Main Concepts of Image Editing

Table of contents:

# Field of use

## Digital images

Digital images are mostly used in the areas web-publishing, e-mail distribution or editing and printing photos. Most photos today are taken with digital cameras, both by professional and amateur photographers. That way they can be manipulated on a computer.

## Main functions of image editing tools

Today an image editing application is part of the standard equipment of a computer. Therefore, there is a wide range of image editing programmes on the market, e.g. Photoshop (Adobe), Photo Paint (Corel), PhotoDraw (Microsoft), Gimp. Basically, they are all equipped with the same tools that work in similar ways.

Even if you do not use all functions right from the beginning or do not want to learn them just yet, it might be worth buying such a programme because you can use it every day to transform files. Converting images into different image formats is one of the basic functions of an image editing application, sometimes only in order to make a file smaller.

Details concerning image formats can be found on page 10

Further basic functions are the selection of parts of an image, filling, retouching or painting, changing of image quality or simply adding text, a feature I will go into in detail later.

## Copyright

Copyright is the right of the creator to his original works.

Basically, you should assume that a piece of work is protected by copyright and that you need permission to publish it. There is no copyright if the creator has permitted general use or if the copyright terms have expired (at the latest after 70 years).

If, for example, images, photos or graphics, which you have scanned or copied from a website are considered as “personal intellectual creations“ they are protected by copyright and you cannot publish them on your own website or anywhere else without explicit permission from the copyright holder.

If there are people in a photo and you publish the photo without their consent they may report you.

If you manipulate a photo, image or graphic in such a way that you can still recognise the original picture, you may only publish it with the permission of the copyright holder. Major modifications of the original work, however, that make it practically impossible to identify it can be published without the consent of the original creator.

If you still publish the work without the permission of the creator, you will face the following consequences:  
Since the creator has a claim for cease and desist he or she can demand that the work be withdrawn from publishing. Moreover, the creator can also demand damages and you might be criminally prosecuted (fine or prison sentence).

You will find further details on copyright e.g. on [**Wikipedia**](http://www.wikipedia.org).

# Digital Images

## Key features

The key feature of a digital image is that the individual image formats (pixel, vector graphic) are represented digitally in binary code.

## Pixel

Pixels are also known as picture elements. They are the smallest single component of a digital raster graphics. The term has its origin in the English words pictures (Pics -> Pix) and element and is often abbreviated as “px“.

The resolution of an image is the number of horizontal and vertical picture points that a projector can display. The higher the resolution the more detailed the displayed picture appears.

Bitmap pictures consist of a high number of individual image points and each of them has its own colour information. Lines are displayed by a succession of many separate pixels. If you want to display a picture in detail you need more pixels, for rough images you need fewer pixels.

## Resolution

The unit for the resolution of images is dpi (dots per inch), meaning that the number of image points which are found along an inch of a picture are counted. E.g. a resolution of 100 dpi means that on an area of 100 x 100 inches there are 10.000 pixels.

The resolution has a strong influence on the storage space needed for an image. If an image is edited later, a loss of quality and sharpness occurs because all the image’s pixels are modified.

The scanning resolution depends above all on the grid properties, the output and the scaling factor.

Tip: If you don’t want to print the images but only publish them on the Internet or keep them on your PC, a resolution of 72 or 96 dpi is enough because it keeps storage space low. Usually you won’t be able to see the difference between 72 dpi and 96 dpi resolution, anyway.  
If you want to print images you should use a higher resolution because otherwise the quality of the image will not be satisfactory.

# Colour

## Colour concepts

The most common colour concepts are the models RGB (additive colour model), CMYK (subtractive colour model) and HSB.

The computer monitor, for example, works on the basis of additive colour mixture. Not all colours that are displayed on the screen can be printed as such. The colours on the screen and for the print-out are created in completely different ways.

### The RGB model

Here the colours are created by adding light of different colours.

There are three basic colours (primary colours) – red, green and blue. They cannot be created by mixing other colours. If you mix the primary colours in equal (100%) shares, the result will be the colour WHITE (all other equal shares will get different shades of black). If you mix two primary colours in equal shares (100%) you will get the secondary colours cyan, magenta and yellow.

### The CMYK model

This colour model is used in the pre-printing stage. It is not coloured light that is mixed but the colours result from the reflexion of light.

There are also three primary colours (cyan, magenta and yellow). The colour black (Key–Black) is used separately because mixing the three primary colours results in an imperfect dark brown. This happens because the colour saturation of the printing process is not sufficient. This is also the reason for the abbreviation CMYK (Cyan, Magenta, Yellow, Key).

### The HSB model

HSB stands for Hue, Saturation and Brightness. The colours are defined by these three settings and often used by professional photographers.

There are 360 different hues of colours and the different hues are determined by their position on a circle.

The saturation influences the pureness of colour and is given in per cent (0 % grey, 100 % fully saturated). It always states the portion of grey in relation to the colour hue.

Brightness or (half) tone value says how bright or dark a colour is and it is also given in per cent.

100 per cent brightness is WHITE.

0 per cent brightness is BLACK.

## Hue, saturation, colour balance

Hue, saturation and brightness are considered the basic properties of a colour.

Hue is used to distinguish colourful from less colourful. Saturation is the degree of colourfulness of a picture. You can change these properties of your pictures if you think it is not colourful enough or has a saturation which is too high or too low.

To do so you must open the dialogue window hue/saturation which can be found under the menu item image/adjust. In this dialogue box you can go to edit to set those colours which you want to modify. If the display view is activated in the control field you can see the result of your actions on the image without delay. When you have finished you can confirm your chosen settings by pressing the OK button.

If your image shows undesired hues, like unpleasant red hues, you can adapt them via the dialogue window colour hue. You will find it under the menu item image/adjust.

Here you can also determine the area for which you want to choose your colour balance. For depth, middle tones and lighter.

## Colour palette

The colour palette contains only the number of colours which are actually needed in a picture (max. 256). Each pixel is allocated one colour from a table. In the application Photoshop you will find the colour table only in the mode indexed colours.

The advantage here is, that such a colour table shows only the number of colours that are actually needed for a picture.

Indexed colours are especially useful for pictures that need fewer colours (comics, drawings, logos…). As photos usually need more than 256 colours you will have to accept certain limitations here. In order to display colours that are not included in the colour table of the indexed image anyway, you can simulate colours by dithering. This procedure is, therefore, called dithering.

However, the disadvantage here is that the grid points can be clearly seen.

## Colour depth

The colour depth is measured in Bit and determines the number of colours which an image can contain at the most and the number of Bits required to save the colour information.

### 1 Bit, BLACK/WHITE

1 Bit is the smallest information unit. If a picture is saved in this data type it means that the pixel can only be BLACK or WHITE. The pixels can be arranged in such a way that grey hues and shades appear. This data record needs only very little storage place.

### 4 Bit, indexed 16 colours

Images with indexed colours have their own colour tables where available colours are defined. If any colours are not available in the table, however, it is possible to simulate them by dithering.

### 8 Bit, indexed 256 colours

The same as for 4-Bit images applies here.

### 16 Bit, 65.536 colours

RGB-HiColor. All colours of a colour screen are built on the basis of the three colours red, green and blue. This data type is mainly used for images of photographic quality.

### 24 Bit, more than 16.7 million colours

RGB real colours. Here, as above, all colours of a colour screen are built on the basis of the three colours red, green and blue. But more than 16.7 million colours mean that practically all colours of the visible spectrum are displayed. This data type is used for images of photographic quality.

## Transparency

In the application Photoshop you can easily create images with a transparent background. If you want to save the image with the transparent areas you must be careful which data format you choose.

If you save the image, e. g. , in .jpg format the background will become automatically WHITE and the transparency will be lost.

The .gif format, however, is a completely different matter. Here you must be careful to activate the checkbox transparency before you save the image.

Please note that using transparency does not always render the desired effect. It always depends on the background in front of which the image will be displayed in the end.

## Contrast, brightness, gamma

If a picture is too dark or too bright or if you want to increase or decrease the contrasts you can go to the selection brightness/contrast. To do so you go to adjust in the menu image and in the submenu to brightness/contrast. Only here you can change the desired hue correction by moving the slider left and right. That way you modify the bright and dark areas of the image, i.e. light and shade.

Instead of changing brightness and contrast separately you can also carry out an adjustment of the levels.

To do so you go to the option adjust/ levels in the menu image. The dialogue box levels will open. It contains a number of sliders and enter boxes to choose precisely the levels you want. If you move the slider under a histogram you adapt the values of the image.

The gamma value of the screen influences the brightness and/or darkness of an image displayed in a browser.

Windows systems have a different gamma value than Mac OS systems (Windows 2.2 – Mac OS 1.8). Therefore, images appear darker in windows.

In the preview mode you can see how your images are displayed on systems with different gamma values. Additionally, you can change the gamma value of your images as needed in order to compensate for the differences.

Tip: Slight changes in brightness and contrast can lead to a considerable quality improvement in many images.  
Bear in mind, that an image always appears brighter than it does when you print it. The reason for this is that paper becomes saturated with printer colour and that leads to the hue increase.

## Colour mode

Using Photoshop CS 3 allows you to change the colour mode of an image later.

You will find the different colour modes in the menu image under mode.

### Bitmap

In order to apply this mode you must convert the image into a grayscale mode . If you attribute the Bitmap mode to the image, it has a colour saturation of one Bit. That means that the image has only the colours WHITE and BLACK or in between.

### Grayscale

If you choose this mode the image gets a colour saturation of 8 Bit or 256 different scales of grey.

### Duotone

Similar to the Bitmap mode the image here must be converted into the grayscale mode first. Then the Duotone mode gives you the possibility to choose between two-colour images (Duotone), three-colour images (Tritone), four-colour images (Quadtone) or grayscale. Apart from black one to three accenting colours are used here.

### Indexed colours

This mode is especially applied in those cases, when images are intended for use by electronic media. The original image colour is transformed into a maximum of 256 colours of a palette. This mode is mainly used for multi-media applications, especially for the Internet, because the storage space needed is very low.

### RGB colours

This mode works with the colours of light and can produce 16.7 million colours. Therefore, this mode is best suited for the manipulation of an image or a photo.

### CMYK colours

The colour saturation of 32 Bit or 4.3 billion colours of the CMYK mode requires the largest amount of storage space of all colour modes. It is mainly used for reproductions and printing with process colours.

### LAB colours

Der LAB mode has a colour saturation of 24 Bit or 16.7 million colours. Therefore, it is equal in size to the RGB mode but so far it is has not been used as widely.

### Multi channel

Multi channel images also have 8 Bit. It is possible to transform images with more than one channel here. To do so, the channels are numbered in sequence and displayed in grayscale. The grayscale can then determine the colour values of the individual pixels.

Tip: If you want to print your image only in BLACK/WHITE it is best to convert it into grayscale mode because the data size is relatively small.  
Most images and photos are saved in RGB mode which is best used for manipulation and publishing.

# Graphic formats

## Raster and vector graphics

Raster graphics are often also called pixel graphics or Bitmap. It is a method to describe two-dimensional images in the form of data. The main feature of this image format is that it consists of defined pixels.

The characteristics of the individual pixels are determined by colour saturation, colour space and memory arrangement.

The structure of raster graphics can be compared with traditional techniques like mosaic or cross stitching.

This type of graphics is especially suitable to display more complex images like photos.

The typical and most well-know graphic formats for pixel graphics are GIF, JPEG, BMP, TIFF and PNG.

You will get pixel graphics, for example, from your digital camera, when you scan images or edit them using an image editing application.

The disadvantage of raster graphics is the fact, that the resolution is not kept the same in the event of changes and that information is lost when the image is made smaller. Raster graphics also need a relatively high amount of memory space.

In contrast to raster graphics it is possible to modify, make smaller, distort or compress vector graphics. They can keep properties of lines, curves or areas, you can modify them afterwards and their data size is relatively small.

Vector graphics are made of lines, curves and areas which can be described as being mathematically exact, using vectors. They are a method to describe two-dimensional graphics or three-dimensional objects in the form of data.

Vector graphics are, therefore, best suited to display geometrical figures or scripts. To display more complex images, for example photos, vector graphics are, however, unsuitable because it is hardly possible to calculate them mathematically.

The disadvantage is that the computational cost to display the graphics on the screen or printer is much higher because each image described by vectors must be converted into a raster graphics.

Vector graphics are often used, for example, in CAD applications to make technical drawings or to create illustrations or Clip-Arts.

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## Lossless compression format

The lossless compression format means that the data size of an image is reduced. It reduces the space needed but the quality remains the same.

The image formats TIFF, GIF and PNG, for example, are examples of lossless compression formats.

### TIFF formats

The Tiff format is imported by most programmes and it is the most common image format. It can be compressed by 20 to 40% without any quality loss.

### GIF format

The most widely used compression format in the Internet is the GIF format. It is mainly used for work which is intended to be viewed on screen. It supports transparency and also animation. The disadvantage, however, is that a maximum of 256 colours can be used.

### PNG format

The PNG format (pronounced: PING) is mainly used for web graphics. It combines the advantages of GIF and JPEG without their disadvantages. The compression takes place without quality loss depending on the colour saturation. Transparency and true colours are possible. It is licence free. Older browser might have problems in supporting this format.

## Lossy compression formats

In case of lossy compression formats the data size of the image is also reduced. In this case, not only the amount of memory needed is reduced but also the quality compared to lossless compression.

Lossy compression formats are JPEG and JPEG2000.

### JPEG format

The JPEG format is usually used to display photos and other half-tone images in the Internet. The only disadvantage of this format is, as stated above, that losses occur during compression. On the other hand it compresses in true colour mode, supports CMYK, RGB and grayscale images. Most photos made by digital cameras are saved in JPEG format.

### JPEG2000

As opposed to the former JPEG format, JPEG2000 is able to carry out lossless as well as lossy compression. This format allows the best compression rates for lossy photo-similar images. The advantages over the traditional JPEG format are, for example, a better compression rate at the given quality, the easy transition from lossy to lossless compression, the possibility to compress and decompress certain parts of the image in better quality. Unfortunately, JPEG2000 has not yet been widely used. The reason for that is that most browsers cannot display it without an additional module and that free coding software is hard to get.

## Comparison of graphic formats

Here is a comparison of the individual graphic formats based on a 200 x 133 px image with a colour saturation of 8 Bit.

## Attributing a data type

There are a great number of different image editing applications, each with their special, individual data types. The most widely known are among others:

### PSD, Photoshop Document

This data format belongs to Adobe Photoshop, no matter which version. The format PSD saves all used image files in a lossless way. Any information about the different levels and the used settings of a picture remain the same.

PSD files, however, are relatively large. On the other hand they can be displayed by other applications (Paint Shop Pro, Gimp, etc.).

### PSP, Paint Shop Pro

Originally, Paint Shop Pro used to be a pure image viewing and graphic converting application and it is a pixel-oriented drawing application. It has quickly become a popular application in professional life now. Especially smaller companies and private users have decided to use it due to its large range of functions which are provided at a relatively low price.

### XCF, Gimp

Like Photoshop the image editing application Gimp saves the images with all level information.

### CPT, Corel Photo-Paint Image

This image editing application makes it possible to manipulate entire images or only certain parts of the image. You can use it to manipulate images, adapt the resolution or simply set the number of colours of a picture, just like when using the Photoshop application.

Tip: Generally, saving in this format is an advantage if you intend to manipulate an image later on because all information is saved. Photoshop files can also be displayed by other applications.