# The MYSTERY OF MEGAPIXELS

## Improve Evidentiary Photography with the Latest in Digital Cameras

By Scott Broad

Fundamentally, the latest digital cameras haven't changed from their ancestral roots; they all still focus light through a lens, control the amount of light that enters the camera body, and expose a recording medium. The usual recording medium has long been a sheet of plastic coated with an emulsion containing light-sensitive silver halide salts (a long name for film). However, the "film" of the digital camera is not the archival silver-coated plastic strip but an electronic sensor called a CCD.

The CCD, or charged coupled device, is merely a receptor that captures the light focused onto its surface by the lens. The surface of the CCD is covered with a grid of tiny, light-sensitive diodes called pixels, which convert light into an electrical charge. A pixel is a contraction of the term picture element.

Modern digital cameras have grids made up of millions of pixels. For example, a CCD may have a grid that is 2,560 pixels wide by 1,920 pixels tall. This single CCD sensor would therefore contain 4,915,200 pixels (2,560 x 1,920). Practically speaking, printing "Four million, nine hundred and fifteen thousand, two hundred pixels" on the chassis of a small digital camera is not economically feasible so it has been universally shortened and now referred to as a five megapixel — 5 MP — camera. Make no mistake about it though, the marketing departments of the camera manufac-

*Photograph 1- Original composition*

*Photograph 2- unrealistic CCD (.0000567 MP) with image placed overtop*

turers always round the pixel count up!

As discussed earlier, the lens focuses light (the image) onto the surface of the CCD. For example, if the goal were to capture the image in photo No.1 we would focus the shot through the lens. After pressing the shutter release button, the lens directs the light onto the surface of the CCD.

Each pixel encompasses a fraction of the entire focused image as shown in photo No.2 and accumulates an electrical charge based on the light intensity.

The CCD electronics transfer the charge on each pixel to an analog-to-digital converter (A to D). The A to D modifies the millions of pixel values into digital values and thus digitizes your image (sorry to break it to you, but digital cameras are actually analog; only the storage data is digital).

Unfortunately, there is a catch: Pixels are colour blind. They only register the accumulated intensity of the light exposure, not the colour "value." In order for a pixel to record colour correctly, colour filters must be placed over the sensor.

Three primary colour filters are used; red, green and blue (RGB). Because human eyes are most sensitive to green, half of the filters are green, 25 per cent are red and 25 per cent are blue.

The filters are placed over the pixels in an order called the Bayer Pattern (named after the inventor, not the aspirin) which, as shown in photo No.2, has alternating red and green filter rows with blue and green filter rows. Because a pixel is covered with a filter, it can only record the intensity of the light that matches that filter. In other words, if the pixel is covered with a blue filter, it blocks the other colours from entering and only records the intensity of the blue light allowed to enter it.

After the pixels record the intensity of the filtered light, the A to D converter sends the information to the microprocessor, which, in a process called interpolation, reconstructs the image. Interpolation samples the colours of the surrounding pixels and calculates the two colours the pixel didn't record. Remember, this calculation is a "best guess scenario" so some errors may occur should the image be very colour dynamic.

From the preceding, it can be deduced that the more pixels on your CCD, the more accurately light and colour can be reproduced. Because each pixel can only record a single value for the intensity of light covering it, pixels covered with multiple light intensities are averaged and then recorded. A greater number of pixels allows for less averaging and records greater detail.

## So, bigger is better?

Not necessarily. Before running out to purchase a 39 MP digital camera, understand that the final print size of the image is just as important as the capturing of the image.

You need approximately 200 pixels-per-inch to recreate a decent photograph print. So for a 5" x 7" print to stick on the fridge, a 1,200 x 1,600 image (2 MP) will be fine. For an 11" x 14" you'll want 2,200 x 2,800 (6 MP).

If your life long dream is to post pictures on the Web (I know what you are all thinking) then the photograph produced by a 1.0 MP camera is about four times larger than you require. However, if you want a good quality 8" x 10" print suitable for framing, a 4 MP camera will likely appear on your next expense account report under the heading "evidence gathering equipment."

*8 Megapixel Capture*

*2 Megapixel Capture*

To illustrate this point, the two photographs above were captured using two different settings. The first picture was taken at 8 MP, and the second at 2 MP. I defy you to tell the difference.

The pictures appear the same because the output size does not utilize all of the recorded detail in the 8 MP picture. Just as the CCD averages the capturing of detail during the storage of the image, a printer will average the return of the data if there are too many pixels to render in the image.

However, there is a significant visual difference if an image is enlarged beyond that at which it was stored.

It is evident that the 2 MP camera was forced to "average" a greater variance of light intensities, exposing the surface area of each pixel during the recording process. When the image was reproduced greatly enlarged, the pixel averaging resulted in a blurred picture.

Therefore, as foregoing examples demonstrate, bigger does not always mean better. There is really no significant difference for a photograph printed at a given smaller size compared to that of a camera with a higher Megapixel count.

The following chart is a quick reference indicating suitable print sizes (well, they look good to me at that size).

- 8 MP — 3,264 x 3,448 — 12" x 16"
- 6 MP — 2,800 x 2,200 — 11" x 14"
- 5 MP — 2,592 x 1,944 — 10" x 13"
- 4 MP — 2,272 x 1,704 — 8" x 10"
- 3 MP — 2,048 x 1,536 — 6" x 8"
- 2 MP — 1,600 x 1,200 — 5" x 7"
- .3 MP — 640 x 480 — 2" x 3"

## Beyond pixels

Are pixels the only consideration? Definitely not. There are many technological advances that affect picture quality during both storage and reproduction. Like most manufactured merchandise, CCD sensors are also not created equal. There are 8 MP chips that would fit on the tip of a finger and 8 MP chips that would fit in the palm of a hand. When it comes to chip physical size, with all things being equal, bigger is often better.

There are also several different microprocessor algorithmic schemes used in the storage of data, the interpolation of colour and the averaging of intensity. Manufacturers often use proprietary processing, each with varying results.

## Pick of the litter

All major camera manufacturers make excellent products. The camera that is right for you is one that allows you to complete the tasks you require. Think of the camera as a tool: The greater the requirements of the task, the more flexible the tool should be.

The author of this article uses a camera with a 10+ MP chip. Why? Well, for one, it is not uncommon to provide photographs that will ultimately end up in a courtroom situation. The photos are often enlarged many times their original size in order to supply a clear view to all involved. Using a smaller chip camera would make this difficult as shown in the earlier visual examples.

This information should provide you with enough of an understanding to help you determine what "size" of camera you need (regardless of the sales hype you hear). "Overkill" exists in camera technology, therefore, an informed decision will save time, money and annoyance.

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*8 Megapixel Capture*

*2 Megapixel Capture*