

Doing Lenna with BMP2SHR – A Case Study in SHR Photos

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Background

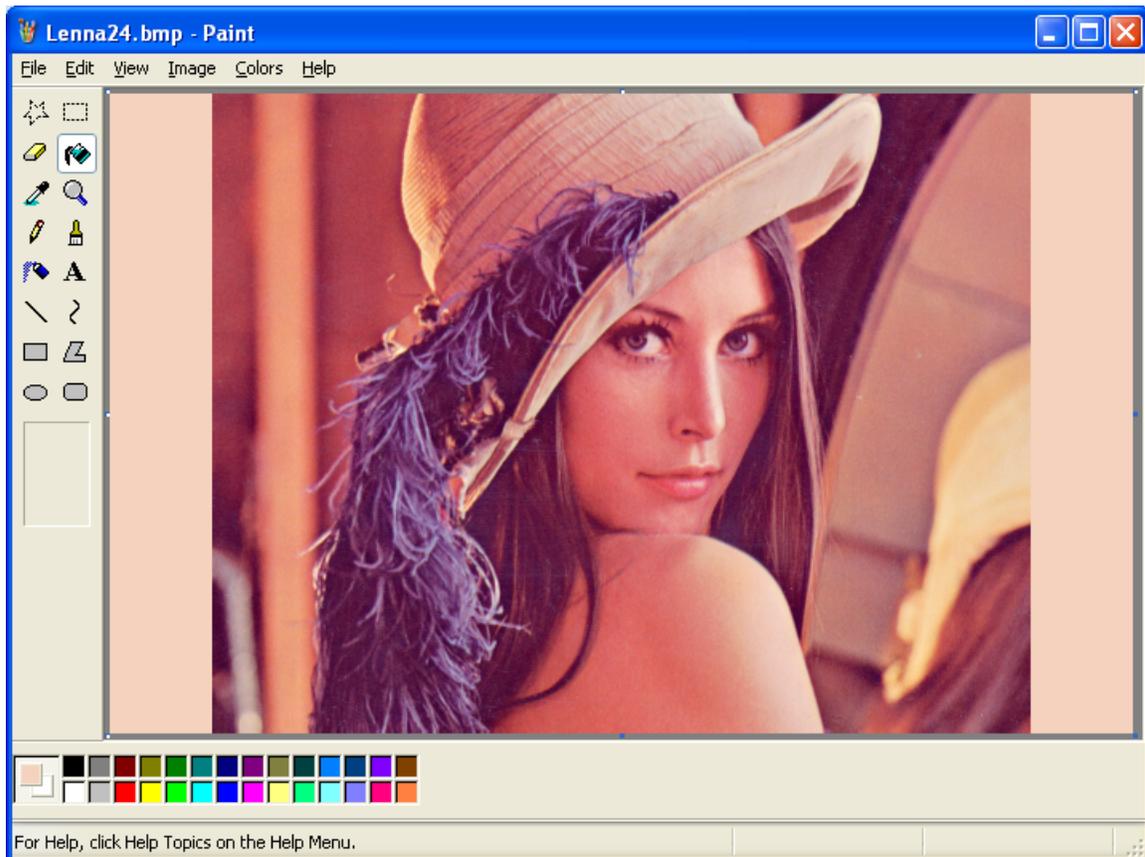
When I released BMP2SHR Version 2.0, Nick Westgate commented in the comp.sys.apple2 newsgroup (csa2) that Lenna has been a standard in image processing for a long time. Michael Mahon added that at Bell Labs she was known as Lena:

<http://en.wikipedia.org/wiki/Lenna>

So I decided to process Lenna using BMP2SHR and see what I could do with her.

Preparing Lenna

Lenna's dimensions are 512 x 512 which matches nothing that I have ever programmed for except a TGA Image for a Targa Board (in the late '80's). But the aspect ratio seems to be 4:3 which is well suited for both the GS and the PC.



Without Error Diffusion – 24-Bit “Pure Lenna”

Given a nominal size of 640 x 400 to work with, I cropped Lenna vertically to preserve pixel integrity. To provide a dominant flesh color for BMP2SHR’s population-method quantization to SHR’s 16 colors per line, I used the eyedropper tool to extract a color from the image that looked like a good candidate and centre-framed Lenna with 64 pixel side borders in flesh. This ensured that orphan colors on each line (including white) would likely map to the flesh color in the side border with the downside of only having 15 colors per palette for each line to map to other colors.

Saving as a 24 bit BMP provided me with a “pure” Lenna for conversion with the original sampling intact.

With Error Diffusion – 256 Color “GIF Lenna”

Many Photo Editors are available in Windows. Some, like Microsoft Office Picture Manager offer conversion to the 256 Color GIF format and use error diffusion combined with other techniques to resample the colors in a 24 bit photo to a 256 Color palette.

After using Microsoft Office Picture Manager to create a GIF file from “pure” Lenna, I exported error diffused “GIF” Lenna in Picture Manager to a 256 Color BMP.

Both Lennas were now ready for Conversion in BMP2SHR to mode3200 Color Brooks format SHR files and mode320 GreyScale PIC format SHR files.

I would do one more preparation and then Lenna would be ready to go!

Error Diffused GreyScaling before Conversion – “Grey Lenna”

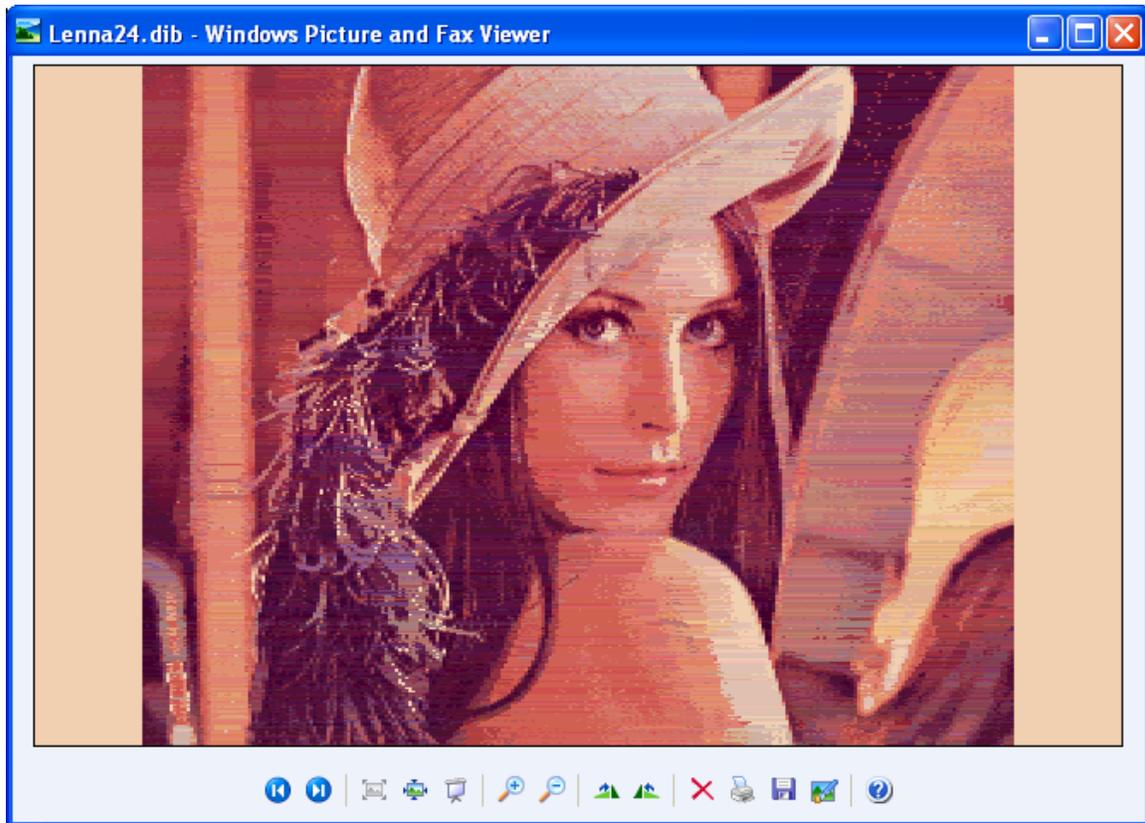
Using a Windows editor to reduce color saturation in an image will mute the colors and can result in a blended effect at the expense of color contrast. Using a Windows editor to eliminate color saturation will produce a GreyScale image. This pre-blending provides better GreyScale results from a photo that has been reduced to 256 colors using error diffusion than from a “pure” photo in 24 bit format.

For my final preparation of my third input file for BMP2SHR I eliminated color saturation in “GIF” Lenna, and exported error diffused and unsaturated “GIF” Lenna in Picture Manager to a second 256 Color GreyScaled BMP.

So now it was time for BMP2SHR to have its way with all three Lennas!

Doing Lenna in 24 Bit Color – “Pure Lenna”

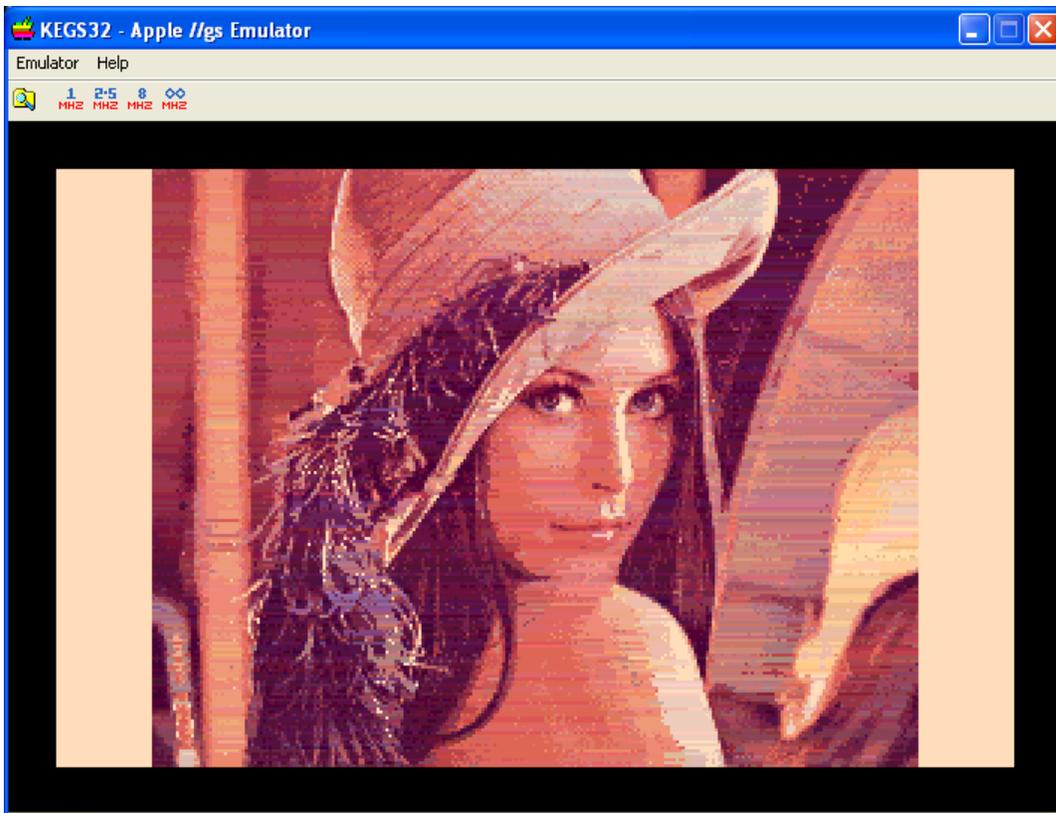
The following is the DIB facsimile of BMP2SHR’s VOC Brooks Format output using command line options QA A10 (10 thresholds instead of the default 6):



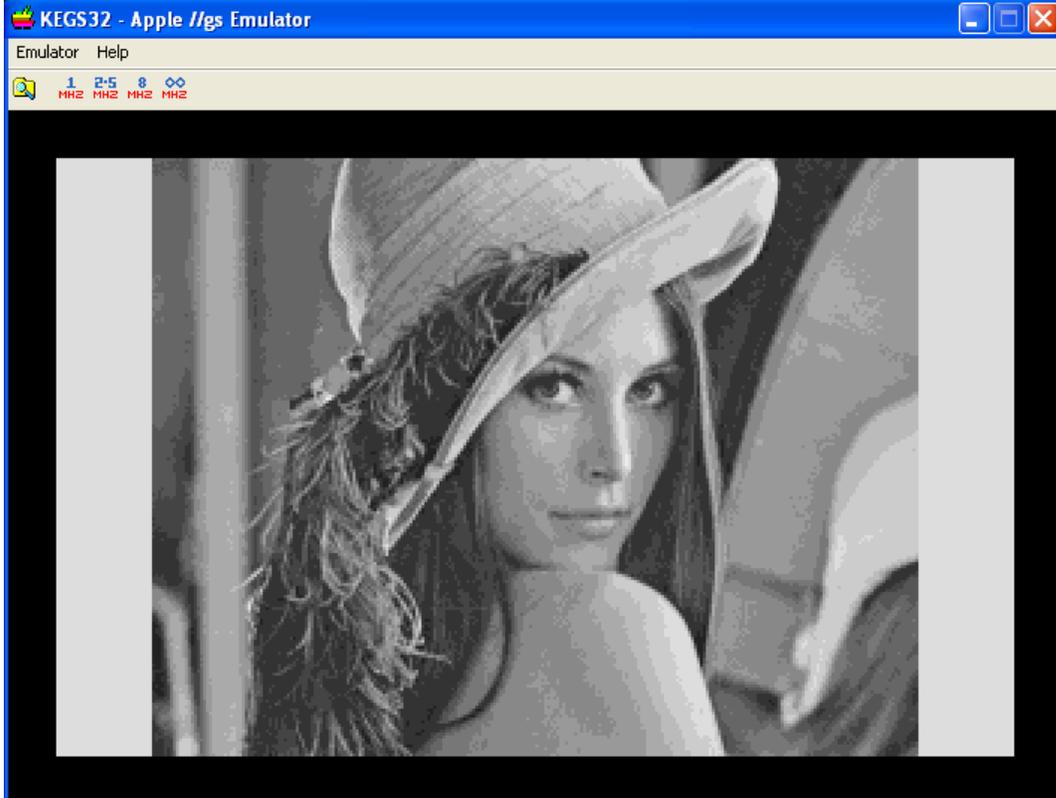
The DIB is 640 x 400 but horizontal actual resolution is 320 x 400 with every even pixel repeated twice. Of course this is only a facsimile, and a fictional one at that, because as far as I know, there are no Brooks loaders for the VOC. So a more realistic simulation is to view Lenna in the kegs32 emulator (see next page).

BMP2SHR also creates 16 level single palette merged GreyScale PIC files as well as Brooks files when processing a photo. (These GreyScale images are inferior to error-diffused and unsaturated GreyScale Images of photos like the last images in this document.)

The results of both Brooks and Single-Palette GreyScale are shown in kegs32 on the next page. Keep in mind that the Brooks image is lossy and missing every second line and every second pixel. The Brooks Image shows relatively high contrast banding due to palette inconsistency between lines. Both the Brooks and GreyScale images show rings especially in lighter areas.

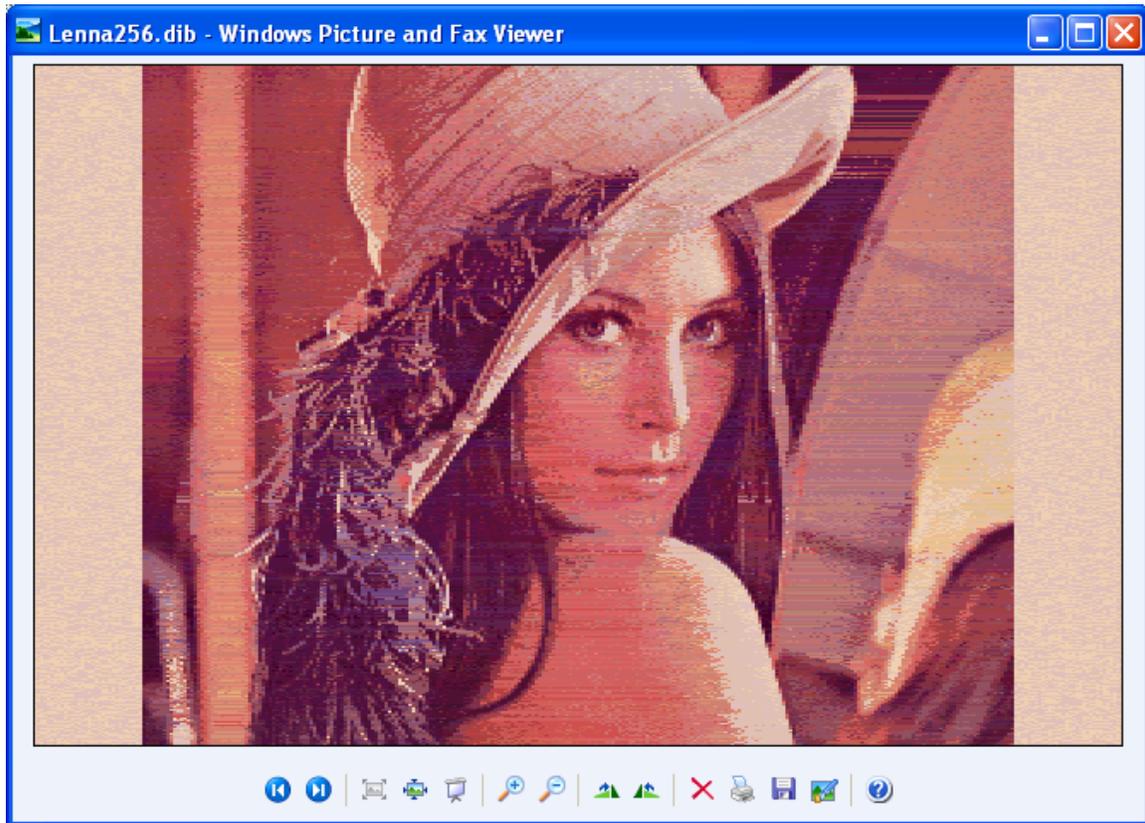


KEGS 0.91 | Vol:5 | sim MHz:??? | Eff MHz: 2.55 | s6d1: 0 | s6d2: 0 | s5d1: 0/0 | s5d2: 0/0



KEGS 0.91 | Vol:5 | sim MHz:??? | Eff MHz: 2.55 | s6d1: 0 | s6d2: 0 | s5d1: 0/0 | s5d2: 0/0

Doing Lenna in 256 Colors – “GIF Lenna”



The above is the DIB facsimile of BMP2SHR’s VOC Brooks Format output from the 256 Color error-diffused Lenna. Like its 24-bit counterpart, command line options are QA A10 (10 thresholds instead of the default 6):

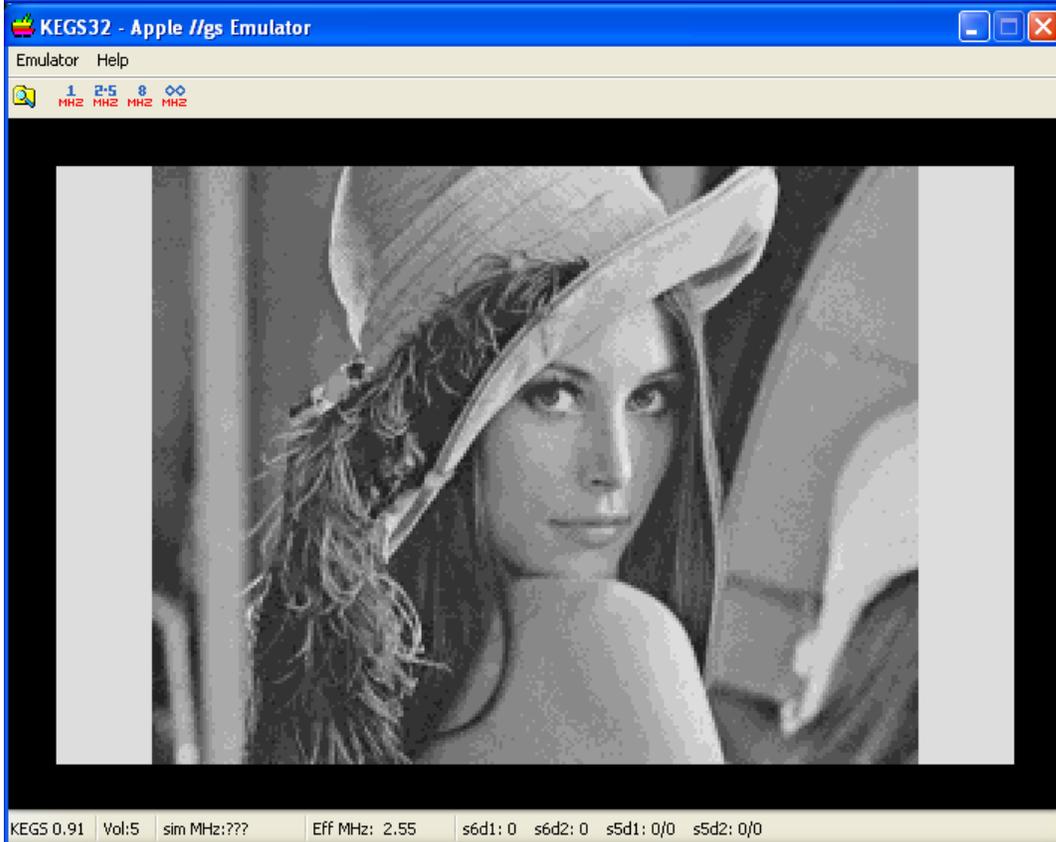
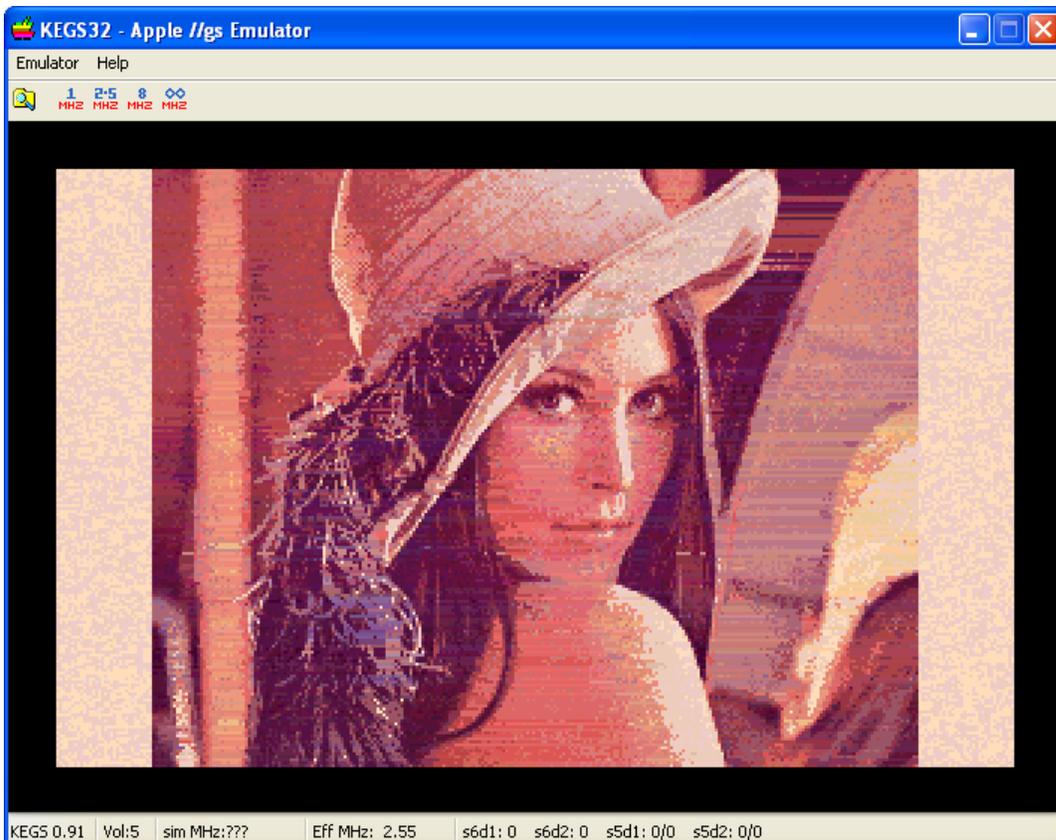
As shown on the next page, the Brooks Image banding is softer than in the output from the “pure” Lenna 24 bit BMP due to the error diffused color reduction algorithm used by Microsoft Office Picture Manager.

Both the Brooks and GreyScale images show less pronounced rings than the output from the “pure” Lenna BMP. But as mentioned earlier, Grey Scaling in BMP2SHR is general purpose.

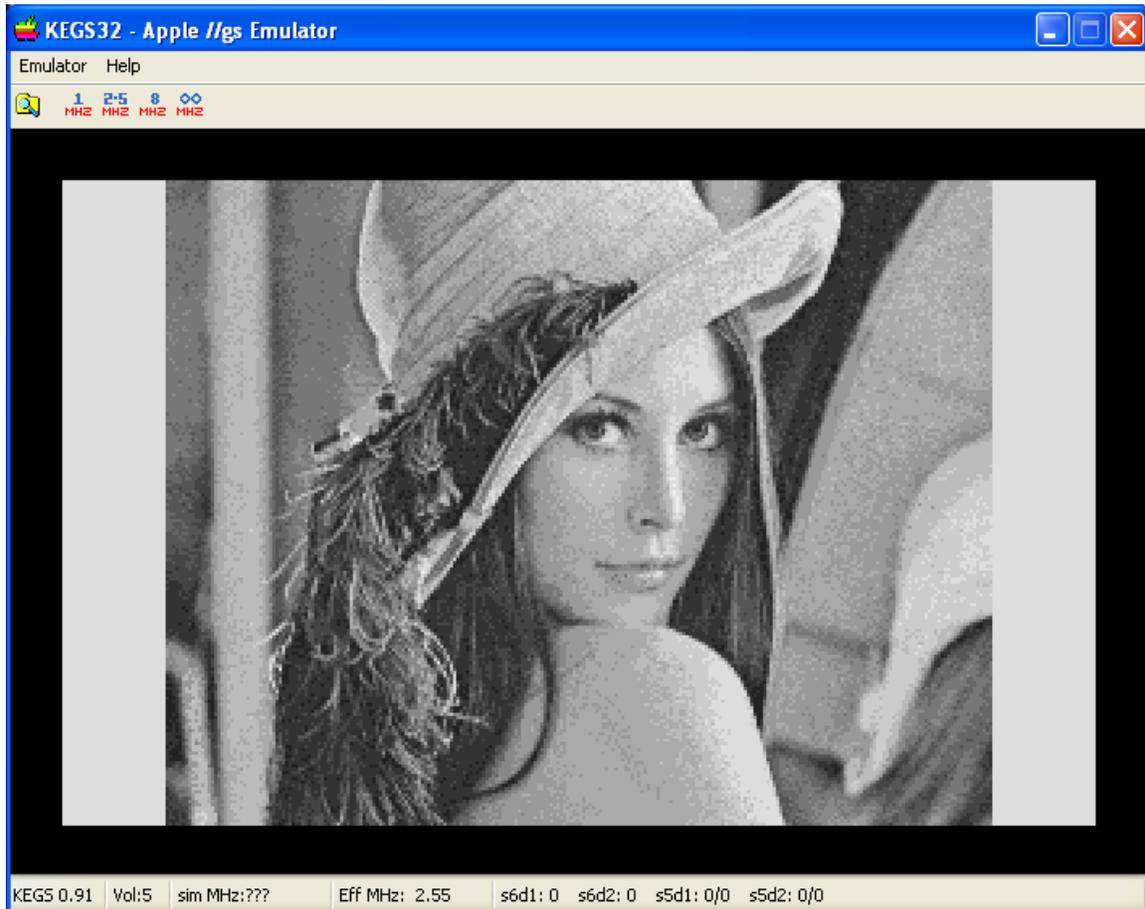
It is the simple average calculation of the 3 RGB intensities of a digital color.

GreyScaling can be much more advanced:

<http://en.wikipedia.org/wiki/Grayscale>



Doing “Unsaturated Lenna”



Well, there you have it! The GreyScale MultiPalette PIC File above was created with the error diffused and “unsaturated” Lenna 256 Shades of GreyScale BMP. The command line contained a single option; option O – preserve original colors.

So why did this GreyScale outperform the other conversions? I’ll get to that in a minute.

Few visible and soft transitions make this the best quality overall conversion. Sadly because of the limited palette scheme and low color depth of the SHR display on the Apple IIgs, combined with the general purpose nature of BMP2SHR, better color conversion is unlikely without additional massaging outside of BMP2SHR.

As to whether error diffusion produces better results for a photo depends on preference and the photo itself. For close-ups error diffusion may be best. For Windows users in this day and age, there are many photo editors available like Microsoft Office Picture Manager. The version I use came with Microsoft Office 2003 a decade ago.

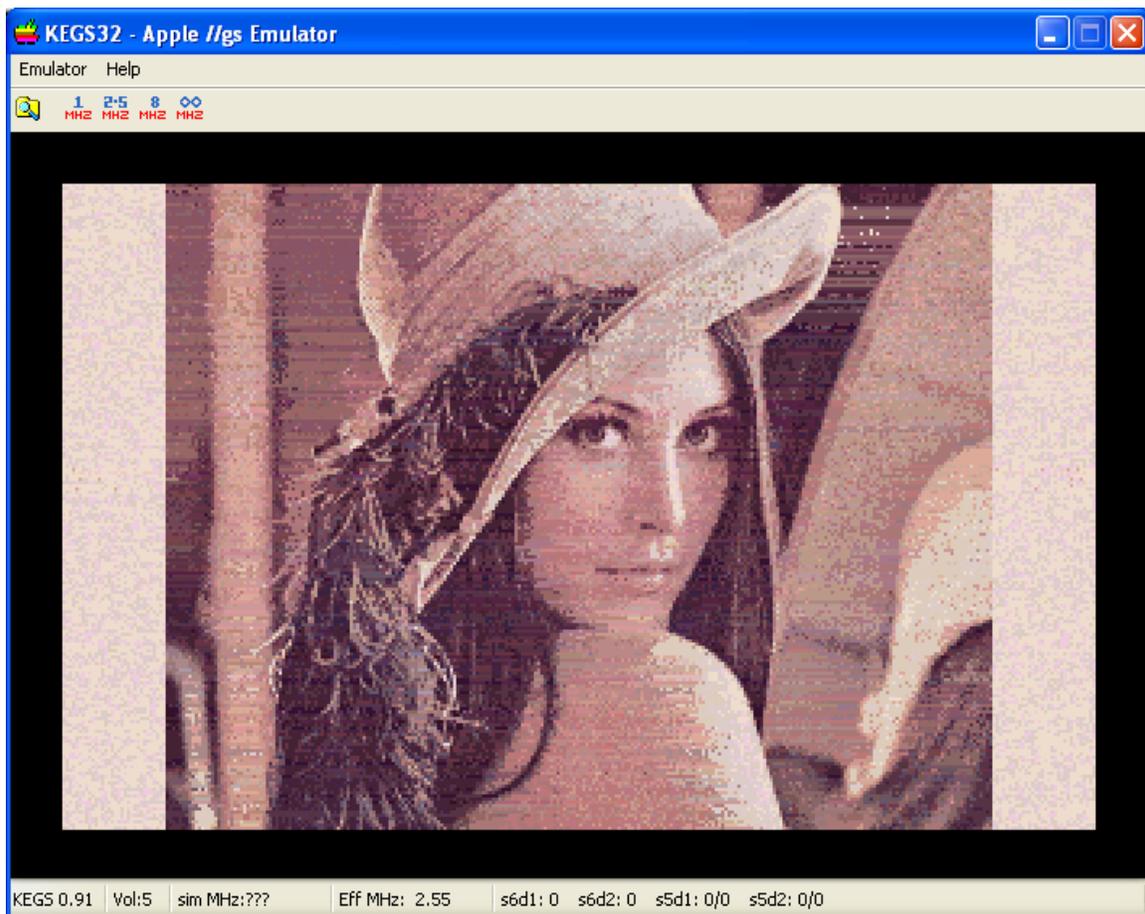
So whether you are doing Lenna, or your family photos, it is a relatively straight forward task to prepare your BMPs before processing using the techniques that I have discussed

in this and the other documents that I have provided with BMP2SHR, and using many other techniques as well.

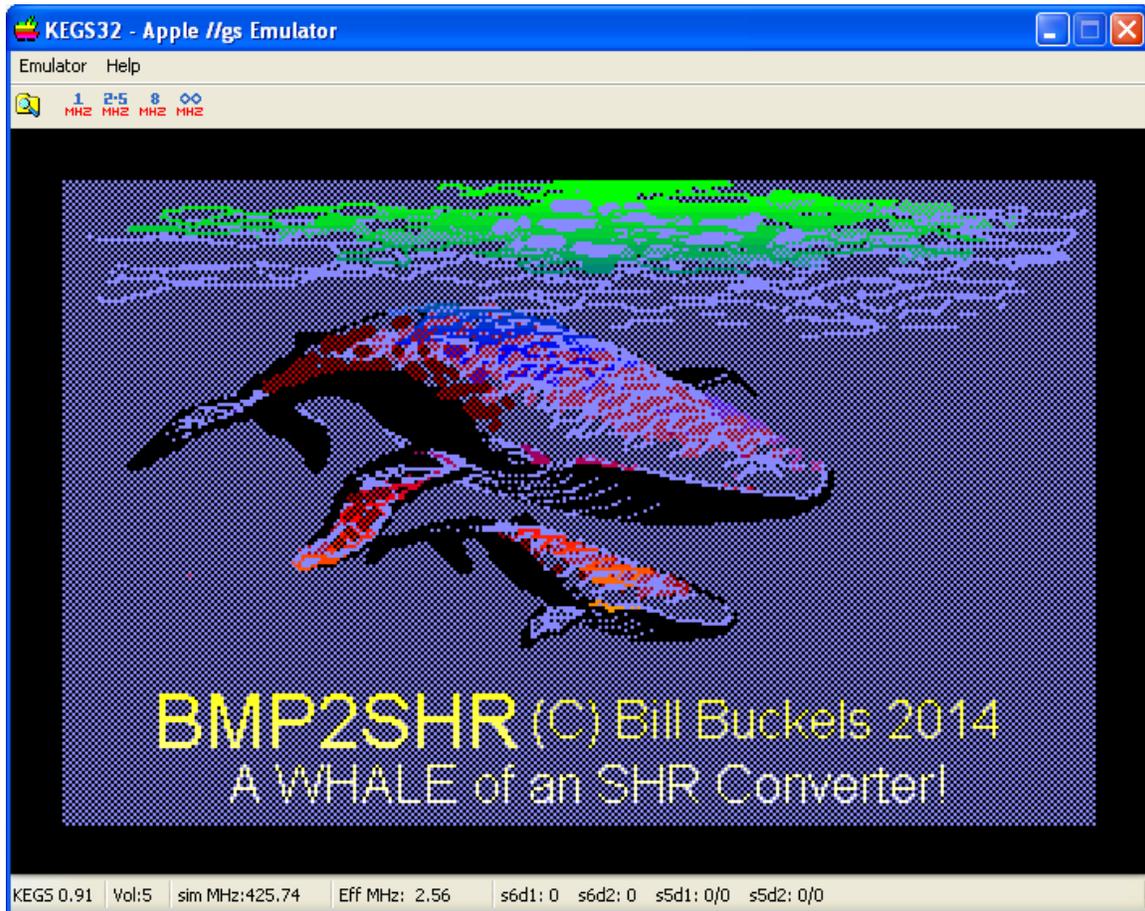
Now for the Naked Truth as to why unsaturated Lenna is better than the other Grey Lennas. Like anything else, BMP2SHR has limitations. All 3 Grey Lennas have the same 13 levels of grey, but the saturation elimination that Microsoft Office Picture Manager provides for producing GreyScale is superior to the simple averaging in BMP2SHR.

Doing “Hybrid Lenna”

As previously noted, using a Windows editor to reduce color saturation in an image will mute the colors and can result in a blended effect at the expense of color contrast. The following error-diffused “GIF” Lenna has 50% saturation removed (and again converted using command line options QA A10). It is essentially a hybrid between a GreyScale and a Color image:



Links:



BMP2SHR Download:

<http://www.aztecmuseum.ca/extras/B2S.zip>

BMP2SHR User's Manual (included in the above):

<http://www.aztecmuseum.ca/extras/bmp2shr.pdf>

BMP2SHR Tutorial (included in the above):

<http://www.aztecmuseum.ca/extras/bmp2shrTutorial.pdf>

Lenna Case Study Files:

This document:

<http://www.aztecmuseum.ca/extras/Lenna.pdf>

BMP's and Disk Image – 2mg format (includes this document):

<http://www.aztecmuseum.ca/extras/Lenna.zip>

