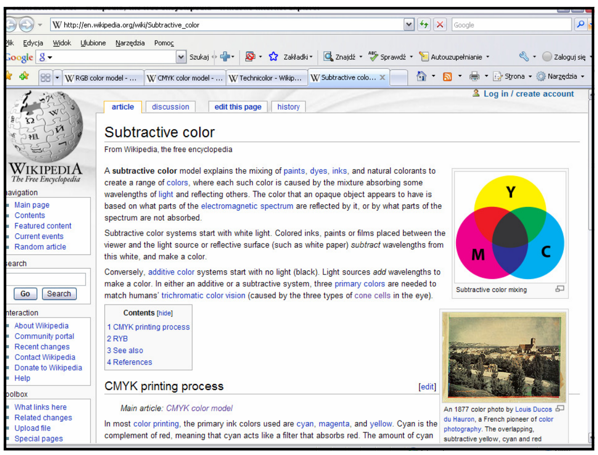
The CRT uses an evacuated glass envelope which is large, deep, heavy, and relatively fragile. Display technologies without these disadvantages, such as flat plasma screens, liquid crystal displays, DLP, OLED displays have replaced CRTs in many applications and are becoming increasingly common as costs decline.

An exception to the typical bowl-shaped CRT would be the flat CRTs[1][2] used by Sony in their Watchman series (the FD-210 was introduced in 1982). One of the last flat-CRT models was the FD-120A. The CRT in these units was flat with the electron gun located roughly at right angles below the display surface thus requiring sophisticated electronics to create an undistorted picture free from effects such as keystoning.

Contents [hide]

Cutaway rendering of a color CRT: **1.** Electron guns **2.** Electron beams **3.** Focusing coils **4.** Deflection coils **5.** Anode connection **6.** Mask for separating beams for red, green, and blue part of displayed image **7.** Phosphor layer with red, green, and blue zones **8.** Close-up of the phosphor-coated inner side of the screen

Magnified view of a shadow mask color CRT.



http://en.wikipedia.org/wiki/Subtractive_color

Subtractive color

From Wikipedia, the free encyclopedia

A **subtractive color** model explains the mixing of paints, dyes, inks, and natural colorants to create a range of colors, where each such color is caused by the mixture absorbing some wavelengths of light and reflecting others. The color that an opaque object appears to have is based on what parts of the electromagnetic spectrum are reflected by it, or by what parts of the spectrum are not absorbed.

Subtractive color systems start with white light. Colored inks, paints or films placed between the viewer and the light source or reflective surface (such as white paper) *subtract* wavelengths from this white, and make a color.

Conversely, additive color systems start with no light (black). Light sources *add* wavelengths to make a color. In either an additive or a subtractive system, three primary colors are needed to match humans' trichromatic color vision (caused by the three types of cone cells in the eye).

Contents [hide]

CMYK printing process [edit]

Main article: CMYK color model

In most color printing, the primary ink colors used are cyan, magenta, and yellow. Cyan is the complement of red, meaning that cyan acts like a filter that absorbs red. The amount of cyan

Subtractive color mixing

An 1877 color photo by Louis Ducos du Hauron, a French pioneer of color photography. The overlapping, subtractive yellow, cyan and red

RGB 2 CMY

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

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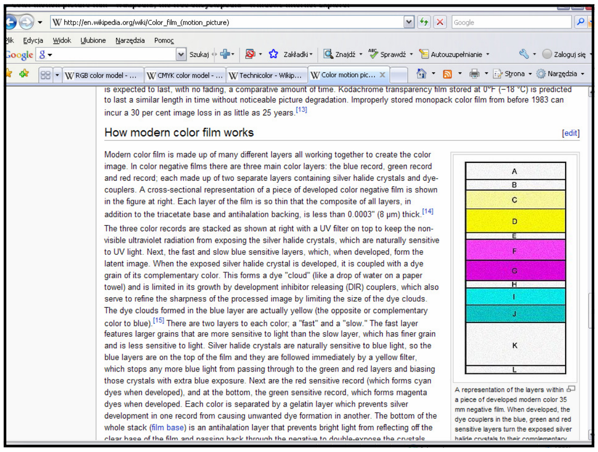
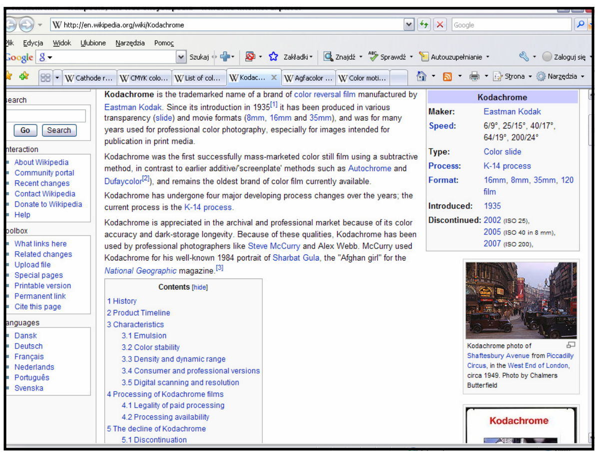

http://en.wikipedia.org/wiki/Color_film_(motion_picture)
is expected to last, with no fading, a comparative amount of time. Kodachrome transparency film stored at 0°F (−18 °C) is predicted to last a similar length in time without noticeable picture degradation. Improperly stored monopack color film from before 1983 can incur a 30 per cent image loss in as little as 25 years.[13]
How modern color film works
[edit]
Modern color film is made up of many different layers all working together to create the color image. In color negative films there are three main color layers: the blue record, green record and red record; each made up of two separate layers containing silver halide crystals and dye-couplers. A cross-sectional representation of a piece of developed color negative film is shown in the figure at right. Each layer of the film is so thin that the composite of all layers, in addition to the triacetate base and antihalation backing, is less than 0.0003" (8 µm) thick.[14]
The three color records are stacked as shown at right with a UV filter on top to keep the non-visible ultraviolet radiation from exposing the silver halide crystals, which are naturally sensitive to UV light. Next, the fast and slow blue sensitive layers, which, when developed, form the latent image. When the exposed silver halide crystal is developed, it is coupled with a dye grain of its complementary color. This forms a dye "cloud" (like a drop of water on a paper towel) and is limited in its growth by development inhibitor releasing (DIR) couplers, which also serve to refine the sharpness of the processed image by limiting the size of the dye clouds. The dye clouds formed in the blue layer are actually yellow (the opposite or complementary color to blue).[15] There are two layers to each color; a "fast" and a "slow." The fast layer features larger grains that are more sensitive to light than the slow layer, which has finer grain and is less sensitive to light. Silver halide crystals are naturally sensitive to blue light, so the blue layers are on the top of the film and they are followed immediately by a yellow filter, which stops any more blue light from passing through to the green and red layers and biasing those crystals with extra blue exposure. Next are the red sensitive record (which forms cyan dyes when developed), and at the bottom, the green sensitive record, which forms magenta dyes when developed. Each color is separated by a gelatin layer which prevents silver development in one record from causing unwanted dye formation in another. The bottom of the whole stack (film base) is an antihalation layer that prevents bright light from reflecting off the
A
B
C
D
E
F
G
H
I
J
K
L
A representation of the layers within a piece of developed modern color 35 mm negative film. When developed, the dye couplers in the blue, green and red sensitive layers turn the exposed silver


http://en.wikipedia.org/wiki/Kodachrome
Kodachrome is the trademarked name of a brand of color reversal film manufactured by Eastman Kodak. Since its introduction in 1935[1] it has been produced in various transparency (slide) and movie formats (8mm, 16mm and 35mm), and was for many years used for professional color photography, especially for images intended for publication in print media.
Kodachrome was the first successfully mass-marketed color still film using a subtractive method, in contrast to earlier additive/'screenplate' methods such as Autochrome and Dufaycolor[2]), and remains the oldest brand of color film currently available.
Kodachrome has undergone four major developing process changes over the years; the current process is the K-14 process.
Kodachrome is appreciated in the archival and professional market because of its color accuracy and dark-storage longevity. Because of these qualities, Kodachrome has been used by professional photographers like Steve McCurry and Alex Webb. McCurry used Kodachrome for his well-known 1984 portrait of Sharbat Gula, the "Afghan girl" for the National Geographic magazine.[3]
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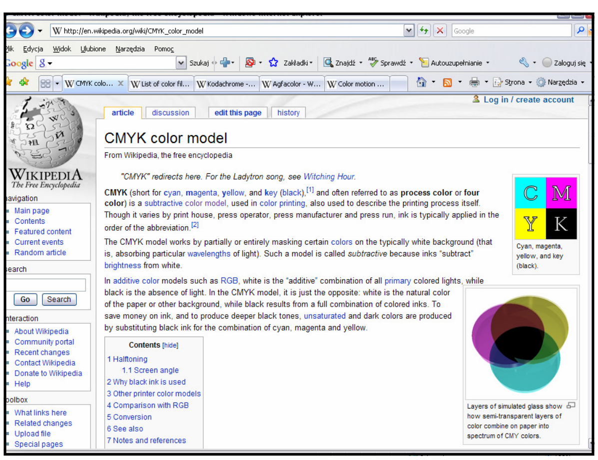
2 Product Timeline
3 Characteristics
3.1 Emulsion
3.2 Color stability
3.3 Density and dynamic range
3.4 Consumer and professional versions
3.5 Digital scanning and resolution
4 Processing of Kodachrome films
4.1 Legality of paid processing
4.2 Processing availability
5 The decline of Kodachrome
5.1 Discontinuation
Kodachrome
Maker: Eastman Kodak
Speed: 6/9°, 25/15°, 40/17°, 64/19°, 200/24°
Type: Color slide
Process: K-14 process
Format: 16mm, 8mm, 35mm, 120 film
Introduced: 1935
Discontinued: 2002 (ISO 25), 2005 (ISO 40 in 8 mm), 2007 (ISO 200),
Kodachrome photo of Shaftesbury Avenue from Piccadilly Circus, in the West End of London, circa 1949. Photo by Chalmers Butterfield
Kodachrome


http://en.wikipedia.org/wiki/CMYK_color_model
CMYK color model
From Wikipedia, the free encyclopedia
"CMYK" redirects here. For the Ladytron song, see Witching Hour.
CMYK (short for cyan, magenta, yellow, and key (black),[1] and often referred to as process color or four color) is a subtractive color model, used in color printing, also used to describe the printing process itself. Though it varies by print house, press operator, press manufacturer and press run, ink is typically applied in the order of the abbreviation.[2]
The CMYK model works by partially or entirely masking certain colors on the typically white background (that is, absorbing particular wavelengths of light). Such a model is called subtractive because inks "subtract" brightness from white.
In additive color models such as RGB, white is the "additive" combination of all primary colored lights, while black is the absence of light. In the CMYK model, it is just the opposite: white is the natural color of the paper or other background, while black results from a full combination of colored inks. To save money on ink, and to produce deeper black tones, unsaturated and dark colors are produced by substituting black ink for the combination of cyan, magenta and yellow.
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1 Halftoning
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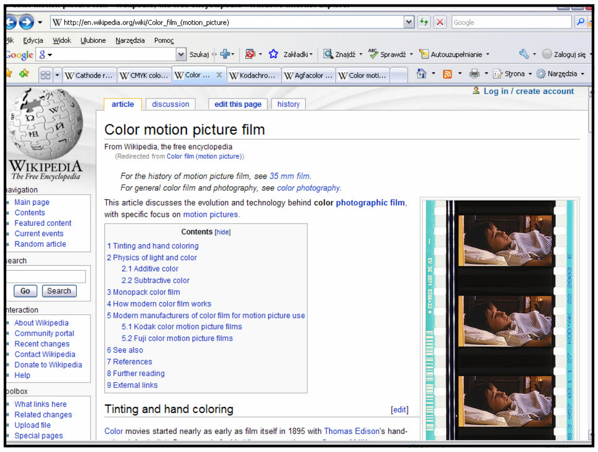
2 Why black ink is used
3 Other printer color models
4 Comparison with RGB
5 Conversion
6 See also
7 Notes and references
C M Y K
Cyan, magenta, yellow, and key (black).
Layers of simulated glass show how semi-transparent layers of color combine on paper into spectrum of CMY colors.



Color motion picture film

From Wikipedia, the free encyclopedia
(Redirected from Color film (motion picture))

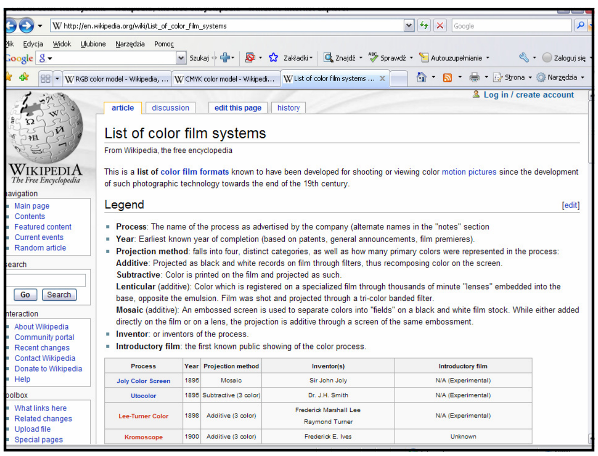
For the history of motion picture film, see 35 mm film.
For general color film and photography, see color photography.

This article discusses the evolution and technology behind **color photographic film**, with specific focus on motion pictures.

Contents [hide]

Tinting and hand coloring [edit]

Color movies started nearly as early as film itself in 1895 with Thomas Edison's hand-



List of color film systems

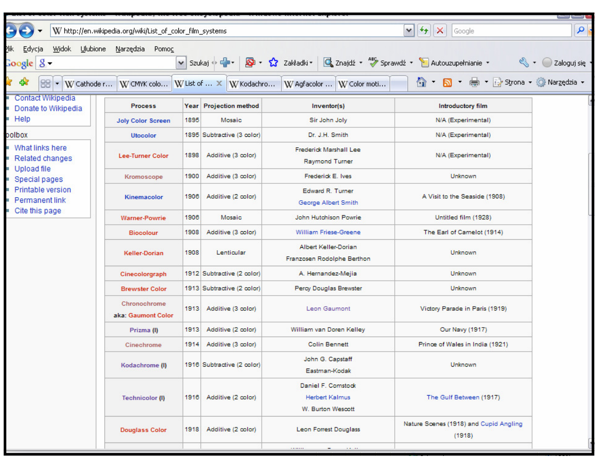
From Wikipedia, the free encyclopedia

This is a **list of color film formats** known to have been developed for shooting or viewing color motion pictures since the development of such photographic technology towards the end of the 19th century.

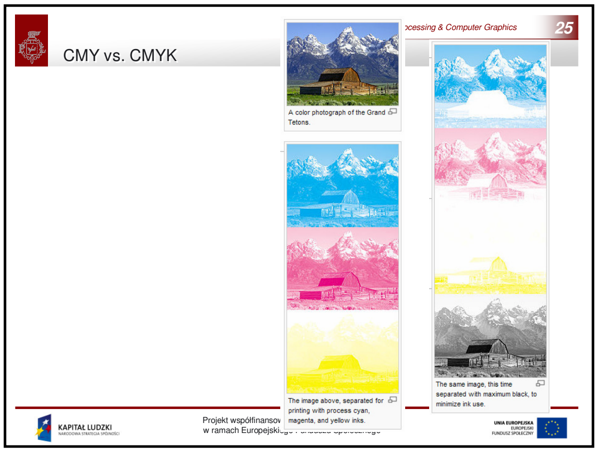
Legend [edit]

- **Process**: The name of the process as advertised by the company (alternate names in the "notes" section
- **Year**: Earliest known year of completion (based on patents, general announcements, film premieres).
- **Projection method**: falls into four, distinct categories, as well as how many primary colors were represented in the process:
  Additive: Projected as black and white records on film through filters, thus recomposing color on the screen.
  Subtractive: Color is printed on the film and projected as such.
  Lenticular (additive): Color which is registered on a specialized film through thousands of minute "lenses" embedded into the base, opposite the emulsion. Film was shot and projected through a tri-color banded filter.
  Mosaic (additive): An embossed screen is used to separate colors into "fields" on a black and white film stock. While either added directly on the film or on a lens, the projection is additive through a screen of the same embossment.
- **Inventor**: or inventors of the process.
- **Introductory film**: the first known public showing of the color process.

Process	Year	Projection method	Inventor(s)	Introductory film
Joly Color Screen	1895	Mosaic	Sir John Joly	N/A (Experimental)
Utocolor	1895	Subtractive (3 color)	Dr. J.H. Smith	N/A (Experimental)
Lee-Turner Color	1898	Additive (3 color)	Frederick Marshall Lee Raymond Turner	N/A (Experimental)
Kromoscope	1900	Additive (3 color)	Frederick E. Ives	Unknown



Process	Year	Projection method	Inventor(s)	Introductory film
Joly Color Screen	1895	Mosaic	Sir John Joly	N/A (Experimental)
Utocolor	1895	Subtractive (3 color)	Dr. J.H. Smith	N/A (Experimental)
Lee-Turner Color	1898	Additive (3 color)	Frederick Marshall Lee Raymond Turner	N/A (Experimental)
Kromoscope	1900	Additive (3 color)	Frederick E. Ives	Unknown
Kinemacolor	1906	Additive (2 color)	Edward R. Turner George Albert Smith	A Visit to the Seaside (1908)
Warner-Powrie	1906	Mosaic	John Hutchison Powrie	Untitled film (1928)
Biocolour	1908	Additive (3 color)	William Friese-Greene	The Earl of Camelot (1914)
Keller-Dorian	1908	Lenticular	Albert Keller-Dorian Franzosen Rodolphe Berthon	Unknown
Cinecolorgraph	1912	Subtractive (2 color)	A. Hernandez-Mejia	Unknown
Brewster Color	1913	Subtractive (2 color)	Percy Douglas Brewster	Unknown
Chronochrome aka: Gaumont Color	1913	Additive (3 color)	Leon Gaumont	Victory Parade in Paris (1919)
Prizma (I)	1913	Additive (2 color)	William van Doren Kelley	Our Navy (1917)
Cinechrome	1914	Additive (3 color)	Colin Bennett	Prince of Wales in India (1921)
Kodachrome (I)	1916	Subtractive (2 color)	John G. Capstaff Eastman-Kodak	Unknown
Technicolor (I)	1916	Additive (2 color)	Daniel F. Comstock Herbert Kalmus W. Burton Wescott	The Gulf Between (1917)
Douglass Color	1918	Additive (2 color)	Leon Forrest Douglass	Nature Scenes (1918) and Cupid Angling (1918)


CMY vs. CMYK
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A color photograph of the Grand Tetons.
The image above, separated for printing with process cyan, magenta, and yellow inks.
The same image, this time separated with maximum black, to minimize ink use.
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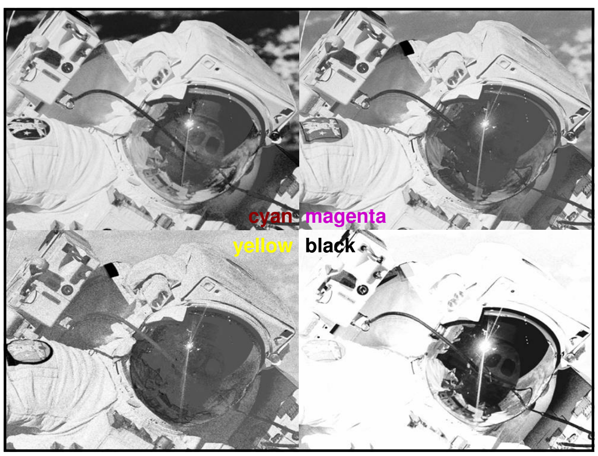
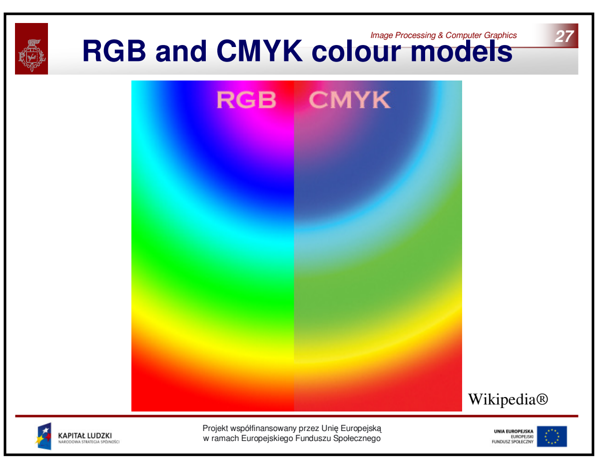
Projekt współfinansow
w ramach Europejski


cyan
magenta
yellow
black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RGB and CMYK colour models
RGB
CMYK
Wikipedia®
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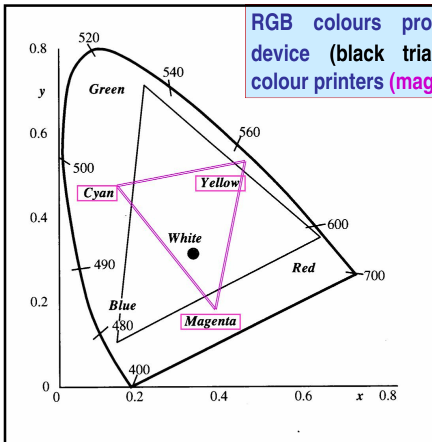
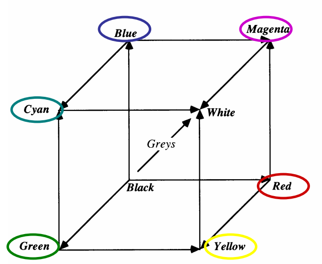
Projekt współfinansowany przez Unię Europejską
w ramach Europejskiego Funduszu Społecznego

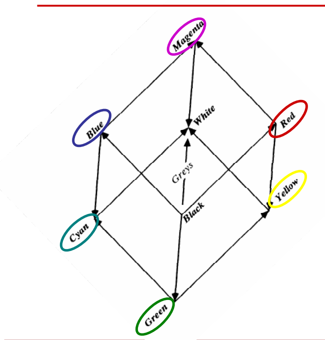


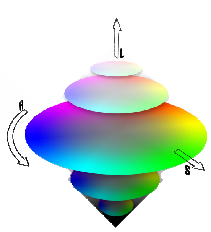
RGB colours produced by CRT device (black triangle) and CMY colour printers (magenta tringle)

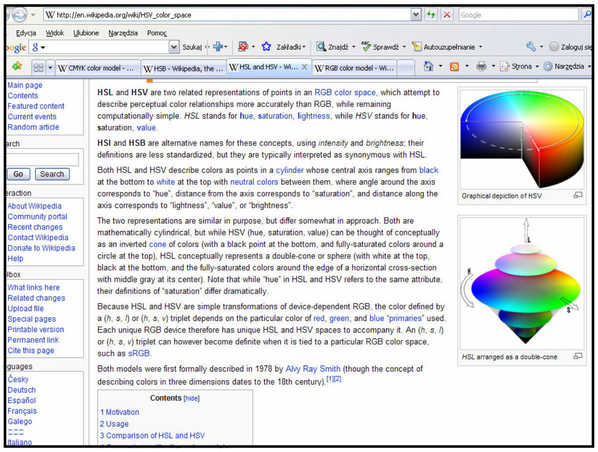
RGB vs. HSB colour space

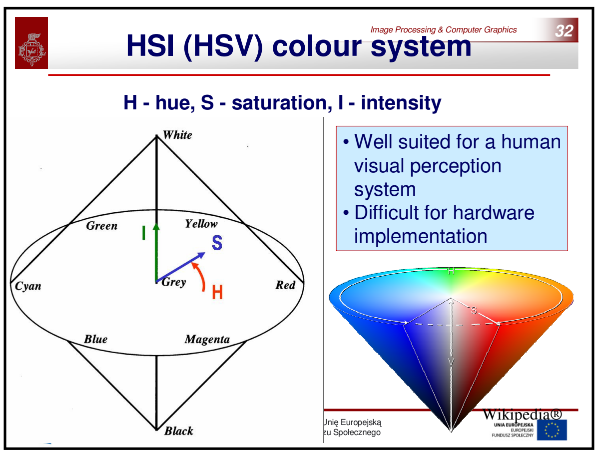


RGB vs. HSB colour space






http://en.wikipedia.org/wiki/HSV_color_space
HSL and HSV are two related representations of points in an RGB color space, which attempt to describe perceptual color relationships more accurately than RGB, while remaining computationally simple. HSL stands for hue, saturation, lightness, while HSV stands for hue, saturation, value.
HSI and HSB are alternative names for these concepts, using intensity and brightness; their definitions are less standardized, but they are typically interpreted as synonymous with HSL.
Both HSL and HSV describe colors as points in a cylinder whose central axis ranges from black at the bottom to white at the top with neutral colors between them, where angle around the axis corresponds to "hue", distance from the axis corresponds to "saturation", and distance along the axis corresponds to "lightness", "value", or "brightness".
The two representations are similar in purpose, but differ somewhat in approach. Both are mathematically cylindrical, but while HSV (hue, saturation, value) can be thought of conceptually as an inverted cone of colors (with a black point at the bottom, and fully-saturated colors around a circle at the top), HSL conceptually represents a double-cone or sphere (with white at the top, black at the bottom, and the fully-saturated colors around the edge of a horizontal cross-section with middle gray at its center). Note that while "hue" in HSL and HSV refers to the same attribute, their definitions of "saturation" differ dramatically.
Because HSL and HSV are simple transformations of device-dependent RGB, the color defined by a (h, s, l) or (h, s, v) triplet depends on the particular color of red, green, and blue "primaries" used. Each unique RGB device therefore has unique HSL and HSV spaces to accompany it. An (h, s, l) or (h, s, v) triplet can however become definite when it is tied to a particular RGB color space, such as sRGB.
Both models were first formally described in 1978 by Alvy Ray Smith (though the concept of describing colors in three dimensions dates to the 18th century).[1][2]
Graphical depiction of HSV
HSL arranged as a double-cone
Contents [hide]
1 Motivation
2 Usage
3 Comparison of HSL and HSV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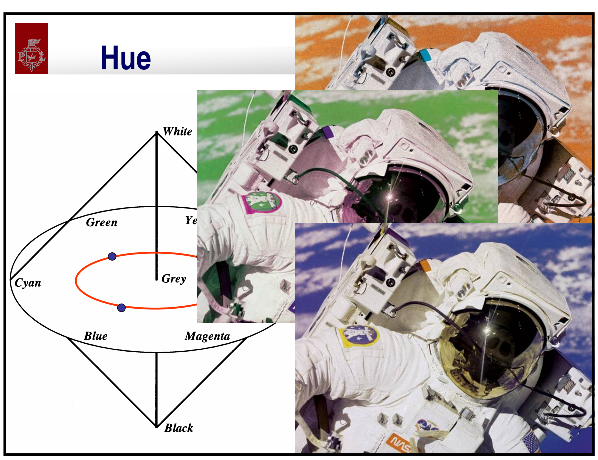
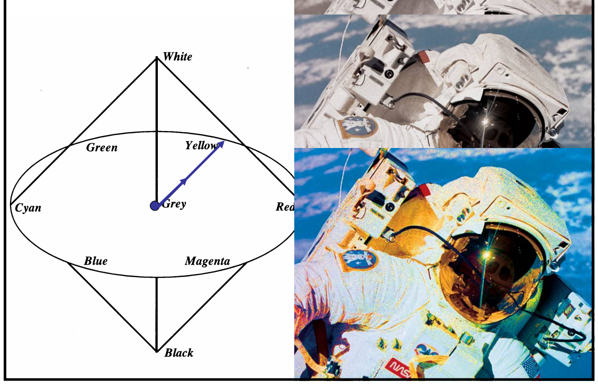
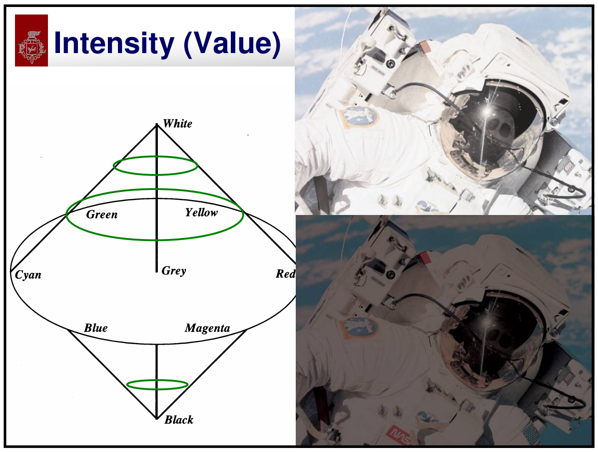
HSI (HSV) colour system
H - hue, S - saturation, I - intensity
White
Green
Yellow
Cyan
Grey
Red
Blue
Magenta
Black
I
S
H
• Well suited for a human visual perception system
• Difficult for hardware implementation
Wikipedia®

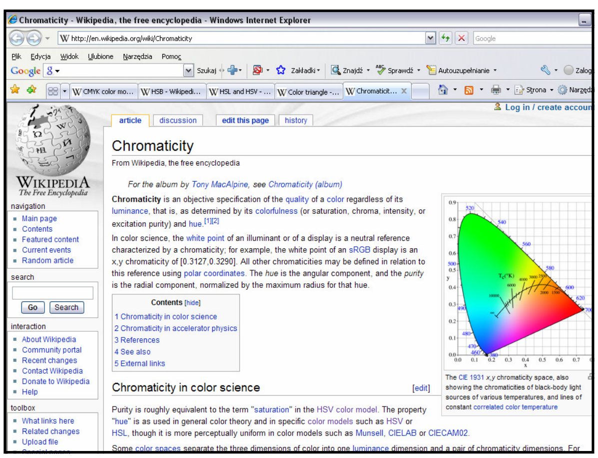

Hue
White
Green
Cyan
Grey
Blue
Magenta
Black

Saturation



Intensity (Value)




Chromaticity - Wikipedia, the free encyclopedia - Windows Internet Explorer

http://en.wikipedia.org/wiki/Chromaticity

article | discussion | edit this page | history

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Chromaticity

From Wikipedia, the free encyclopedia

For the album by Tony MacAlpine, see Chromaticity (album)

Chromaticity is an objective specification of the quality of a color regardless of its luminance, that is, as determined by its colorfulness (or saturation, chroma, intensity, or excitation purity) and hue.[1][2]

In color science, the white point of an illuminant or of a display is a neutral reference characterized by a chromaticity; for example, the white point of an sRGB display is an x,y chromaticity of [0.3127,0.3290]. All other chromaticities may be defined in relation to this reference using polar coordinates. The *hue* is the angular component, and the *purity* is the radial component, normalized by the maximum radius for that hue.

Contents [hide]

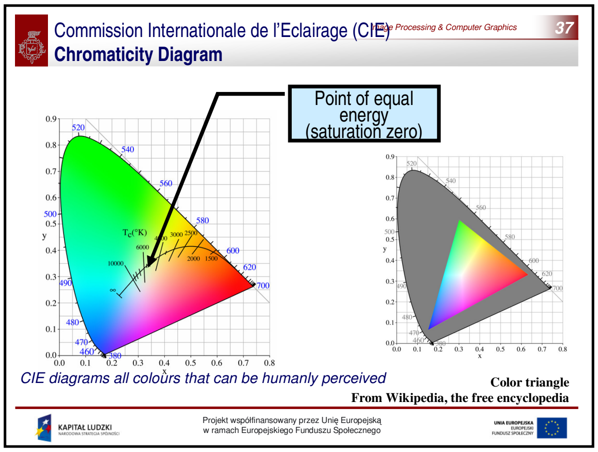
1 Chromaticity in color science
2 Chromaticity in accelerator physics
3 References
4 See also
5 External links

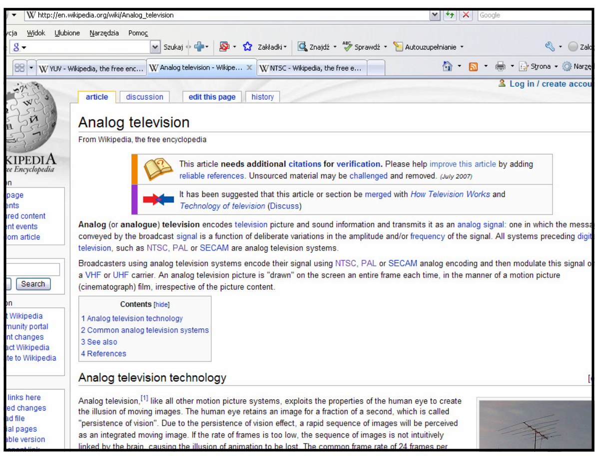
The CIE 1931 *x,y* chromaticity space, also showing the chromaticities of black-body light sources of various temperatures, and lines of constant correlated color temperature

Chromaticity in color science [edit]

Purity is roughly equivalent to the term "saturation" in the HSV color model. The property "hue" is as used in general color theory and in specific color models such as HSV or HSL, though it is more perceptually uniform in color models such as Munsell, CIELAB or CIECAM02.

Some color spaces separate the three dimensions of color into one luminance dimension and a pair of chromaticity dimensions. For





http://en.wikipedia.org/wiki/Analog_television

Analog television

From Wikipedia, the free encyclopedia

This article **needs additional citations for verification.** Please help improve this article by adding reliable references. Unsourced material may be challenged and removed. *(July 2007)*

It has been suggested that this article or section be merged with *How Television Works* and *Technology of television* (Discuss)

Analog (or **analogue**) **television** encodes television picture and sound information and transmits it as an analog signal: one in which the messa[ge] conveyed by the broadcast signal is a function of deliberate variations in the amplitude and/or frequency of the signal. All systems preceding digit[al] television, such as NTSC, PAL or SECAM are analog television systems.

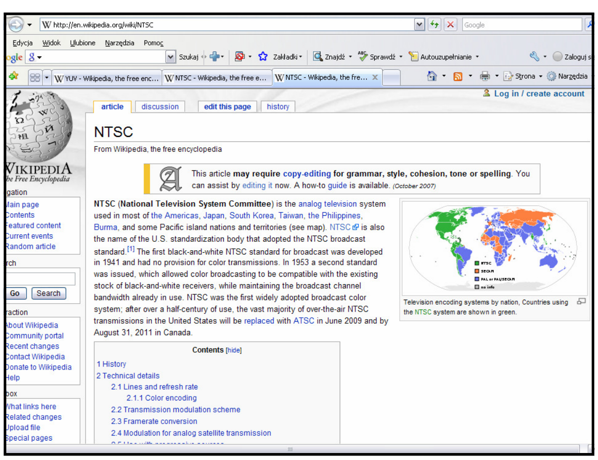
Broadcasters using analog television systems encode their signal using NTSC, PAL or SECAM analog encoding and then modulate this signal o[n] a VHF or UHF carrier. An analog television picture is "drawn" on the screen an entire frame each time, in the manner of a motion picture (cinematograph) film, irrespective of the picture content.

Contents [hide]

1 Analog television technology
2 Common analog television systems
3 See also
4 References

Analog television technology

Analog television,[1] like all other motion picture systems, exploits the properties of the human eye to create the illusion of moving images. The human eye retains an image for a fraction of a second, which is called "persistence of vision". Due to the persistence of vision effect, a rapid sequence of images will be perceived as an integrated moving image. If the rate of frames is too low, the sequence of images is not intuitively linked by the brain, causing the illusion of animation to be lost. The common frame rate of 24 frames per



http://en.wikipedia.org/wiki/NTSC

NTSC

From Wikipedia, the free encyclopedia

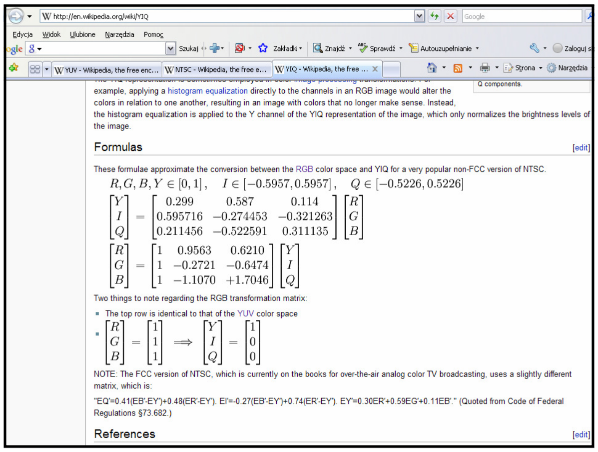
This article **may require copy-editing for grammar, style, cohesion, tone or spelling**. You can assist by editing it now. A how-to guide is available. *(October 2007)*

NTSC (**National Television System Committee**) is the analog television system used in most of the Americas, Japan, South Korea, Taiwan, the Philippines, Burma, and some Pacific island nations and territories (see map). NTSC is also the name of the U.S. standardization body that adopted the NTSC broadcast standard.[1] The first black-and-white NTSC standard for broadcast was developed in 1941 and had no provision for color transmissions. In 1953 a second standard was issued, which allowed color broadcasting to be compatible with the existing stock of black-and-white receivers, while maintaining the broadcast channel bandwidth already in use. NTSC was the first widely adopted broadcast color system; after over a half-century of use, the vast majority of over-the-air NTSC transmissions in the United States will be replaced with ATSC in June 2009 and by August 31, 2011 in Canada.

Television encoding systems by nation, Countries using the NTSC system are shown in green.

Contents [hide]

1 History
2 Technical details
2.1 Lines and refresh rate
2.1.1 Color encoding
2.2 Transmission modulation scheme
2.3 Framerate conversion
2.4 Modulation for analog satellite transmission



http://en.wikipedia.org/wiki/YIQ

example, applying a histogram equalization directly to the channels in an RGB image would alter the colors in relation to one another, resulting in an image with colors that no longer make sense. Instead, the histogram equalization is applied to the Y channel of the YIQ representation of the image, which only normalizes the brightness levels of the image.

Formulas

These formulae approximate the conversion between the RGB color space and YIQ for a very popular non-FCC version of NTSC.

$$R,G,B,Y \in [0,1], \quad I \in [-0.5957, 0.5957], \quad Q \in [-0.5226, 0.5226]$$

$$\begin{bmatrix} Y \\ I \\ Q \end{bmatrix} = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ 0.595716 & -0.274453 & -0.321263 \\ 0.211456 & -0.522591 & 0.311135 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1 & 0.9563 & 0.6210 \\ 1 & -0.2721 & -0.6474 \\ 1 & -1.1070 & +1.7046 \end{bmatrix} \begin{bmatrix} Y \\ I \\ Q \end{bmatrix}$$

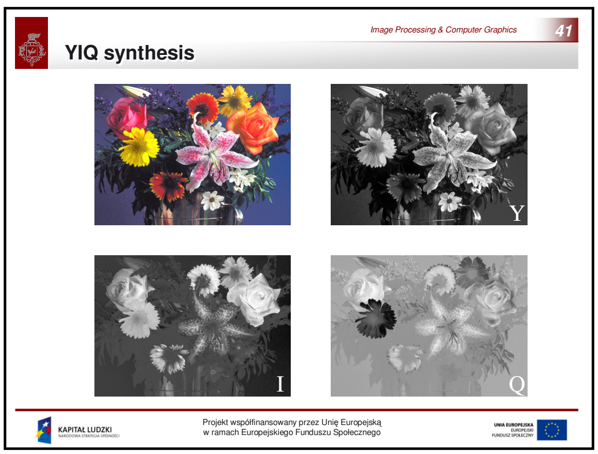
Two things to note regarding the RGB transformation matrix:

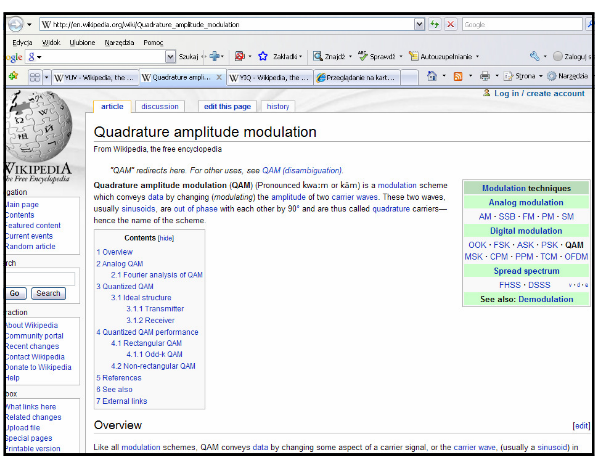
- The top row is identical to that of the YUV color space
- $\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} \Longrightarrow \begin{bmatrix} Y \\ I \\ Q \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$

NOTE: The FCC version of NTSC, which is currently on the books for over-the-air analog color TV broadcasting, uses a slightly different matrix, which is:

"EQ'=0.41(EB'-EY')+0.48(ER'-EY'). EI'=-0.27(EB'-EY')+0.74(ER'-EY'). EY'=0.30ER'+0.59EG'+0.11EB'." (Quoted from Code of Federal Regulations §73.682.)

References





http://en.wikipedia.org/wiki/Quadrature_amplitude_modulation

Quadrature amplitude modulation

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"QAM" redirects here. For other uses, see QAM (disambiguation).

Quadrature amplitude modulation (**QAM**) (Pronounced kwa:m or kăm) is a modulation scheme which conveys data by changing (*modulating*) the amplitude of two carrier waves. These two waves, usually sinusoids, are out of phase with each other by 90° and are thus called quadrature carriers—hence the name of the scheme.

Modulation techniques
Analog modulation
AM · SSB · FM · PM · SM
Digital modulation
OOK · FSK · ASK · PSK · QAM
MSK · CPM · PPM · TCM · OFDM
Spread spectrum
FHSS · DSSS
See also: Demodulation

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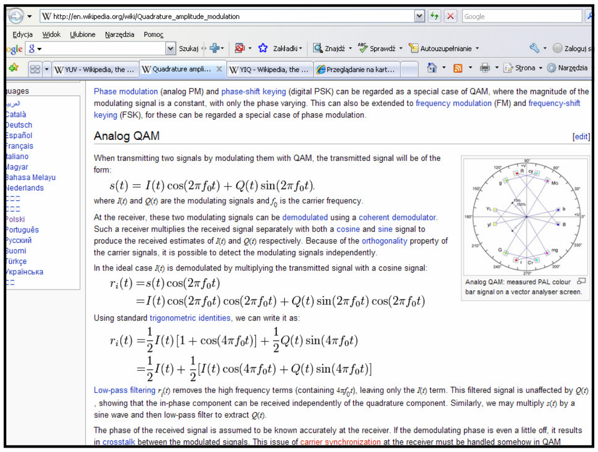
Overview

Like all modulation schemes, QAM conveys data by changing some aspect of a carrier signal, or the carrier wave, (usually a sinusoid) in



http://en.wikipedia.org/wiki/Quadrature_amplitude_modulation

Phase modulation (analog PM) and phase-shift keying (digital PSK) can be regarded as a special case of QAM, where the magnitude of the modulating signal is a constant, with only the phase varying. This can also be extended to frequency modulation (FM) and frequency-shift keying (FSK), for these can be regarded a special case of phase modulation.

Analog QAM

When transmitting two signals by modulating them with QAM, the transmitted signal will be of the form:

$$s(t) = I(t)\cos(2\pi f_0 t) + Q(t)\sin(2\pi f_0 t),$$

where $I(t)$ and $Q(t)$ are the modulating signals and f_0 is the carrier frequency.

At the receiver, these two modulating signals can be demodulated using a coherent demodulator. Such a receiver multiplies the received signal separately with both a cosine and sine signal to produce the received estimates of $I(t)$ and $Q(t)$ respectively. Because of the orthogonality property of the carrier signals, it is possible to detect the modulating signals independently.

In the ideal case $I(t)$ is demodulated by multiplying the transmitted signal with a cosine signal:

$$\begin{aligned} r_i(t) &= s(t)\cos(2\pi f_0 t) \\ &= I(t)\cos(2\pi f_0 t)\cos(2\pi f_0 t) + Q(t)\sin(2\pi f_0 t)\cos(2\pi f_0 t) \end{aligned}$$

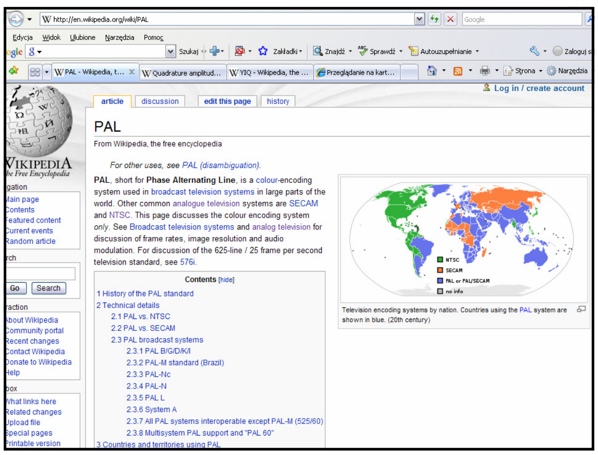
Using standard trigonometric identities, we can write it as:

$$\begin{aligned} r_i(t) &= \frac{1}{2}I(t)\left[1 + \cos(4\pi f_0 t)\right] + \frac{1}{2}Q(t)\sin(4\pi f_0 t) \\ &= \frac{1}{2}I(t) + \frac{1}{2}\left[I(t)\cos(4\pi f_0 t) + Q(t)\sin(4\pi f_0 t)\right] \end{aligned}$$

Low-pass filtering $r_i(t)$ removes the high frequency terms (containing $4\pi f_0 t$), leaving only the $I(t)$ term. This filtered signal is unaffected by $Q(t)$, showing that the in-phase component can be received independently of the quadrature component. Similarly, we may multiply $s(t)$ by a sine wave and then low-pass filter to extract $Q(t)$.

The phase of the received signal is assumed to be known accurately at the receiver. If the demodulating phase is even a little off, it results in crosstalk between the modulated signals. This issue of carrier synchronization at the receiver must be handled somehow in QAM

Analog QAM: measured PAL colour bar signal on a vector analyser screen.



http://en.wikipedia.org/wiki/PAL

PAL

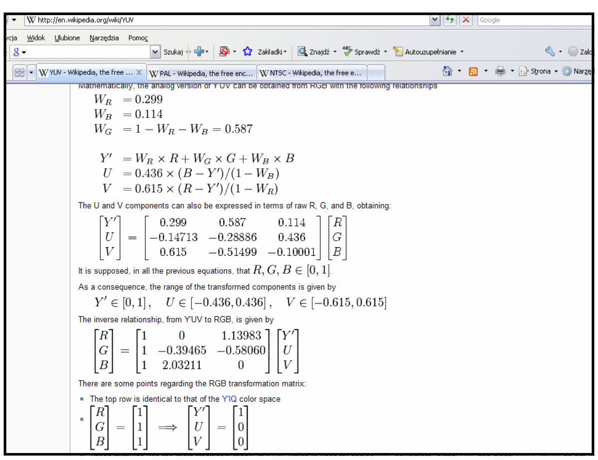
From Wikipedia, the free encyclopedia

For other uses, see PAL (disambiguation).

PAL, short for **Phase Alternating Line**, is a colour-encoding system used in broadcast television systems in large parts of the world. Other common analogue television systems are SECAM and NTSC. This page discusses the colour encoding system *only*. See Broadcast television systems and analog television for discussion of frame rates, image resolution and audio modulation. For discussion of the 625-line / 25 frame per second television standard, see 576i.

Contents [hide]

Television encoding systems by nation. Countries using the PAL system are shown in blue. (20th century)



http://en.wikipedia.org/wiki/YUV

Mathematically, the analog version of Y'UV can be obtained from RGB with the following relationships

$$\begin{aligned} W_R &= 0.299 \\ W_B &= 0.114 \\ W_G &= 1 - W_R - W_B = 0.587 \end{aligned}$$

$$\begin{aligned} Y' &= W_R \times R + W_G \times G + W_B \times B \\ U &= 0.436 \times (B - Y')/(1 - W_B) \\ V &= 0.615 \times (R - Y')/(1 - W_R) \end{aligned}$$

The U and V components can also be expressed in terms of raw R, G, and B, obtaining:

$$\begin{bmatrix} Y' \\ U \\ V \end{bmatrix} = \begin{bmatrix} 0.299 & 0.587 & 0.114 \\ -0.14713 & -0.28886 & 0.436 \\ 0.615 & -0.51499 & -0.10001 \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

It is supposed, in all the previous equations, that $R, G, B \in [0, 1]$.

As a consequence, the range of the transformed components is given by

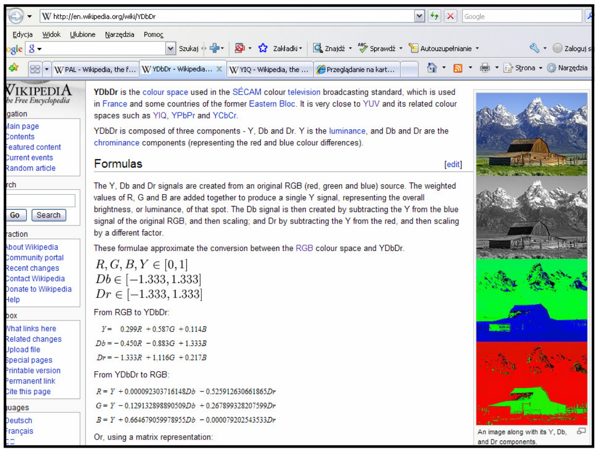
$$Y' \in [0,1], \quad U \in [-0.436, 0.436], \quad V \in [-0.615, 0.615]$$

The inverse relationship, from Y'UV to RGB, is given by

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1 & 0 & 1.13983 \\ 1 & -0.39465 & -0.58060 \\ 1 & 2.03211 & 0 \end{bmatrix} \begin{bmatrix} Y' \\ U \\ V \end{bmatrix}$$

There are some points regarding the RGB transformation matrix:

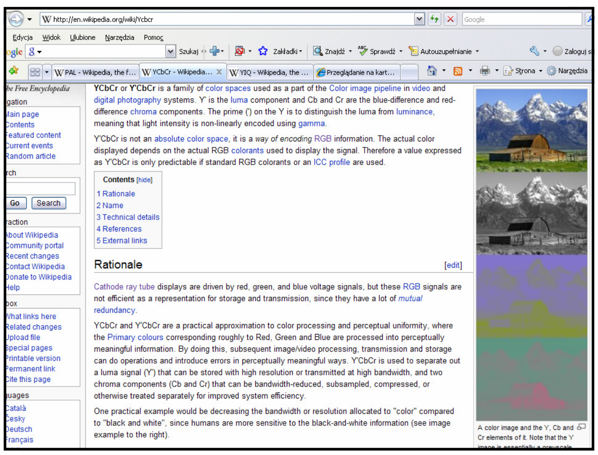
- The top row is identical to that of the Y'IQ color space
- $\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} \Longrightarrow \begin{bmatrix} Y' \\ U \\ V \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$



$R, G, B, Y \in [0,1]$
$Db \in [-1.333, 1.333]$
$Dr \in [-1.333, 1.333]$

$Y = 0.299R + 0.587G + 0.114B$
$Db = -0.450R - 0.883G + 1.333B$
$Dr = -1.333R + 1.116G + 0.217B$

$R = Y + 0.000092303716148Db - 0.525912630661865Dr$
$G = Y - 0.129132898890509Db + 0.267899328207599Dr$
$B = Y + 0.664679059978955Db - 0.000079202543533Dr$



Color models

- RGB (additive)
- CMY (subtractive)
- CMYK (print)
- YIQ (NTSC TV)
- YUV (PAL TV)
- HSL, HSB, HSV (NTSC, PAL TV)
- YDBDR (SECAM TV)
- YCBCR

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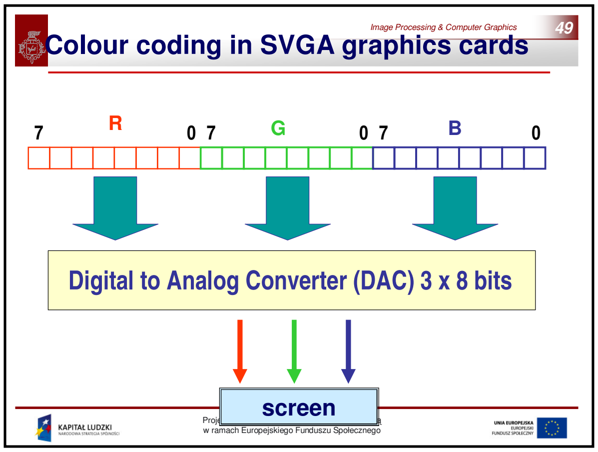
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7
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0 7
G
0 7
B
0
Digital to Analog Converter (DAC) 3 x 8 bits
screen
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w ramach Europejskiego Funduszu Społecznego
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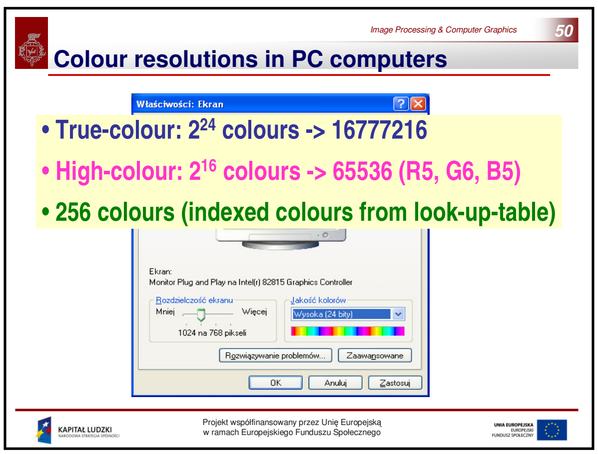
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Colour resolutions in PC computers
Właściwości: Ekran
• True-colour: 2^24 colours -> 16777216
• High-colour: 2^16 colours -> 65536 (R5, G6, B5)
• 256 colours (indexed colours from look-up-table)
Ekran:
Monitor Plug and Play na Intel(r) 82815 Graphics Controller
Rozdzielczość ekranu
Mniej
Więcej
1024 na 768 pikseli
Jakość kolorów
Wysoka (24 bity)
Rozwiązywanie problemów...
Zaawansowane
OK
Anuluj
Zastosuj
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w ramach Europejskiego Funduszu Społecznego
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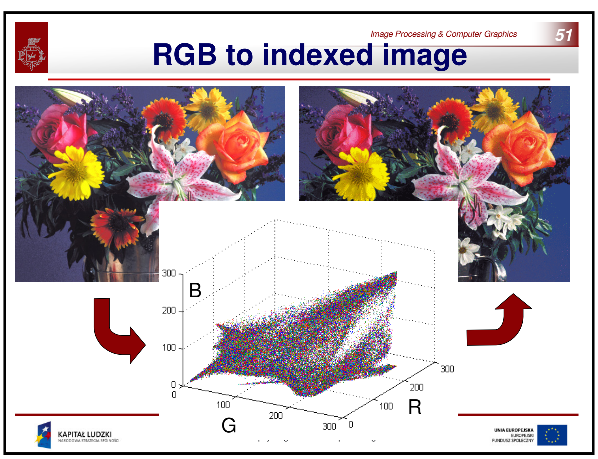
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0
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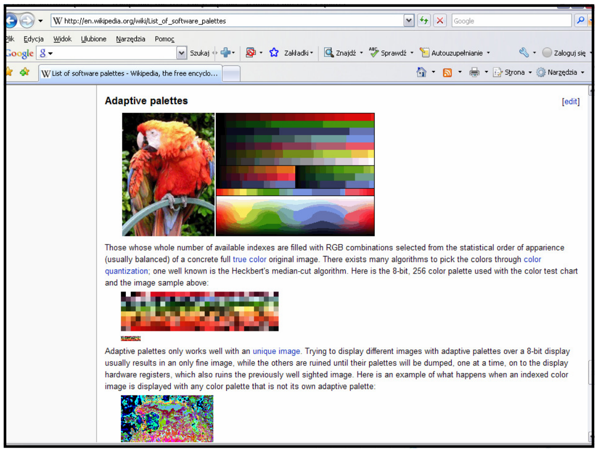


http://en.wikipedia.org/wiki/List_of_software_palettes

List of software palettes - Wikipedia, the free encyclo...

Adaptive palettes

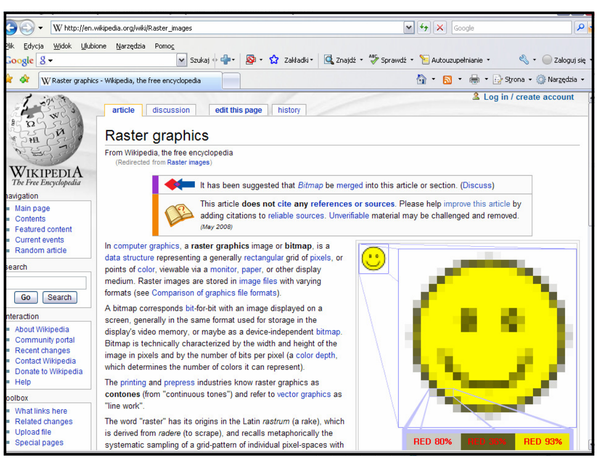
[edit]

Those whose whole number of available indexes are filled with RGB combinations selected from the statistical order of apparience (usually balanced) of a concrete full true color original image. There exists many algorithms to pick the colors through color quantization; one well known is the Heckbert's median-cut algorithm. Here is the 8-bit, 256 color palette used with the color test chart and the image sample above:

Adaptive palettes only works well with an unique image. Trying to display different images with adaptive palettes over a 8-bit display usually results in an only fine image, while the others are ruined until their palettes will be dumped, one at a time, on to the display hardware registers, which also ruins the previously well sighted image. Here is an example of what happens when an indexed color image is displayed with any color palette that is not its own adaptive palette:

Raster and vector images

- Raster vs. vector images (graphics)
- 2D and 3D images (graphics)



http://en.wikipedia.org/wiki/Raster_images

Raster graphics - Wikipedia, the free encyclopedia

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Raster graphics

From Wikipedia, the free encyclopedia
(Redirected from Raster images)

It has been suggested that *Bitmap* be merged into this article or section. (Discuss)

This article **does not cite any references or sources**. Please help improve this article by adding citations to reliable sources. Unverifiable material may be challenged and removed. *(May 2008)*

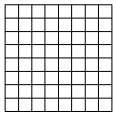
In computer graphics, a **raster graphics** image or **bitmap**, is a data structure representing a generally rectangular grid of pixels, or points of color, viewable via a monitor, paper, or other display medium. Raster images are stored in image files with varying formats (see Comparison of graphics file formats).

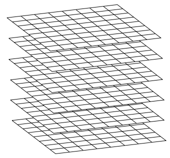
A bitmap corresponds bit-for-bit with an image displayed on a screen, generally in the same format used for storage in the display's video memory, or maybe as a device-independent bitmap. Bitmap is technically characterized by the width and height of the image in pixels and by the number of bits per pixel (a color depth, which determines the number of colors it can represent).

The printing and prepress industries know raster graphics as **contones** (from "continuous tones") and refer to vector graphics as "line work".

The word "raster" has its origins in the Latin *rastrum* (a rake), which is derived from *radere* (to scrape), and recalls metaphorically the systematic sampling of a grid-pattern of individual pixel-spaces with

Raster graphics





- size
- resolution
  (iso-, anisotropic)
- pixel
  (picture element)
- voxel
  (volume element)

Bitmap format

header

```
42 4D 36 05 00 00 00 00 00 00 36 04 00 00 28 00
00 00 10 00 00 00 10 00 00 00 01 00 08 00 00 00
00 00 00 01 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 80 00 00 80
00 00 00 80 80 00 80 00 00 00 80 00 80 00 80 80
```

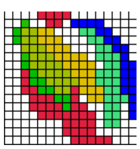
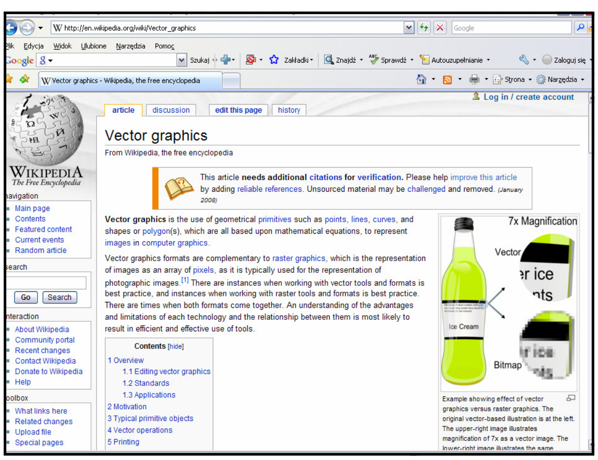


image data

```
FF FF FF FF 4F 4F 4F 4F FF FF FF FF FF FF FF FF
FF FF 31 FF FF 4F 4F FF FC FC FC FC FF FF FF FF
FF 30 35 35 37 37 FF FF FF BA BA FC FC FF FF FF
FF 30 35 35 37 37 37 FF FF FF BA BA FC FC FF FF
FF FF 35 35 35 37 37 37 FF FF FF BA BA FC FC FF
FF FF 31 35 35 35 37 37 37 37 FF BA BA BA FC FF
FF FF 30 35 35 35 35 37 37 37 37 FF BA BA FC FC
FF FF 4F 30 35 35 35 35 37 37 37 BA BA BA FC FC
FF FF 4F 30 30 35 35 35 35 37 37 BA BA BA FC FC
FF FF 4F 4F 30 30 35 35 4F 37 37 37 BA BA FC FC
FF FF FF 4F 4F 4F 30 30 4F FF 37 37 BA BA BA FC
FF FF FF 4F 4F 4F 4F 30 4F 4F FF FF BA BA FF FC
FF FF FF FF 4F 4F 4F 4F 4F 4F 4F FF BA BA FF FC
FF FF FF FF FF FF FF 4F 4F 4F 4F FF BA BA FF FF
FF FF FF FF FF FF FF 4F 4F 4F 4F FF FF FF FF FF
FF FF FF FF FF FF FF FF 4F 4F 4F 4F 4F FF FF FF
```

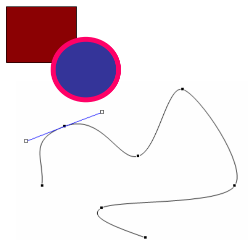
color LUT
(palette)

```
40 00 40
40 60 00
40 40 80
00 40 40
A0 00 40
40 C0 00
40 40 E0
...
...
...
```

Vector graphics (2D)

- Primitives
- Vectors



Vector graphics (Windows EMF)

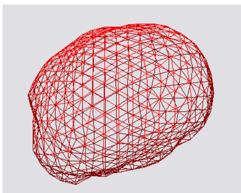
- ENHMETAHEADER
  - DWORD iType;
  - DWORD nSize;
  - RECTL rclBounds;
  - RECTL rclFrame;
  - DWORD dSignature;
  - DWORD nVersion;
  - DWORD nBytes;
  - DWORD nRecords;
  - WORD nHandles;
  - WORD sReserved;
  - DWORD nDescription;
  - DWORD offDescription;
  - DWORD nPalEntries;
  - SIZEL szlDevice;
  - SIZEL szlMillimeters;
  - DWORD cbPixelFormat;
  - DWORD offPixelFormat;
  - DWORD bOpenGL;
- ENHMETARECORD
  - DWORD iType;
  - DWORD nSize;
  - DWORD dParm[];

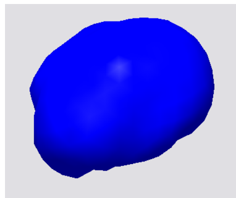
Windows API for EMFs

```
kontekst=CreateEnhMetaFile(NULL, ”plik.emf”, NULL, NULL);
    MoveToEx(kontekst, x, y, NULL);
    LineTo(kontekst, x, y);
    Rectangle(kontekst, x1, y1, x2, y2);
    TextOut(kontekst, x, y, ”Napis”, z);
CloseEnhMetaFile(kontekst);
            PRINTDLG pd;
            PrintDlg(&pd); kontekst = pd.hDC;
            StartPage(kontekst);
                HENHMETAFILE hemf = GetEnhMetaFile(”plik.emf”);
                PlayEnhMetaFile(kontekst, hemf, &rect);
                DeleteEnhMetaFile(hemf);
            EndPage(kontekst);
            DeleteDC(kontekst);
```

Vector graphics (3D)

- Surface
- Vectors (vertices)





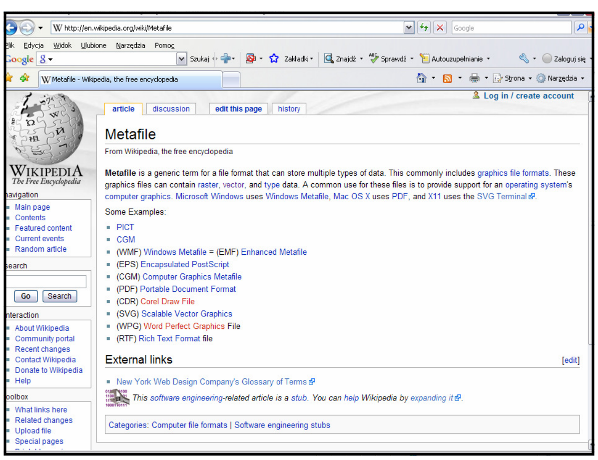
Vector graphics in OpenGL

```
glBegin(GL_TRIANGLES);
  glColor3f(0.2f, 0.2f, 0.8f);
  glNormal3f(0.58f, 0.58f, 0.58f);
  glVertex3f(0.0f, 60.0f, 0.0f);
  glVertex3f(60.0f, 0.0f, 0.0f);
  glVertex3f(0.0f, 0.0f, 60.0f);

  glColor3f(0.7f, 0.7f, 0.2f);
  glNormal3f(0.0f, 0.0f, -1.0f);
  glVertex3f(0.0f, 60.0f, 0.0f);
  glVertex3f(0.0f, 0.0f, 0.0f);
  glVertex3f(60.0f, 0.0f, 0.0f);

  glNormal3f(-1.0f, 0.0f, 0.0f);
  glVertex3f(0.0f, 60.0f, 0.0f);
  glVertex3f(0.0f, 0.0f, 60.0f);
  glVertex3f(0.0f, 0.0f, 0.0f);

  glNormal3f(0.0f, -1.0f, 0.0f);
  glVertex3f(0.0f, 0.0f, 60.0f);
  glVertex3f(60.0f, 0.0f, 0.0f);
  glVertex3f(0.0f, 0.0f, 0.0f);
glEnd();
```

http://en.wikipedia.org/wiki/Metafile

Metafile - Wikipedia, the free encyclopedia

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Metafile

From Wikipedia, the free encyclopedia

Metafile is a generic term for a file format that can store multiple types of data. This commonly includes graphics file formats. These graphics files can contain raster, vector, and type data. A common use for these files is to provide support for an operating system's computer graphics. Microsoft Windows uses Windows Metafile, Mac OS X uses PDF, and X11 uses the SVG Terminal.

Some Examples:

- PICT
- CGM
- (WMF) Windows Metafile = (EMF) Enhanced Metafile
- (EPS) Encapsulated PostScript
- (CGM) Computer Graphics Metafile
- (PDF) Portable Document Format
- (CDR) Corel Draw File
- (SVG) Scalable Vector Graphics
- (WPG) Word Perfect Graphics File
- (RTF) Rich Text Format file

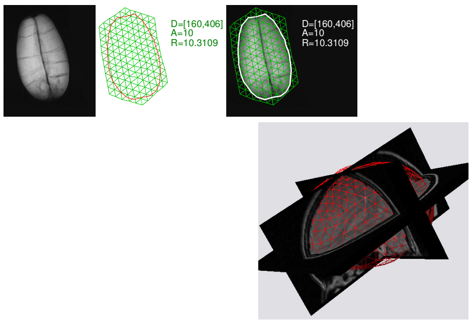
External links [edit]

- New York Web Design Company's Glossary of Terms

This software engineering-related article is a stub. You can help Wikipedia by expanding it.

Categories: Computer file formats | Software engineering stubs

Metafiles (RG+VG)



Summary, discussion and quiz

Summary, discussion and quiz

KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI

UNIA EUROPEJSKA
EUROPEJSKI
FUNDUSZ SPOŁECZNY

„ Image Processing and Computer Graphics”

Prezentacja multimedialna współfinansowana przez Unię Europejską w ramach Europejskiego Funduszu Społecznego w projekcie pt.

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