Image Enhancing on Consumer's Displays for Increased Printing

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Abstract

Traditionally, digital image science technology has been automatically applied by the photolab printer processing module or PC. It may not be required or applied for perfectly exposed and color balanced images. Applying image science to most other files will improve both image display and print results by adjusting color balance, background/subject ~ density/contrast, removal of unwanted redeye, gradation and other issues. Enhanced image science technology will also improve image detail when interpolation is required, smooth-out JPEG Blocking*, reduce noise and sharpen files. Applying image science post-capture on the device, online when image viewing or at the kiosk will increase the percentages of acceptable images printed generating revenue from what may have been discarded files by the consumer.

1. Introduction

Noritsu's image science technology was created in 1976 for use within the QSS-1 One Hour Photo Lab system for automatic color and density exposure calculations from negatives to photographic color paper. As digital imaging evolved, the Charged Coupled Device (CCD) was utilized in photo printers; first replacing photocell technology followed by scanners digitalizing the film negative. The digital film data was then processed for exposure from a variety of methods: Cathode Ray Tube (CRT); Micro Light Valve Array (MLVA); Digital Light Processing (DLP); Laser Emitting Diode (LED) or Optical Laser print exposure engines. Digitizing the scanned film image allowed for thousands of image reference points to be used as data for image science software to analyze resulting in superior print quality. This was the first step in separating background from subject and adjusting exposure and color accordingly. Noritsu image science technology, branded as *AccuSmart* in 2005, is now available as a separate module for use on smart phones, smart devices, websites and image kiosks, as well as custom third party software applications such as digital picture frames. Image science continues to evolve providing for improved image quality post capture.

2A. Image Capture

It is widely believed there are more images captured daily by cameraphones than those captured on dedicated digital cameras plus film captures at the film sales peak in year 2000. Many industry professionals suggest that cameraphone image captures are less than ideal for making prints. As a result this important market segment is not being fully embraced for its actual print potential. Most cameraphones utilize low grade CMOS sensors and have a fixed aperture utilizing shutter speed to adjust exposure; images often have low dynamic range and/or are blurry due to subject or camera movement. Outdoor image captures with a clean lens, yield good results due to adequate lighting and fast shutter speeds. Current models of cameraphones are capable of creating 4x6 and 8x10 prints superior to that of Disk and 110 format cameras of years past (it should be noted that combined Disk and 110 format achieved approximately 25% of the North American film market in the 1980's).

2B. AccuSmart Camera

Image science is available as an App for Apple's iPhone, AccuSmart Camera. Available at the iTunes store, this application instantly processes the iPhone image capture through a smart phone version of AccuSmart image science. While the original image is saved, the AccuSmart Camera creates a second file after processing it through its algorithms resulting in a superior image file and increasing the potential for printing. A wide variety of image enhancements are available including improved facial lighting for portraits, foreground subject lightening in bright sky scenes, increased contrast with night scenes by setting a white point and black point and improved color balance in mixed or ambient lighting.

2C. AccuSmart Editor

Image science must be applied beyond the cameraphone image, print order kiosk and online print ordering. AccuSmart Editor, also available at iTunes, will process image files through the smart device's AccuSmart algorithms creating a higher quality image increasing potential for print selections.

AccuSmart Editor features are incorporated in a new combined camera and editor App called QualiCam which remains powered by AccuSmart technology.

3A. Low Resolution Image Files

Based on consumer print quality expectations of viewing low resolution files on a monitor and believing they will make sharp prints, digital print order kiosks and on-line print order websites are often configured to prevent printing of files below 800x600 pixels to reduce waste should the customer reject the resulting print due to low sharpness. Traditionally low resolution image files are often from poor quality image captured devices and/or high compression resulting in JPEG Blocking.

What may be the world's largest source of low resolution archived image files is a resource that has not yet been promoted to its full printing potential. Facebook [1] currently archives standard image files at 720x540 for over 800 million members with 350 million accessing their Facebook account through their smart device. There are on average, 250,000,000 images uploaded daily, nearly 3,000 images per second. Many of these image files are downsized from high quality files and are ideal for interpolation to 4x6 and 8x10 prints that result in print quality levels that meet or exceed consumer print quality expectations.

Imaging professionals often configure digital print order kiosks to warn consumers or even refuse to make 4x6 prints from 640x480 / 0.3 MP image files, due to interpolation levels of 2.8x2.5 times. These same kiosks may also accept 24"x30" poster print orders from 9 MP files which also require 2.8x2.5 times
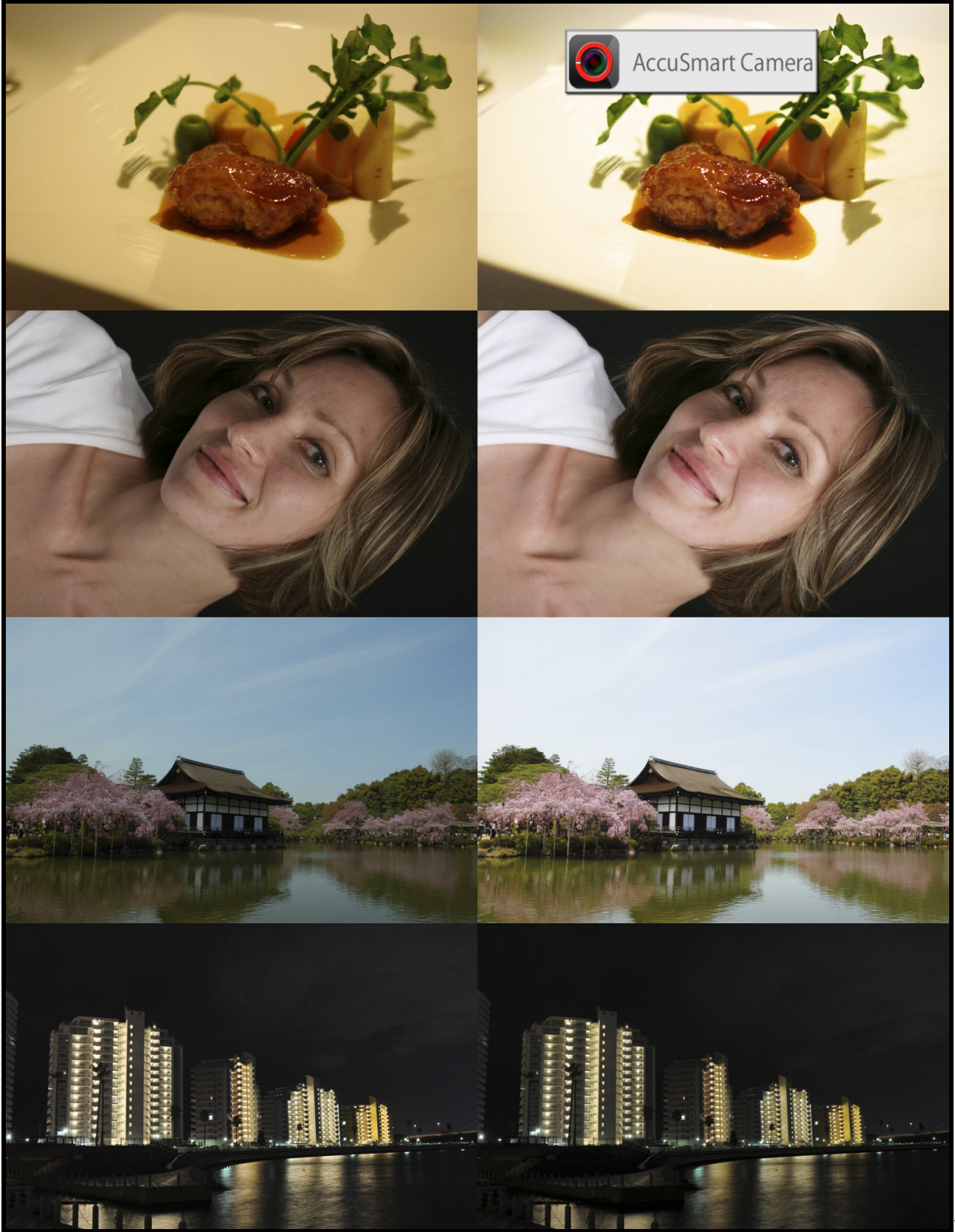
Figure 1. iPhone AccuSmart Camera Ver1.0 before & after comparisons

interpolation magnification. While a 0.3MP file may be inferior in pixel quality to a 9MP file, downloaded 0.4 MP Facebook files have evened the playing field in reference to interpolation results.

3B. Downloading files from Facebook

In early 2011, Facebook started to offer uploading and downloading of image files up to 2100x2100 pixels referring them as High Resolution. Uploading high resolution files to Facebook is slow as home broadband upload speeds are less than ideal for this function. A typical home broadband download speed is 5 Mbps with a typical upload at 10% of the download speed; only 0.5 Mbps upload. Uploading 10 high Resolution files to Facebook requires approximately 15 minutes on a typical home internet broadband. A smart phone may upload as low as 0.1 Mbps.

The vast majority and growing number of Facebook image archive files are less than 720x540/0.4MP files. These files can be downloaded as a JPEG or BMP format and while a BMP is often better suited for interpolation than a high ratio compressed JPEG, Facebook BMP files are 15-bit color (32,768 colors) while the Facebook JPEG remains 24-bit (16,277,216 colors). As Facebook 24-bit JPEG files do not exhibit JPG Blocking caused from high compression algorithms the JPEG file creates a better quality image and print due to greater color depth. Facebook JPEG downloads average 90% compression / 1:10 ratios

3C. Noritsu AccuSmart Interpolation Algorithms with Facebook files

Nearest Neighbor style algorithms are excellent for upsizing (interpolation) image data that has vertical and horizontal lines. However undesirable jaggies are created for angles and curves. Bicubic style algorithms are excellent for use with angles and curves as they create a smoother transition, but that transition is seen as an unsharp area. AccuSmart algorithms provide an excellent balance creating a good 4x6 print from Facebook 720x540 files.

4. Noritsu AccuSmart Vision Software

Currently under development for law enforcement agencies, *AccuSmart Vision Software* is designed to provide enhanced image detail by utilizing new image science algorithms that sharpen, adjust contrast, smooth JPEG Blocking and interpolate files to improve print results beyond current expectations.

Applying the printers' image science at the consumer level will show the consumer a higher quality display of their file prior increasing the potential for printing. Applying a printers' image science such as AccuSmart after another brand image science has already been applied restricts the full potential of AccuSmart image enhancement. *AccuSmart Vision Software* algorithms will be available as an independent module and may be used in future versions of Noritsu's EZ-Controller Printer software

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Example of typical Facebook upload & download:

	Facebook Upload	Facebook Download	
	Original File	JPEG	BMP
Image Dimensions	1200x1800	420x720	420x720
Image Size	2.16MP	0.3MP	0.3MP
File Size	6.48MB	53KB	673KB
Color Depth	24-Bit	24-Bit	15-Bit
Possible Color Shades	16,277,216	16,277,216	32,768

*JPEG Blocking occurs when files are compressed to low quality lossy compression ratios reducing image quality when 8x8 pixels blocks are created causing noticeable pixilation.

Figure 2. *Two camera image captures; one as a TIFF with no compression and as a high compression JPEG demonstrating JPEG Blocking:*

Figure 3. *Facebook JPG & BMP downloads demonstrating reduced BMP color depth even in B&W, no detail loss due to JPEG Blocking:*
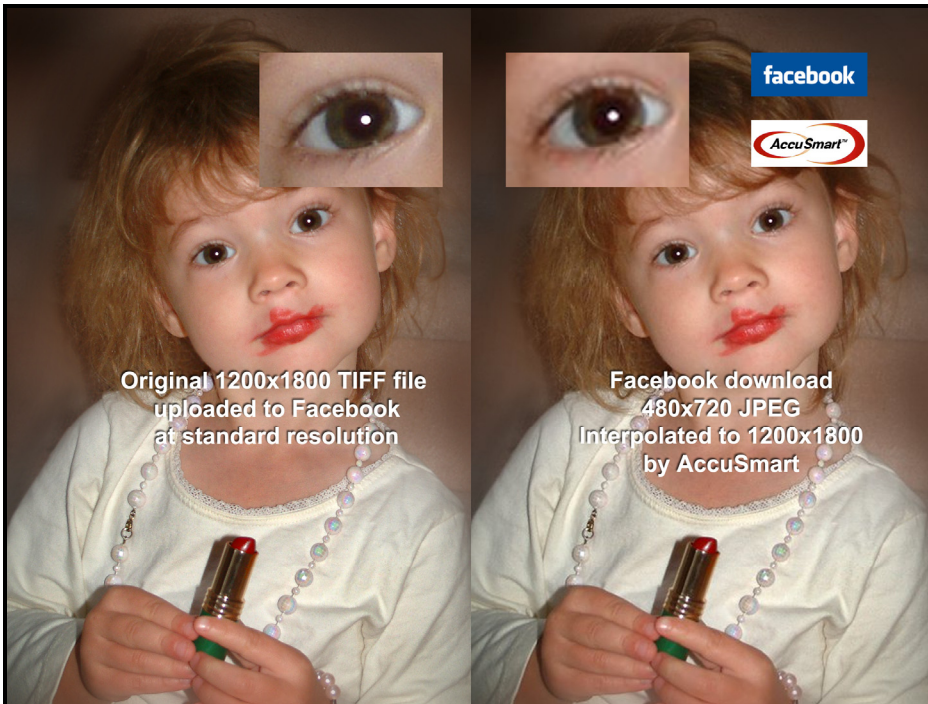

Figure 4. *Facebook upload and AccuSmart interpolation to 4x6 print, skin tone color balance is also improved:*

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Figure 5. *AccuSmart Vision Software before & after comparison; Sharpening:*

Figure 6. *AccuSmart Vision Software before & after comparison; JPEG Block Smoothing reduces pixilation:*

Figure 7. *AccuSmart Vision Software before & after comparison; Noise Reduction:*

5. Conclusion

While image quality from cameraphone captures continues to improve, consumer printing habits are changing. Their printing habits can be influenced by providing them with improved images within the capture device display, on their viewing display at home and at print order kiosks. Current image science already dispels last decade's thinking about small and poor files and future image science technology will enhance print capabilities even further. Combine AccuSmart image science with the excellent color gamut, contrast range and small droplet size of Noritsu DRY Inkjet Printers and results from poor and small files are superior to that of traditional AgX RA laser systems. Image files should no longer be categorized as "too poor to print" based on file size or image quality.

6. References

(1) Statistics as of Nov 1, 2011 at
http://www.facebook.com/press/info.php?statistics

7. Biography

With the emergence of digital imaging in the 90's, Ron was established as leader in digital imaging creating interactive learning CD's on digital imaging for the photographic industry. With over 36-years imaging experience, prior to Noritsu Ron was with FujiFilm after starting his career in wholesale photofinishing quality control. His education includes a Technical Diploma as a Photographic Technician and he is a worldwide communication liaison with Noritsu Japan International Sales, Marketing, and R&D divisions.

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