SDFI®-TeleMedicine

Secure Digital Forensic Imaging – Secure Beyond Reasonable Doubt®

SDFI's Negative Invert Filter

(For Advanced SDFI® Users)

This document and our description and explanation of the SDFI® Negative Invert Filter should not to be considered a scientific document. **"Color" is a science onto itself.** This document can be considered an excellent reference on the subject where it relates to the use of global filters used on digital images presented on a computer screen.

GENERAL INFORMATION

When either one or both of these filters is applied to a digital picture, the actual numeric RGB value of each picture element is inverted or converted. This is done globally over the entire surface of the picture, all at the same time so there are no additions or subtractions made to the image itself.

An excellent general example of a filter would be putting sunglasses on when you are down on the beach. Your sunglasses do not distort your view, they simply allow you to see better. Other specific examples within the forensic medical world include a green filter or gel used on a old Colposcope or even Toluidine Blue, sometimes used during pelvic exams or acetic acid (such as common table vinegar) applied to a cervix when looking for abnormal tissue.

The entire filtering process is simple to do and see. To do it, press the correct combination of keys on your keyboard and you see it on your computer screen. To explain it, we need to break the full process into two separate processes, the Negative Filter process and the Invert Filter process.

The "Negative Invert Filter" is two completely separate digital filters, applied one after another. Each filter, when called upon, independently reads the numeric RGB value of color within the image pixels or picture elements and either "INVERT(S)" the numeric value of that pixel, thus the invert filter, or it converts the numeric pixel value from a positive value to a negative value, thus the "NEGATIVE" filter.

As a real time example, the invert filter inverts the RGB values in each pixel. The background color of the SDFI web page is blue, specifically each "blue" pixel has an exact RGB color value of 45, 45, 190. When the invert filter is applied, the RGB pixel values become 210, 210, 65. In a 24-bit JPG image, the maximum range is from 0 to 255. In a RAW file the range is from 0 to 65,536. The filter works on both file formats.

RED =	45 to 210	or	255-45 = 210
GREEN =	45 to 210	or	255-45 = 210
BLUE =	190 to 65	or	255-190 = 65

LEGAL INFORMATION

A filtered image is **NOT** valid or legal without the original beside it. **NEVER** evaluate ANY filtered image without having access to the original. To ensure that pictures, pictures are legal and original, SDFI users capture a RAW file alongside the JPG file. Regardless of your position with the legal arena, prosecution or defense, you are entitled to ask for the original if you feel any image has been fraudulently spot changed. When in doubt, as for the RAW file!

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THE SDFI® NEGATIVE FILTER

The old film based photography process first produces "negative" film strips and then they were converted to printed paper based "positives" through a chemical process. A negative filter does the same thing based on additive and subtractive pixel color values originally captured by a digital camera. (Digital filters can be applied to ANY image from any camera or any scanned picture.)

A positive image is a normal looking color image. A negative color image is a tonal inversion of a color positive image.

Every color, all 16,777,216 possible colors in a 24-bit JPG, can produce a variety of tones. How light or dark these "tones" are depends on the numbered color values within each pixel. It is critically important to realize that color tones are relative to other color(s) shown in that area of an image. How dark or light a "tone" is depends on what other colors are shown. How our brain processes and perceives color is another separate science onto itself that cannot be explained here.

When you apply a negative filter to a color positive image, a static string of computer code converts complementary colors for each pixel in the original image. It then color reverses the image, were red areas of the image appear "cyan-ish", green areas appear "magenta-ish" and blue areas appear "yellow-ish".

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THE SDFI® INVERT FILTER

The Invert Filter inverts the numeric color value in each pixel to produce an opposite numeric color value. Reds are turned to Cyans, Greens are turned to Magentas and Blues are turned to Yellows.

Display color, like the color you see when you look at your computer screen, is made up of RGB colors or Red, Green and Blue colors. Computer screens and standard JPG color images display a range of colors. Each of those individual RGB colors is defined by a number from 0 through 255. 0 is black, 128 is gray and 255 is white.

Again, EACH of the three colors, Red, Green and Blue, has their own range of color between 0 and 255. The number 0 has value, meaning is it worth something when discussing and presenting images on a standard computer screen. This means that you can have 255 reds from 1, 0, 0 to 255, 0, 0. ("0, 0, 0" represents pure black, "255, 0, 0" represents a "pure high red".)

Each pixel in a "regular" 24-bit JPG color image has a combination of RGB colors in it. This means that even if there is "No Visible Red" in a pixel, your computer allocates space for the color red in each and every pixel throughout an entire image. (A single image might have 15,000,000 pixels. A million or more pixels together is called a Megapixel.)

The three primary additive colors, Red, Green and Blue, are always discussed in the "Red, Green, Blue" color order. Subsequently the numeric value of these colors is also discussed in RGB color order. "0,0,0" is a pixel with only black in it. "128, 128, 128" is a pixel with gray in it. "255, 255, 255" is a pixel with only white in it. Each of the three numbers, separated by a comma, represents each of the three primary additive (R)ed, (G)reen and (B)lue colors, always referred to as RGB.

Examples:

255, 0, 0 can be considered "pure high red". Inverted, red has the numeric value of 0, 255, 255 or a high cyan.
0, 255, 0 can be considered "pure high green". Inverted, green has the numeric value of 255, 0, 255 or a high magenta.
0, 0, 255 can be considered "pure high blue". Inverted, blue has the numeric value of 255, 255, 0 or a high yellow.

As a real time Invert filter example, the background color of the SDFI web page is blue, specifically each pixel has an exact RGB color value of 45, 45, 190. When the invert filter is applied, the RGB pixel values become 210, 210, 65 (In a JPG image, the maximum range is from 0 to 255. In a RAW file the range is from 0 to 65,536. The filter works on both file formats).

RED = 45 to 210 or 255-45 = 210
GREEN = 45 to 210 or 255-45 = 210
BLUE = 190 to 65 or 255-190 = 65

To understand what actually happens when any filter is applied, you need to learn about the numeric value of color, specifically RGB values and about CMY values. Then you need to learn and understand the value of color "tones".

After the Negative-Invert filter is applied, you get a picture that has high contrast, nothing more.

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SDFI® Word and Acronym Glossary *(as they are related to digital color on cameras and computers.)*

Primary Positive Additive Color(s) = Red, Green, Blue. The common acronym used is RGB.
Secondary Negative Subtractive Color(s) = Cyan, Magenta, Yellow. The common acronym used is CMY.

Pure High Red = 255,0,0. A description of the highest value of red shown in a 24 bit image without any Green or Blue mixed in. "Pure High Red" can also be used to describe color in 48 bit RAW images. Pure High Red = 65536,0,0.

Pure High Green = 0,255,0. A description of the highest value of green shown in a 24 bit image without any Red or Blue mixed in. "Pure High Green" can also be used to describe color in 48 bit RAW images. Pure High Red = 0,65536,0.

Pure High Blue = 0,0,255. A description of the highest value of blue shown in a 24 bit image without any Red or Green mixed in. "Pure High Blue" can also be used to describe color in 48 bit RAW images. Pure High Red = 0,0,65536.

High Cyan = 0,255,255. The highest values of green and blue mixed together without any red.
High Magenta = 255,0,255. The highest values of red and blue mixed together without any green.
High Yellow = 255,255,0. The highest values of red and green mixed together without any blue.

Cyan-ish = A mixed array of color that typically shows more cyan that other colors.
Magenta-ish = A mixed array of color that typically shows more magenta that other colors.
Yellow-ish = A mixed array of color that typically shows more yellow that other color values.

JPG or JPEG = Joint Photographic Experts Group.
Invert = The "exact" reversal of numeric color values in a pixel or an array of pixels.

Positive = In reference to a "normal" color image showing a majority of positive color values, red, green and blue.
Negative = In reference to a negative color image showing a majority of negative color values, cyan, magenta and yellow.

Negative Filter = A global software filter that uses a matrix of software code to perform a tonal inversion of the positive color values in a positive digital image. [-1, 0, 0, 0, 255, 0, -1, 0, 0, 255, 0, 0, -1, 0, 255, 0, 0, 0, 1, 0]

Invert Filter = A global software filter that exactly reverses the numeric color values within a pixel or an array of pixels.

Negative Invert Filter = A combination of two filters, used one after another, to display high contrast in an image.

Digital Image = A digital image is a representation of a two-dimensional image using ones and zeros (binary)
Digital Picture = See "Digital Image" above.
Digital Photograph = See "Digital Image" above.
Pixel = Acronym for "Picture Element"

Color Tone = How light or dark a color is, rather than what the actual color is.

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URL Links To Understanding Color

http://tigger.uic.edu/~hilbert/Glossary.html

http://www.color.org/index.xalter

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

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

http://r0k.us/graphics/SIHwheel.html

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

http://en.wikipedia.org/wiki/Negative_(photography)

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

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

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

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

http://www.flepstudio.org/forum/tutorials/493-digital-negative-image-actionscript-3-0-a.html

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